Today, there are a variety of technology solutions for creating chatbots, including universal platforms such as Google's Dialogflow, Microsoft's Azure Bot Service, and IBM's Watson Assistant, as well as chatbot builders such as ActiveChat, SendPulse, and BotPress. The disadvantage of the considered platforms and designers is the limitation of the free plan.

This study considered the development and integration of an informative chatbot into the department's website in order to create a virtual assistant for potential applicants and applicants. The relevance of the study is due to the modern conditions of admission, limited opportunities to conduct career guidance events in connection with the consequences of the COVID 19 pandemic and the war on the territory of Ukraine.

The object of research is a system of informing website users using natural language. A software product has been developed, which is an information system for applicants.

The dynamic JavaScript programming language combined with the Node.js code execution environment and the Telegraf library was chosen to create the chatbot. The Heroku cloud platform with an integrated Heroku PostgreSQL database became the server for the operation of the chatbot. The system is implemented using the @BotFather Telegram service, which makes it possible to integrate it into any web resource. The stages of chatbot development are highlighted with examples of information, linguistic, and technical support. An analysis of the compliance of the developed chatbot with regard to the criteria of informativeness, multimodality, emotionality, productivity, and interactivity was carried out. The structure of the information content of the chatbot, which includes a set of modules, has been developed. A test version of the chatbot has been designed, tested, and integrated into the website of the Department of Applied Linguistics, which will continue to be tested and improved in 2023–2024.

Practical significance: the structure of information content and the method of developing a chatbot could be used to develop authentic systems for informing applicants in institutions of higher education

Keywords: chat bot, information system, computer-mediated communication, interactivity, Telegram, artificial intelligence

UDC 004.934

DOI: 10.15587/1729-4061.2024.299200

DEVELOPMENT OF A NATURAL LANGUAGE CHATBOT INTERFACE FOR WEBSITE USERS

Yuriy Lynnyk
PhD, Associate Professor*
Lyubov Krestyanpol
Corresponding author
PhD, Associate Professor*
E-mail: lkrestyanpol@gmail.com
Elina Rozvod
PhD, Senior Lecturer*
*Department of Applied Linguistics
Lesya Ukrainka Volyn National University
Voli ave., 13, Lutsk, Ukraine, 43025

Received date 01.12.2023
Accepted date 13.02.2024
Published date 28.02.2024

***How to Cite**: Lynnyk, Y., Krestyanpol, L., Rozvod, E. (2024). Development of a natural language chatbot interface for website users. Eastern-European Journal of Enterprise Technologies, 1 (2 (127)), 35–44. doi: https://doi.org/10.15587/1729-4061.2024.299200*

1. Introduction

The task to reproduce human communication with the help of computer capabilities has been of interest to scientists for a long time. In particular, back in the middle of the 20th century, scientists wondered whether it was possible to build dialog systems that would be able to communicate at such a level that an ordinary person would not be able to distinguish whether a program (artificial intelligence system) is talking to him/her or a real person.

The term "artificial intelligence" includes the following fields of research: machine learning, neural networks, biomechanics, natural language processing, and pattern recognition. Our work proposes to create an intelligent conversational chatbot using neurolinguistic programming, which is part of artificial intelligence, which can advise and provide necessary information regarding the admission campaign and training in a certain educational program.

A chatbot is software that interacts with users using natural language. The purpose of such a program is to imitate human conversation. This process is implemented by integrating into the system, the so-called language model, and computer algorithms for reproducing informal communication between a person and a computer using natural language. It should be noted that the target audience of the chatbot is entrants, their parents, and first-year students who visit the department's website. It is important that the chatbot will provide round-the-clock informational support. Research into the development of intelligent conversational chatbots is relevant as it opens up new opportunities for designing interactive intelligent systems, contributing to improved access to information and enabling convenient communication between a person and a computer.

2. Literature review and problem statement

Work [1] describes an algorithm for checking the intellectual abilities of a machine, known as the Turing test. If the interlocutor is convinced that a real person is talking to him/her, the machine successfully passes this test. However, the Turing test has shortcomings, including the subjectivity of evaluation, the limitation of criteria, and the lack of consideration of emotions and context, which complicates its objectivity and relevance.

Paper [2] substantiates the process of creating the first chatbot "ELIZA", the purpose of which was to embody the work of a psychotherapist. This chatbot studied key words among the input text, which it used to paraphrase statements and ask questions. The disadvantage of this program was that the chatbot had a limited ability to interact due to the lack of ability to understand context and long-term dialogue.

Study [3], which describes the ALICE chatbot, is of practical importance. The program's algorithm was pat-

tern-based, so ALICE was unable to understand conversation and generate responses that expressed emotions or attitudes. However, it could support dialog on any topic and had more than 41,000 templates. In addition, the expediency of using a special AIML markup language was substantiated, which allowed developers to use it to create their own chatbots. However, the program did not have a mechanism for saving and analyzing conversation history.

As noted in work [4], the creation of the SmarterChild chatbot by the ActiveBuddy company was the revolution of chatbot technologies, which not only provided information but also helped in everyday tasks, which contributed to the development of machine intelligence and changed the way a person interacts with a computer.

In 2016, the social network Facebook launched its own instant messaging platform, which allowed the creation of its own chatbots. As a result, chatbot developers gained access to a huge audience of Facebook users, prompting the development of chatbots for business [5].

As evidenced by further studies [6], the development of chatbots stimulated their use to solve problems in various areas of human activity: e-commerce, business support, health care, tourism, restaurant business and food, games, sports, etc. The study describes the possibilities of using deep learning technology for chatbots through the use of recurrent neural networks. An unsolved problem in research is the use of contextual data in the conversational process with users.

The response to this request was the emergence of various platforms and frameworks that allowed developers to significantly simplify and speed up the process of creating chatbots. In particular, an important role in the development of dialog systems was played by the entry into the market of powerful universal solutions from such leading technology companies as Google (Dialogflow), Microsoft (Azure Bot Service), and IBM (Watson Assistant). All the main components of the basic architecture are supplemented with artificial intelligence capabilities. Study [7] proposed an open-source solution focused on providing the developer with the basic components to create a virtual assistant, namely language understanding and response generation.

As the analysis of available proposals [8] shows, in addition to powerful multifunctional platforms with artificial intelligence, there are a large number of relatively simple tools for building chatbots. Usually, they are implemented in the form of intuitive drag-and-drop platforms, or so-called designers. The disadvantage of such services is that their free plan is limited.

It is obvious that chatbots can be used to solve various tasks in the field of education. Study [9] singles out several main areas of application of educational chatbots:

– a tool that helps improve the educational process with the help of repetition of the passed material;

– a means of collecting information (feedback) about the course from students to improve learning and teaching;

– an assistant that answers questions about training;

– an assistant with administrative functions (dispatching assignments, course registration, notifications about the schedule of classes and exams, evaluations).

Studies [9–11] describes the process of developing a chatbot designed to inform users on behalf of an educational institution. To increase the productivity of the information system, it is proposed to use various methods of artificial intelligence, such as text classification, recognition of named objects. An unsolved problem in research is the lack of a framework that can act as an integrated semantic network to analyze user input and generate responses.

Paper [12] describes a university chatbot built on the basis of the Telegram messenger. An approach to choosing a communication scenario is proposed, which is implemented by dividing it into roles (student, father/mother, university employee). This approach makes it possible to delimit the information flow and effectively develop a semantic network.

As the analysis of previous studies showed, the first intelligent systems had problems with the ability to understand context and long-term dialog. Currently, this problem is solved with the help of deep learning technology. Modern platforms and designers like Telegram Bot contain elements of artificial intelligence and make it possible to develop a virtual assistant without special knowledge. However, the method of developing the information structure of a chatbot requires detailed investigation because a number of studies have shown bottlenecks in the development of a semantic network. The approach to distinguishing users by roles also requires further research.

3. The aim and objectives of the study

The purpose of our research is to design a system of interaction of artificial intelligence elements (chatbots) with users of web resources using natural language. This will make it possible to create a conversational chatbot that can advise and provide the necessary information regarding the admissions campaign and training in a certain educational program.

To achieve the goal, the following tasks were set:

– to design the information structure and select the content of the chatbot;

– to justify implementation tools and develop a chatbot of the Department of Applied Linguistics;

– to test the effectiveness of the chatbot using the example of the Department of Applied Linguistics.

4. The study materials and methods

The object of this study is the information system of interaction with website users. The research examines systems that allow interaction with users using natural language. The process of implementing a chat bot using multi-platform messenger technology is described. The bot @BotFather was chosen as the basis for the development of the interaction system.

The main hypothesis of the research assumes that the use of automated web consultants could allow creating and integrating an information system into the web resource, which would increase the level of communication between the user and the resource.

The research was conducted using methods of analysis, comparison, systematization and generalization of theoretical and research data, descriptive method, method of information collection, study and generalization of scientific experience, and empirical research method.

In the study, an integrated methodology was applied for the analysis of the technologies of the researched chatbot.

The use of the method of systematization, generalization of theoretical and research data and the descriptive method enabled the implementation of a number of criteria for the

effective operation of a chatbot in the research process, in particular: informativeness, multimodality, emotionality, productivity, interactivity, security, and accessibility. The method of expert assessment was used to determine the weighting factor of the criteria.

The method of analysis in the study made it possible to collect, analyze, and use data about the behavior of users to improve the efficiency and quality of the chatbot.

The following methods and tools were used to analyze user actions in the chatbot:

– collection of interaction data;
– text analysis;
– tracking user behavior;
– collection of communication information.

In the process of research, the chosen method helped display the statistics of interactions using the chatbot.

To analyze the activity of chatbot users, a comparative method was also used to track and compare interactions in different periods.

Analysis of the literature [5, 13, 14] revealed the main fundamental concepts regarding the technology of creating chatbots. On the basis of the research data, the method of natural language processing ("natural language processing") is considered in this paper. This method is used to divide the entered text or message into sentences and words.

In this study, the principle of functioning of the chatbot described in works [15, 16] has been modernized. Stages – the chatbot receives incoming messages, analyzes them, and sends the result of execution and/or executes a command, supplemented by new stages. Entering a request can be done by text or voice. In the latter case, the voice message must be processed using automatic speech recognition, which will convert it into machine text. After that, the natural language understanding module analyzes the input data and looks for relevant templates or patterns, that is, the system tries to separate the user's intent and the context of the request (Fig. 1).

The nature of the request is influenced by the type of user behavior, which was considered in study [17].

It should be noted that in order to effectively create a chatbot, it is important to understand what criteria allow it to be evaluated.

Based on the results of research [5], several basic principles of creating a chatbot are highlighted, which can help outline the criteria for its effective operation:

1. Informativeness: up-to-date information is available in the necessary volumes. In this way, there is no overload of the user with large amounts of text, but enough information is indicated.

2. Multimodality: the presence of additional elements that complement the meaning. In particular, the inclusion of multimedia elements, effective design of the structure of the text design.

3. Emotionality: the presence of elements that help in establishing an emotional contact with a person and imitating human interaction.

4. Productivity: interaction takes place in a convenient way (using buttons) and there are no delays in the speed of work.

5. Interactivity: the user can interact with the chatbot using buttons; chatbot reacts to user actions.

6. Security: hiding passwords, access keys to the chatbot; user data received from the chatbot is exclusively anonymous.

7. Accessibility: chatbot support and correct display in all versions of the application.

We determined the weighting factor of the above criteria. Since it is impossible to determine the numerical value instrumentally, the method of expert assessment was used in the study. 153 respondents took part in the survey. They had experience using chatbots. Each of them was asked to assign a score from 1 to 10 (for the least important and the most important criteria). The average score of the x_i-th criterion was calculated using the expression:

$$w_{xi} = \frac{w_1}{A}, \quad (1)$$

where w_{xi} is the average score of the ith criterion; w_1 – score of an individual respondent of criterion x_i; A is the number of experts.

The results of the survey of experts are given in Table 1.

Table 1

Expert survey results

Criterion name and designation	Average score (w_{xi})	Weighting factor K_w
Informativeness (x_1)	9.2	0.92
Multimodality (x_2)	6.2	0.62
Emotionality (x_3)	7.3	0.73
Productivity (x_4)	8.7	0.87
Interactivity (x_5)	7.9	0.79
Security (x_6)	7	0.7
Availability (x_7)	3.2	0.32

Determining the weighting factor (K_w) made it possible to determine the most important criterion for the development of a chatbot, according to users. Subsequently, the criteria informativeness (x_1), productivity (x_4), interactivity (x_5), emotionality (x_3) are taken into account when developing a chatbot.

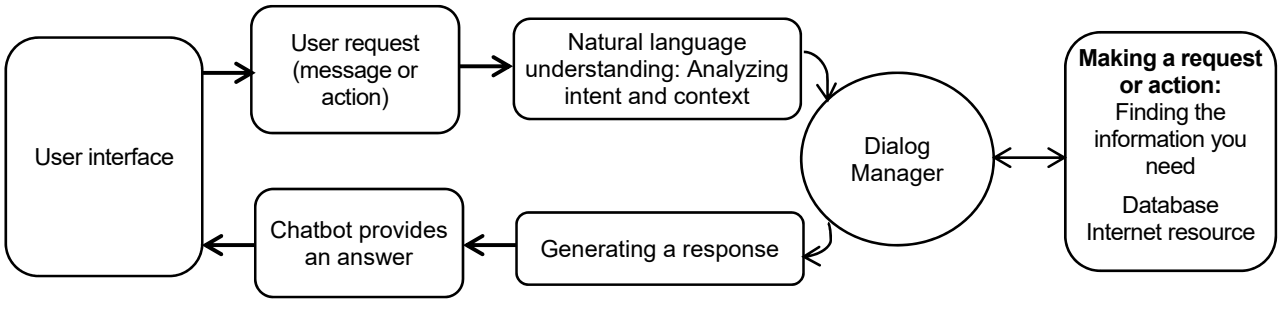


Fig. 1. The principle of chatbot operation

5. Results of the development of a chatbot to optimize informing users of the website

5. 1. Designing the information structure and forming the content of the chatbot

The implementation of a chatbot begins with the stage of structuring information containing informational and linguistic support.

To achieve the informativeness of the chatbot, one needs to build the structure of information presentation and choose the appropriate information.

The chatbot consists of two main modules of information: the module containing the information needed by the applicant "Applicant Module" and the module for freshmen (applicants). Each of them has its own structure. The sources of information in the chatbot are the official website of the Department of Applied Linguistics (https://all.vnu.edu.ua/) and the official website of the Admissions Committee (https://vstup.vnu.edu.ua/) at the Lesya Ukrainka Volyn National University (Ukraine).

The information content "Applicant Module" contains information about the specialty, information about the bachelor's and master's level of education, and contact details (Fig. 2).

The information content of the "Bachelor's Admission" module contains the following subcomponents:

– subjects of the external examination required for admission;

– terms of the introductory campaign;

– deadlines for submitting applications;

– rules of admission to the university (information on the list of required documents;

– a document with the current rules of the admission procedure in the current year and information about the admission committee);

– information on the cost of training on a contractual basis for full-time and part-time forms of education;

– the number of seats on a state basis and the total licensed volume of seats.

The information content of the module "Introduction to Master" contains the following subcomponents:

– information about required entrance tests;

– deadlines for the introductory campaign and submission of applications;

– information on admission rules;

– the cost of training on a contractual basis;

– licensed volume of seats;

– the possibility of entering the state form.

Information for first-year students includes items about the schedule of calls, classes, about lecturers, and contact information about the department.

It should be noted that linguistic support is implemented through the choice of the form of addressing users. The chatbot is aimed at entrants and first-year students, in turn, the age of the target audience is mostly 16–20 years old. In this case, the chatbot's utterances will use the form of address "you", which creates the effect of informal communication, which also helps implement the criterion of emotionality.

The chatbot uses graphic elements in the form of emotional emoticons to add meaning and convey emotions and the tone of the message instead of words.

The multimodality criterion is also implemented using text formatting. In particular, bold highlighting highlights the main information (Fig. 3).

Graphical elements that are used instead of list elements, a green flag with a check mark (Fig. 3, *a*) at the same time symbolizes approval, acceptability, and confirmation. A telephone receiver – to indicate a phone number, a letter with an arrow – to indicate the address of the department's email box, a group of people – to indicate a group chat, a round button – for a geographical location, namely the address of the department.

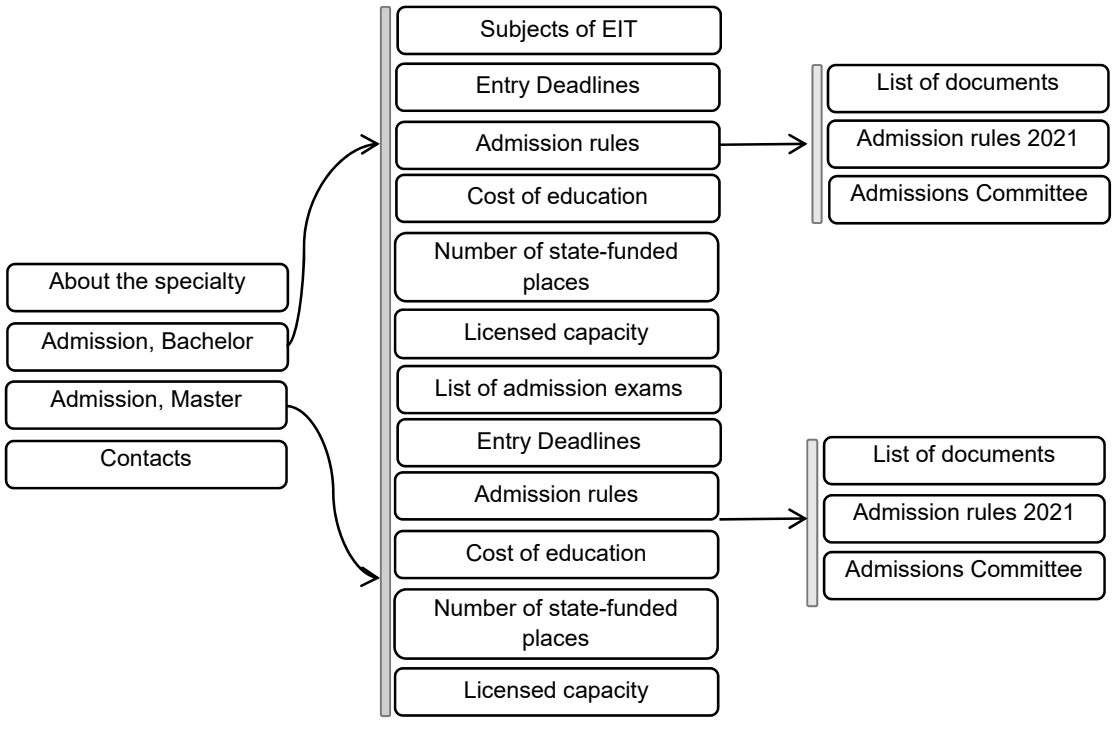
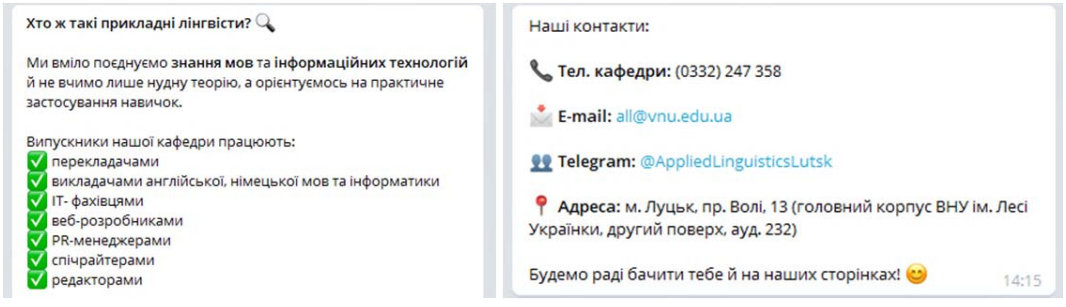


Fig. 2. Information structure of the module "Entrant"



a *b*

Fig. 3. Examples of using graphic elements in chatbot messages

In addition, the space between messages helps improve the visual perception of the structure of the text, which does not appear crowded, and allows the text to be separated.

The analysis of the above allows us to state that the chatbot will mainly perform an informative function – an option for its implementation is the form of a button chatbot. In this form of representation, all information is available through the menu, so the user can choose exactly what s/he needs.

5. 2. Justification of implementation tools and development of the chatbot of the Department of Applied Linguistics

A technological solution that helps create a chatbot and integrate it into the Telegram messenger is considered.

Two groups of tools are distinguished: universal (Dialogflow platforms from Google, Azure Bot Service (Bot Framework) from Microsoft, and Watson Assistant from IBM) and constructors.

Table 2 gives a comparison of universal platforms for creating chatbots.

As can be seen from Table 2, their comparative characteristics were based on the following criteria: availability of Ukrainian language support, integration with the Telegram messenger, availability of a free version, customization (use of third-party programming languages, databases, etc.), resource limitations, access to analytics. Critically important selection criteria were the following three characteristics: availability of Ukrainian language support, integration with the Telegram messenger, availability of a free version. All three platforms meet these requirements. However, the disadvantage of the free tariff plan is certain limitations.

Thus, Azure Bot Service (Bot Framework), despite the advantages in all selection criteria, suspends the services of all services after using the free credit limit of USD100. Customization options and statistics collection will also be stopped or significantly limited [18].

As for IBM Watson Assistant, the free version has fixed limits on the number of users and messages per month. In addition, attendance statistics are stored for only 1 week [19].

Compared to the platforms mentioned above, Google Dialogflow has quite significant resource capacity and offers a special version for educators, student projects, and small businesses. However, for customization, development of additional functionality of the platform and expansion of Dialogflow's statistics collection capabilities, third-party resources are required. In the context of this study, an additional disadvantage is the lack of the possibility of creating a fixed menu [20].

Another way to develop chatbots is to use constructors such as ActiveChat [21], SendPulse [22], and BotPress [23].

A feature of the ActiveChat constructor is the ability to create a chatbot without programming knowledge and integrate it into Telegram. This service supports natural language processing and the ability to create a chatbot using artificial intelligence technologies. The shortcoming of the system is the lack of full support for this technology in the Ukrainian language and in-depth analytics.

The SendPulse constructor is visual. It allows one to attach images, files, video and audio, and feedback buttons to the message. This service makes it possible to view statistics not only of users but also of individual messages and items. The disadvantage is the limited processing of requests (1,000 subscribers and 10,000 messages per month).

Table 2

Comparison table of universal platforms for creating chatbots

The name of the platform	Availability of Ukrainian language support	Integration with Telegram	Availability of a free version	Customization (use of third-party programming languages, databases, etc.)	Resource limitations	Analytics
IBM Watson	+	Through third-party applications	+	Starting with the Plus tariff, 140/month	Maximum number of users: up to 1000 per month	The last 7 days
Google (Dialogflow)	+	+	+	Involvement of external resources is required	Maximum number of messages: up to 10,000 per month	Detailed general analytics. For another, you need to add functionality
Microsoft Azure (Microsoft Bot Framework)	+	+	USD100 free credit for 1 month	A large number of various services	Maximum number of users: no limit	Full analytics

The Botpress platform works on a similar principle and makes it possible to visually build a chatbot. There are such interface elements as images, image gallery, buttons, text. Note that there is no possibility of using video, audio, and files. The service also makes it possible to choose your chatbot hosting. The disadvantages of Botpress are limited resources (only 2,000 thousand messages per month), the complexity of the interface for an ordinary user, and the lack of in-depth statistics. In particular, only basic analytics can be viewed in the system – the number of users per day, the number of conversations, etc.

Analysis of chatbot development tools revealed that the disadvantage of the considered platforms and designers is the limitation of the free plan. It was concluded that the free plan is not suitable for continuous use as it often limits the number of users, interactions, or lacks sufficient customization of the chatbot.

In order to fulfill the purpose of the research, a selection of implementation tools was carried out.

The main components are the development environment and language, application programming interface, server, and database.

The dynamic JavaScript programming language combined with a special Node.js code execution environment was chosen to implement the chatbot. In the process of development and implementation, the Telegraf library was used – a ready-to-use suite of software solutions that facilitates the creation of software, and in this case – a chatbot.

The next important component of the chatbot was the Heroku cloud platform (server), which will support the operation of the chatbot around the clock. In addition, the Heroku platform has an integrated Heroku PostgreSQL database, which will provide storage and management of the data that the chatbot will receive.

The process of creating a chatbot in the Telegram environment consists of the following stages.

Registration and configuration using a special bot @BotFather. This application makes it possible to create and manage your own bots.

BotFather offers several commands to customize your bot, including a name, description, bot information, profile picture, and a list of commands. The */newbot* command is used to create it. Here you need to enter the name of the chat bot, and then a short username, which must end with the word bot.

Generating a link to the bot that can be opened or shared with other users. In addition, a so-called "token" is provided, which makes it possible to access the bot at the software level. It functions as a so-called identifier and at the same time an access code to the bot.

It is worth noting that the short name (*VNU_Applied_Linguistics_bot*) cannot be changed later, but the bot can be renamed using the */setname* command (Fig. 4). It happens as follows: after entering the command, you need to choose a bot and then send a new name. Name the bot *AppLand Assistant*, as a longer name will not fully display.

Implementation of the software part of the chatbot. As mentioned earlier, the Telegram bot is identified by a token generated by BotFather upon creation. We emphasize that the token makes it possible to attach the created code directly to the bot. Thus, the connection between the code and the bot will be established, so all changes made in the code will be reproduced in its operation.

Server code is executed using terminal commands and Node.js. In Visual Studio Code, you can launch the terminal by selecting Terminal→New Terminal from the main menu.

To start working with the Telegraf framework, you need to download it and make sure that the correct file path is set. After that, establish a connection between the code and the Telegram servers using a token. After implementing all the modules of the chatbot, it is worth joining the Heroku server to the Git version control system. As mentioned earlier, they are needed to control the application from a local system (e. g., a computer).

Create a Heroku account. Since the application has already been created, next you need to register a file system folder as a remote repository where the code and required files will be stored. The files in the created files folder are combined into one project using the git system.

Fig. 5 shows how the file structure of the project looks like.

So now the chatbot is running on the Heroku server.

To view chatbot usage statistics, you need to connect the database, namely Heroku Postgres, where the data will be stored (Fig. 6).

After that, the database will be displayed in the *Data* item. Viewing database statistics is not provided by the system but there is a *dataclips* option that makes it possible to display a table from databases and load the table in CSV or JSON format.

To enter and change information in the database, you need to install the PostgreSQL database on your computer.

Thus, the task of substantiating tools for the implementation and development of the chatbot of the Department of Applied Linguistics is implemented on the Telegram platform.

Next, a check of the chatbot's operation in various operating systems and devices was performed, and a review of what interactions were carried out by users during the chatbot testing stage.

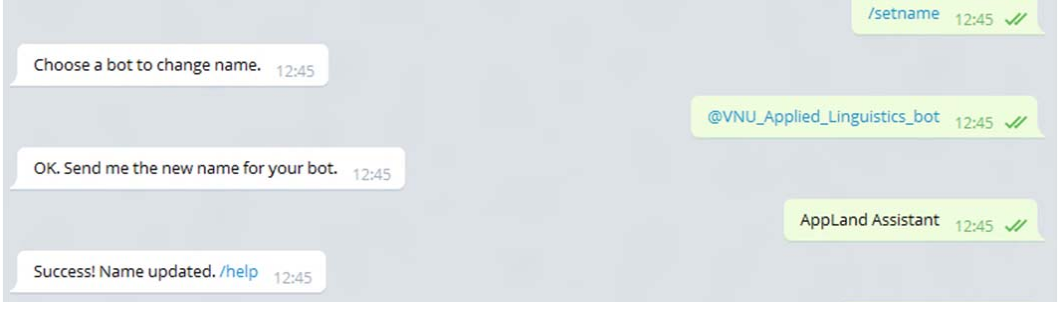


Fig. 4. Renaming the bot using the */setname* command

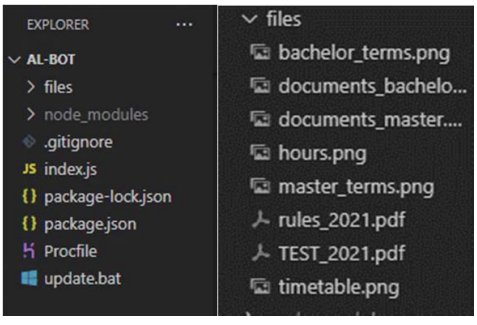


Fig. 5. File structure of the *appland-bot* project

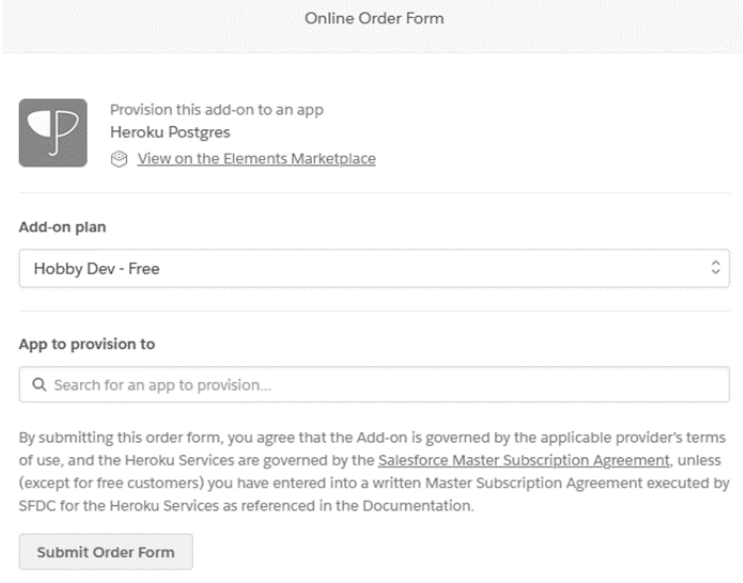


Fig. 6. Create and connect Heroku Postgre to the chatbot

5. 3. Testing the effectiveness of the chatbot on the example of the Department of Applied Linguistics

To check the adequacy of the developed information system, users tested this product.

Testing a chatbot is an important stage, as it will help see the effectiveness of the application. For several months, between July 17 and October 30, 2021, the chatbot was launched, published, and tested among applicants and students at the Department of Applied Linguistics of the Lesya Ukrainka VNU.

Data analysis showed that a total of 51 people used the chatbot (Fig. 7). The greatest number of interactions took place in the period from July 28 to August 27, which is due to the terms of the admission campaign and the acceptance of documents. The main functional task of the chat bot is precisely to inform applicants and simplified procedures for preparing documents for the admission campaign. In September, the number of users decreases.

In Fig. 8, it is possible to observe the interactions that took place between the user and the chatbot during the testing of the "Applicant" module (July 17–August 20). Each number on the plot corresponds to the numerical identifier of a specific feedback button entered into the database. In particular, users were interested in such modules of information as "about the specialty" (1), "contacts" (4 and 26), "bachelor's admission" (2), and "master's admission" (3).

The analysis of user transitions showed that those interested in undergraduate studies pay attention to information about "admission dates" (7), "admission rules" (8), "tuition cost" (9), "number of budget vacancies" (10), "licensed number of vacancies" (11), and "contacts of the admissions committee" (14).

Among the information about the master's degree, the module on "cost of education" (18), "licensed number of vacancies" (20) is of interest. It should be noted that applicants also viewed "call schedule" (23), "class schedule" (24), and "teachers" (25).

As our analysis of the number of interactions reveals, the most popular information was "about the specialty" (1), "call schedule" (23), "class schedule" (24), "teachers" (25), "contacts" (4 and 26). It should be emphasized that during this period of time, such modules as "external study subjects", "list of necessary documents for bachelor's and master's degrees", "admission rules", "admission deadlines" and "number of budget vacancies for master's degree" were not used.

Among the information requested from August 20 to October 30, there is interest in "about specialty" (1), "contacts" (4 and 26), "call schedule" (23), "class schedule" (24) and "teachers" (25). In particular, the "about specialty" button was interacted with 4 times, the "call schedule" – 14 times, the "class schedule" 63 times, the "teachers" button – 15 times, and the "contacts" buttons – 6 times (Fig. 9).

Fig. 10 shows at what time periods specific buttons were used. In particular, it can be seen that at the end of August, they were still interested in information "on bachelor's admission" (2), in particular, "contacts" (4).

It can be observed that "about the specialty" (1) was read even at the beginning of September, but in October the need had already disappeared. In addition, significant interest in the schedule of classes is observed at the end of August and in September, in particular, a total of 53 interactions with this button are carried out.

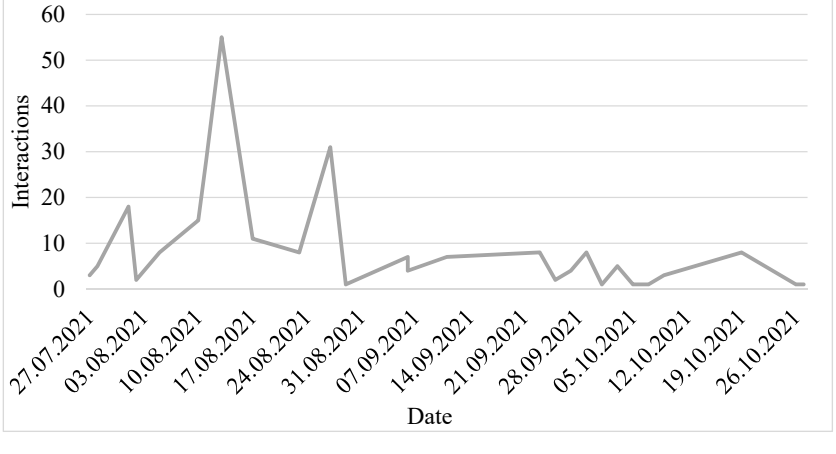


Fig. 7. Activity of chatbot users in the period from July 17 to October 30, 2021

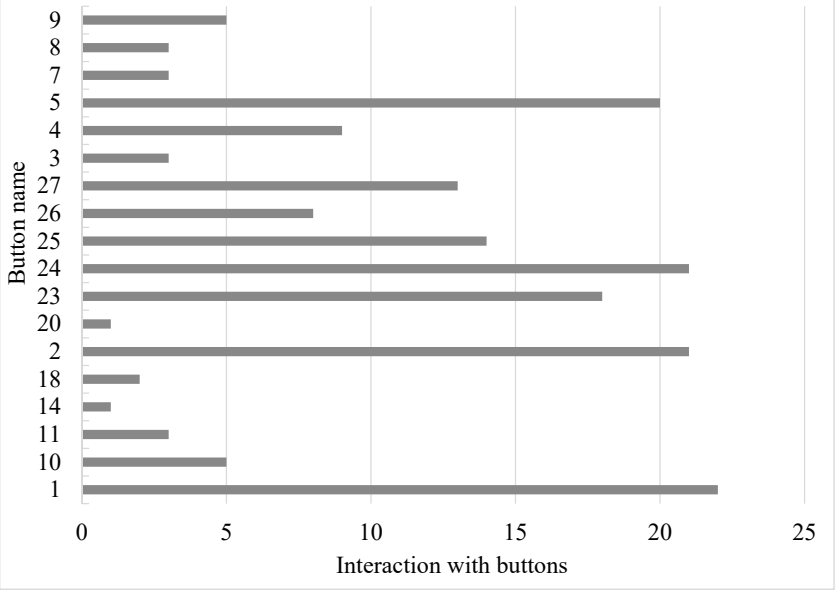


Fig. 8. Histogram of interaction with feedback buttons during testing of the "applicant" module

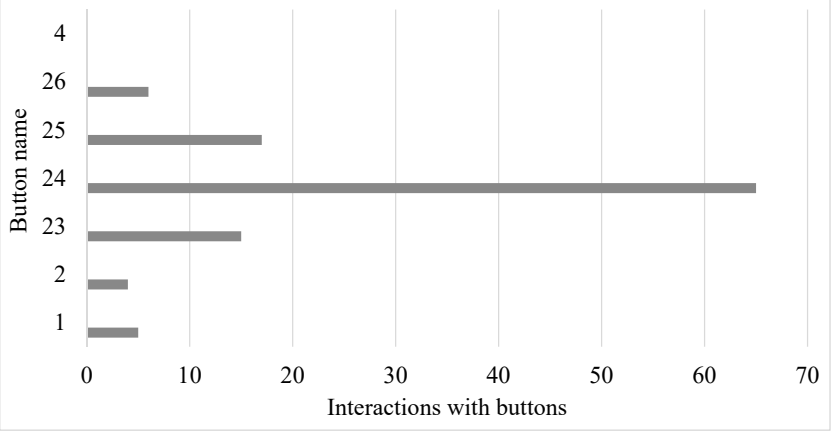


Fig. 9. Results of testing the button of the "freshman" module

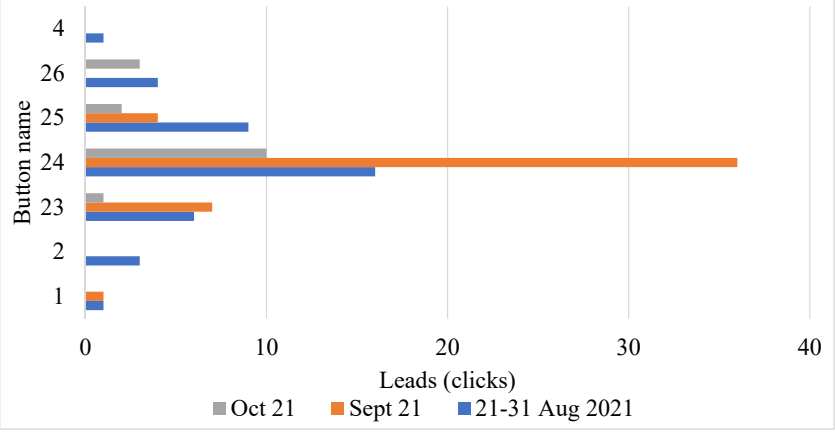


Fig. 10. Monthly interaction with feedback buttons during August 21 — October 30

It is important to note the number of clicks and transitions using all chatbot feedback buttons during the entire testing period. So, the following results were obtained:

– "class schedule" – 84 times; teachers – 29 times;

– "about the specialty" – 26 times;

– "Bachelor admission" – 24 times;

– "call schedule" – 23 times;

– "contacts" – 23 times;

– "the cost of studying at a bachelor's degree" – 5 times;

– "number of budgetary places at the bachelor's degree" – 5 times;

– "terms of admission to bachelor's degree" – three times;

– "rules of admission to the balakavrat" – three times;

– "licensed volume of places at the bachelor's degree" – three times;

– "master's admission" – three times;

– "cost of studying at the master's degree" – twice;

– "contacts of the admissions committee" – 1 time;

– "licensed volume of places at the master's degree" – 1 time;

– "external study subjects" – never;

– "list of necessary documents for bachelor's degree" – never;

– "list of entrance examinations for the master's degree" – never;

– "terms of admission to the master's degree" – never;

– "rules of admission to the master's degree" – never;

– "download test 2021 for masters" – never;

– "number of budgetary places at the master's degree" – never;

– "list of necessary documents for the master's degree" – never;

– "admission rules pdf (document)" – never.

According to the statistics collected during the entire testing period, interaction with the modules was performed 235 times. Out of 22 chatbot modules, 9 had no transitions. Most transitions were made to modules that meet the criterion of informativeness ("class schedule" – 35 % of the total number of visits, teachers – 12.3 %, "about the specialty" – 11 %, "bachelor's introduction" – 10.2 %, "call schedule" – 10 %, "contacts" – 9.8 %, other 9 modules – 11.7 %.

The following was established during testing:

– the most frequently used chatbot buttons were identified, regardless of the type of user (applicant, applicant);

– chatbot buttons that were not used at all were detected. Subsequently, the

possibility of excluding these buttons from the information structure of the chatbot is considered;

– the peak activity of resource users falls on the terms of the introductory campaign;

– for the effective operation of the information system, proper maintenance and timely information filling of the website is necessary.

It should be noted that a flaw in the analytics collection system was discovered during testing. It is technically impossible to track how many times users have selected a role or which links they have opened. Therefore, statistics do not take into account information about the number of people who used certain link buttons. Among these buttons are links to the department's website, the calculation of the competitive score, the website of the admissions committee, the database of test tasks for admission to the master's degree, and the department's pages on Facebook, Instagram, and YouTube.

Having analyzed all user interactions, it can be stated that the information structure (Fig. 2), which contains 22 modules with information, is informative and effective. The consideration of the criterion weighting index (K_w) when developing a chatbot is confirmed by the test results described in this chapter.

6. Discussion of results of checking the operation of the chatbot

To apply the approach of distinguishing users by roles, first of all, the target audience is defined. The target audience of the chatbot is first-year students of the OP Applied Linguistics. Translation and Computational Linguistics (Department of Applied Linguistics), graduates (and their parents), and graduates of the bachelor's level of education who want to enter the master's program. All chatbot users are divided into two groups depending on the level of education (bachelor, master). The applicant module contains two modules with general information that is available when choosing one of the two scenarios. As well as two modules "Bachelor's Entry" and "Master's Entry", which contain specialized information depending on the user's chosen role. During the testing of the chatbot, the "Bachelor Introduction" module was used by 10.2 % of all visitors, which confirmed the effectiveness of the approach of distinguishing users by roles. Also, this approach allowed the user to self-identify and choose a communication scenario. User identification by role speeds up the process of obtaining the necessary information. This approach can be used in chatbots with heterogeneous content.

For the effective design of modules, the weighting factor of the criteria (K_w) was determined, which helped select the most important aspects for the development of the chatbot. Verification of the chat bot showed the most popular modules among users ("class schedule", "about specialty", "bachelor entrance", "call schedule", "contacts"), the content of which meets the criteria of informativeness. Determining the weight factor (K_w) made it possible to predict user leads. This technique can be used when designing a chatbot semantic network.

Chatbot localization at the department level simplifies the product structure and provides a more understandable and accessible interface for users. In addition, the choice of development tools and technologies was based on the free-of-charge approach, the possibility of integration with social networks, and the availability of an application software interface. As a result, Telegram was chosen as one of the most popular instant messaging programs and Heroku cloud platform for fast and free web hosting (Fig. 5) and database (Fig. 6).

Although the chatbot provides accessibility to information and can process requests from multiple users at the same time, it does not provide automatic synchronization with up-to-date data from other websites. As an example, with the websites of other structural divisions of the university. In this study, this is a limitation that leads to irrelevant information provided by the chatbot.

Another limitation is the inability to provide answers to complex questions and process the contextual nuances of speech.

In order to further improve the chatbot, further research plans to improve the statistics module and develop a natural language processing algorithm that will process complex requests from users.

7. Conclusions

1. When designing the information structure of the chatbot, the approach of distinguishing users by roles was applied. The developed structure could serve as a template model and be used in chatbots designed to inform applicants.

2. The choice of the chatbot implementation tool was based on the main components: environment, development language, application programming interface, server, and database. The advantage of the Telegram environment is the possibility of integration into any web resource. The chosen dynamic JavaScript programming language makes it possible to create interactive and dynamic projects. The server is implemented using the Heroku cloud platform, the main advantage of which is round-the-clock support for the chatbot, which ensures its reliability. The integrated application of these tools made it possible to design a user information system.

The chatbot is implemented in the form of a button chatbot. In the course of work, such criteria as informativeness, multimodality, emotionality, productivity, interactivity, security, and accessibility were imple mented.

3. During testing, it was found that the chatbot is actively used by applicants and students at the Department of Applied Linguistics of the Lesya Ukrainka Volyn National University. The analysis showed the peak activity of applicants in July-August, which is associated with the admissions campaign, and September-October, which is associated with the beginning of the educational process. The most interactions were recorded in the modules "about the specialty", "cost of education", "number of budget vacancies", "call schedule", "class schedule", and "teachers". The system's shortcomings were recognized as the limited ability to collect analytics, which makes it difficult to assess the popularity and effectiveness of individual chatbot functions.

Conflicts of interest

The authors declare that they have no conflicts of interest in relation to the current study, including financial, personal, authorship, or any other, that could affect the study and the results reported in this paper.

Funding

The study was conducted without financial support.

Data availability

All data are available in the main text of the manuscript.

Use of artificial intelligence

The authors confirm that they did not use artificial intelligence technologies when creating the current work.

References

1. Turing, A. M. (1950). I.—Computing machinery and intelligence. Mind, LIX (236), 433–460. https://doi.org/10.1093/mind/lix.236.433
2. Weizenbaum, J. (1966). ELIZA—a computer program for the study of natural language communication between man and machine. Communications of the ACM, 9 (1), 36–45. https://doi.org/10.1145/365153.365168
3. Wallace, R. S. (2007). The Anatomy of A.L.I.C.E. Parsing the Turing Test, 181–210. https://doi.org/10.1007/978-1-4020-6710-5_13
4. Adamopoulou, E., Moussiades, L. (2020). Chatbots: History, technology, and applications. Machine Learning with Applications, 2, 100006. https://doi.org/10.1016/j.mlwa.2020.100006
5. Khan, R., Das, A. (2018). Build Better Chatbots. Apress. https://doi.org/10.1007/978-1-4842-3111-1
6. Motger, Q., Franch, X., Marco, J. (2022). Software-Based Dialogue Systems: Survey, Taxonomy, and Challenges. ACM Computing Surveys, 55 (5), 1–42. https://doi.org/10.1145/3527450
7. Pereira, R., Lima, C., Reis, A., Pinto, T., Barroso, J. (2024). Review of Platforms and Frameworks for Building Virtual Assistants. Lecture Notes in Networks and Systems, 105–114. https://doi.org/10.1007/978-3-031-45648-0_11
8. Chatbot reviews. Chatimize. Available at: https://chatimize.com/reviews/
9. Hien, H. T., Cuong, P.-N., Nam, L. N. H., Nhung, H. L. T. K., Thang, L. D. (2018). Intelligent Assistants in Higher-Education Environments. Proceedings of the Ninth International Symposium on Information and Communication Technology - SoICT 2018. https://doi.org/10.1145/3287921.3287937
10. Ushakova, I. (2019). Approaches to Creating Intelligent Chatbots. Information Processing Systems, 2(157), 76–83. Available at: https://journal-hnups.com.ua/index.php/soi/article/view/soi.2019.157.10.
11. Viktorova, L. (2021). Prospects for the application of modern technologies and artificial intelligence in higher education institutions with specific learning conditions. Humanities Science Current Issues, 2 (35), 180–186. https://doi.org/10.24919/2308-4863/35-2-29
12. Morze, N., Buinytska, O., Varchenko-Trotsenko, L. (2017). Use of bot-technologies for educational communication at the university. Available at: https://depot.ceon.pl/bitstream/handle/123456789/15492/16_morze-use_of_bot.pdf
13. Adamopoulou, E., Moussiades, L. (2020). An Overview of Chatbot Technology. Artificial Intelligence Applications and Innovations, 373–383. https://doi.org/10.1007/978-3-030-49186-4_31
14. Chatbots: The Definitive Guide. Available at: https://www.artificial-solutions.com/chatbots
15. Abu Shawar, B., Atwell, E. (2007). Chatbots: Are they Really Useful? Journal for Language Technology and Computational Linguistics, 22 (1), 29–49. https://doi.org/10.21248/jlcl.22.2007.88
16. Clark, A., Fox, C., Lappin, S. (Eds.) (2010). The Handbook of Computational Linguistics and Natural Language Processing. John Wiley & Sons. https://doi.org/10.1002/9781444324044
17. Krestyanpol, L. (2022). Social engineering in the concept of rational and irrational consumer behavior. Frontiers in Nutrition, 9. https://doi.org/10.3389/fnut.2022.961929
18. Azure AI Bot Service documentation. Available at: https://learn.microsoft.com/en-us/azure/bot-service/?view=azure-bot-service-4.0
19. Introduction to Watson Assistant. Available at: https://developer.ibm.com/articles/introduction-watson-assistant/
20. Dialogflow. Available at: https://cloud.google.com/dialogflow/docs/
21. ActiveChat Review. Chatimize. Available at: https://chatimize.com/reviews/activechat/
22. How to create a chatbot in Telegram. SendPulse. Available at: https://sendpulse.com/knowledge-base/chatbot/telegram/create-telegram-chatbot/
23. Get to know Botpress. Available at: https://botpress.com/docs/