Journal of Process Management and New Technologies
www.japmnt.com ISSN: 2334-735X (Print) ISSN: 2334-7449 (Online)
Vol. 10, Issue 1-2, 2022, pp. 125-139

AN EXAMPLE OF CHATBOT IN THE FIELD OF EDUCATION IN THE REPUBLIC OF SERBIA

Aleksandar VUKOMANOVIĆ[1*], Nemanja DERETIĆ[2], Miloš KABILJO[3], Rade MATIĆ[4]

[1]*Belgrade Business and Arts Academy of Applied Studies, Belgrade, Serbia, a.vukomanovic@bpa.edu.rs*

[2]*Belgrade Business and Arts Academy of Applied Studies, Belgrade, Serbia, nemanja.deretic@bpa.edu.rs*

[3]*Belgrade Business and Arts Academy of Applied Studies, Belgrade, Serbia, milos.kabiljo@bpa.edu.rs*

[4]*Belgrade Business and Arts Academy of Applied Studies, Belgrade, Serbia, rade.matic@bpa.edu.rs*

Abstract: *Students can retrieve information from the website or use the services of an existing information system (provided the information system is on the internet). However, we know from experience that searching a website is time-consuming or even inaccurate, and the functionality of the information system is limited. Chatbot makes it more natural, efficient and faster. Chatbot can understand natural language, i.e. written text and voice messages. It gives precise answers and performs all actions intended by the website and / or the information system. But the website and the information system do not have the richness of language that the chatbot has. You have to log in to the information system and know how to use it, and each new version requires new learning. If you know how Viber or FB Messenger work, you probably know how to use chatbot. The services provided by chatbot are visible on communication platforms used by a large number of users, and thus the quality of these services is better. Due to the use of chats, the human resources of the educational institution are redirected/retrained to more responsible and creative jobs because the workload has been relieved. The paper presents a chatbot called ADA, developed at the Belgrade Business and Arts Academy of Applied Studies (BAPUSS), and shows basic usage statistics. It also points out the importance of chatbots as a communication channel in educational institutions.*

Keywords: *chatbot, Weaver, NLU, business process, education*

Original scientific paper
Received: 14.06.2022
Accepted: 22.06.2022
Available online: 22.06.2022

1. Introduction

In this paper we will analyse the implementation of a software solution called Academic Digital Assistant – ADA (chatbot.bpa.edu.rs). ADA is a virtual assistant, a so-called chatbot, based on artificial intelligence and created primarily with the aim of facilitating students, both current and future, to access the necessary information related to their studies and to help them solve everyday student tasks and obligations.

* Corresponding author

The COVID 19 pandemic has dramatically changed education systems around the world, suddenly providing a greater opportunity for the rise of digital communication and eLearning. Education in all countries is tempted as educational institutions, professors, children and parents face the problem of lack of knowledge and interaction with a new challenge - the transition to digital platforms. As young people around the world continue their education from home, communicating with them is more important than ever. (Radulović et al., 2022)

Technology offers a solution on chatbot, all for the purpose of distancing, limiting human resources and improving human-computer interaction. Chatbot simulates human conversations or chats by using messaging platforms (such as Viber or Facebook Messenger) and artificial intelligence to detect user intent, answer questions and provide services.

The ADA chatbot development project is the first of its kind in the Balkans in the field of education to enable better communication, 24/7 accessibility, time saving and faster and more efficient service delivery. The ADA can currently recognise over two hundred different scenarios and this number is constantly increasing. Some of the scenarios most commonly used by students were: checking the time of consultation with the professor, contact details of the professor, checking working hours, registering and cancelling exams, checking credits, paying tuition fees, etc. (Kabiljo et al., 2020; Matić et al., 2022)

The topic of the paper is the establishment of chatbot at a higher education institution. The aim of this paper is to show the justification for the existence of chatbot at a higher education institution. The chatbot ADA presented in this paper is one of the pioneers of application in higher education institutions in Serbia and in the Balkan region in general.

The paper consists of six parts. In the first part, we give an introduction to the project itself. The second chapter gives a brief overview of the literature on chatbots. In the third part, we write about the techniques and technologies used for the project development. The fourth part is dedicated to ADA chatbot and implementation scenarios. The fifth chapter presents the results of the application of ADA chatbot on the example of the Belgrade Business and Arts Academy of Applied Studies. In the sixth part we will complete and conclude the story.

2. Literature Review

In recent decades, the development of conversational agent systems has increased in various sectors such as banking, e-commerce, government administration, insurance, education and other areas (Tarek et al., 2022). Conversational agents, or chatbots, provide a natural language interface to their users (Kerlyl et al., 2007). ELIZA (Weizenbaum, 1966), was considered one of the first chatbots. ELIZA analysed input sentences and generated its response based on composition rules associated with input decomposition.

The use of artificial intelligence (AI) in education is increasing rapidly. The use of chatbot technology in education is one of the most important approaches to improve and promote a more personalised learning experience (Cunningham-Nelson et al., 2019). Chatbots are increasingly being used to enhance interaction with students in today's world of technology, where communication and many other activities rely heavily on online platforms. Chatbot systems can be used as mobile web applications to support learning (Okonkwo & Ibijola, 2021). In the paper Adamopoulou and Moussiades (2020), the different categories of chatbots are presented (Knowledge domain, Service provided, Goals, Response Generation Method, Human-aid, Permissions, Communication channel). Each category has been defined on the basis of a simple criterion, and a chatbot can belong to more than one category at the same time.

There are two approaches to developing a chatbot, depending on the algorithms and techniques used: pattern recognition and machine learning (Adamopoulou & Moussiades, 2020).

3. Techniques and technologies used for project development

A modern chatbot development platform must have the following three parts that truly deliver a conversational experience:

- Natural Language Processing (NLP): Understanding user input and extracting relevant information;
- Conversational flow: Includes managing the context of the conversation;
- Action execution (tasks): To provide simple responses as well as advanced functions such as database queries, Application Programming Interface (API) requests or logical user-defined triggers.

The analysis of the methods, techniques and technologies used to realise chatbots is one of the most common research topics. The focus of technical research is on natural language processing and knowledge of task interpretation in terms of intelligent communication with the user. Four main themes in the implementation of chats have been identified: Natural Language Processing (NLP), Natural Language Understanding (NLU), Natural Language Generation (NLG) and Dialogue Stage Tracking (DST) (Motger et al., 2021).

In NLU, NLG and DST techniques, there is a general categorisation into two main approaches: rule-based approaches and artificial intelligence-based approaches. Four categories of rule-based techniques have been identified: Fixed Inputs, Pure NLP, Vector Space and Pattern Matching. Artificial intelligence-based approach is also divided into four categories of techniques: Ensemble learning, such as decision tree, I/E classifiers such as intent/entity classifiers, web services, solutions that usually combine machine learning (I/E classifiers) and rule-based approaches to NLU tasks. Examples of web services are: RASA (Jiao, 2020), DialogFlow (Muhammad et al., 2020), (Ruane et al., 2020), etc. and neural networks (Bhartiya et al., 2019). The ADA project uses artificial intelligence-based approaches, i.e. its category I/E classifiers. As for the commonly known technological solutions in the implementation of ADA, we have used: Visual Studio, The NET Core Web API, Angular and Microsoft SQL Server.

Visual Studio is a powerful integrated development environment that enables the development of various types of applications. Microsoft SQL Server is a relational database model designed to run on a variety of platforms, from laptops to computers to multiprocessor servers. The NET Core Web API and Dapper (Sigelman et. al, 2010) are backend technologies developed by Microsoft that can run on any operating system, not just Windows. The main task of the .Net Core Web API is to execute backend logic, communicate with the database and provide certain data requested by the client. The ORM client used in this system is called Dapper micro. Angular (angular.io) is an open-source framework for one-page applications developed by Google. Angular gives applications a modern look that looks good on all devices. The application is responsive, meaning it can be displayed on monitors, tablets and mobile devices where it has a custom layout and scaling depending on the screen.

3.1. Natural Language Processing

To understand how a chatbot works, how it knows what we asked it and how it knows what question should be answered, we need to delve a little deeper into the scientific disciplines in the field of artificial intelligence and linguistics.

As already mentioned, a chatbot is a digital assistant (programme) that simulates communication with the user. Depending on the area for which we are developing our chatbot, we adapt the scenarios and areas for which we want to teach it to give answers and provide services. But how is a computer, a machine without a brain, without the ability to think, supposed to know what the user is asking? In the world of information technology and artificial intelligence, this problem is being addressed by a scientific discipline called NLP (Natural Language Processing).

In the 21st century, computers can analyse all kinds of data, monitor our business, perform very complicated operations, and so on. However, when that data is a language, it is a whole different world. Real-world language processing by computers is more complex and we face problems with text segmentation, ambiguity in the meaning of words, dialects, spelling errors and many other little things that affect the final result.

Natural Language Processing (NLP) refers to the branch of computer science - more specifically, the branch of artificial intelligence that enables computers to understand text and spoken words in a similar way to humans. Human language is amazingly complex and varied. We express ourselves in an infinite number of ways, both orally and in writing. Not only are there hundreds of languages and dialects, but each language has its own set of grammatical and syntactical rules, expressions and slang. When we write, we often make spelling mistakes, abbreviations or omit punctuation marks. When we speak, we have regional accents and we mumble, stutter and borrow expressions from other languages. This is why NLP is so unpredictable - minimal progress in NLP development can take years for a company to turn it into a successful business tool. Such a product aims to communicate directly with customers in an appropriate and successful way, without the effort and supervision of the human factor (Nadkarni et al., 2011; Chowdhary, 2020).

NLP combines computational linguistics - the rule-based modelling of human language - with statistical modelling, machine learning models and deep learning. Together, these technologies enable computers to process human language in the form of text or speech data and "understand" its full meaning, along with the intentions and feelings of the speaker or writer. NLP runs computer programmes that translate text from one language to another, respond to spoken commands and compress large amounts of text quickly - even in real time.

NLP is a scientific field concerned with understanding human language, layering sentences and recognising the context and intentions of users, and then manipulating this data to provide information or services to the user, and can be divided into:

- NLU (Natural Language Understanding),
- NLG (Natural Language Generation).

Natural Language Understanding (NLU) is a branch of Natural Language Processing (NLP) that involves converting human language into a machine-readable format. Both NLP and NLU aim to understand unstructured data, but there is a difference between them. NLP is concerned with the way computers are programmed to process language and enable "natural" communication between computers and humans. NLU, on the other hand, focuses on the ability of machines to understand human language, i.e. how to arrange unstructured data so that it can be "understood" and analysed by machines. Think of it this way: before a computer can convert unstructured text into a machine-readable format, machines must first understand the characteristics of human language. (Allen, 1988; Bates, 1995)

Natural language generation is a software process that automatically transforms structured data into human-readable text. With the right data in the right format, the NLG system can

automatically convert spreadsheet numbers to narrative data based on data, or even use word connections to create partially or completely machine-written text. NLG systems use machine learning, deep learning and neural networks, all forms of artificial intelligence (AI), to generate natural human language. These systems can generate natural language in a variety of formats. I can turn numbers into narratives based on pre-set templates. They can predict which words should be generated next (say in an email you are actively typing). The most sophisticated systems can formulate entire summaries, articles or answers. Also, NLG systems have the ability to provide answers to questions about a text or passage of text, which can be a potential opportunity to improve digital and distance learning. With adequate implementation, NLG systems could be used to improve and advance digital learning, precisely because these systems are able to "learn" large texts, even entire books, and answer questions from the text. (Bateman & Zock, 2003; McDonald, 2010)

3.2. UML as a business process (scenario flow) modelling tool

Unified Modelling Language (UML) was created by combining several object-oriented graphical modelling languages. There are currently 14 diagram types, divided into two basic groups: Behavioural diagrams and Structural diagrams. To avoid confusion, it should be noted that the development process cannot be done with UML alone. However, the standardisation and general acceptance of UML has set the stage for harmonising all activities not realised by UML with those realised by it.

The UML was not always the main modelling language as it is today. It was not so long ago that everyone involved in a complex modelling system used a number of different modelling languages, some formal and some informal, each with its own approach to development. Every approach to modelling has advantages and disadvantages, but UML has six major advantages:

- Formal language - each element of the language has a well-defined meaning, so you cannot misunderstand when modelling a particular part of the system;
- It is precise and concise - the entire language consists of precise and simple notations;
- It is compressible - it describes all the important aspects of the system;
- It is adaptable and comprehensive - the language is formal enough to withstand the modelling of massive systems, but can be reduced to the level of a small project to avoid excessive intemperance;
- It builds on lessons learned - a collection of all the best real-world experience gained over the last 20 years in an object-oriented environment;
- It is a standard - UML is controlled by the OMG (Object Management Group), which promotes open standards with the active involvement of a group of academics from around the world.

In this paper we will show 2 diagrams from the UML diagram group, namely:

- Use Case Diagram
- Activity diagram

The use case has the function of providing measurable results for the user or an external system. A use case is a situation in which your system is used to fulfil one or more user requirements. A use case diagram for semester certification and additional informations is shown in Figure 1.

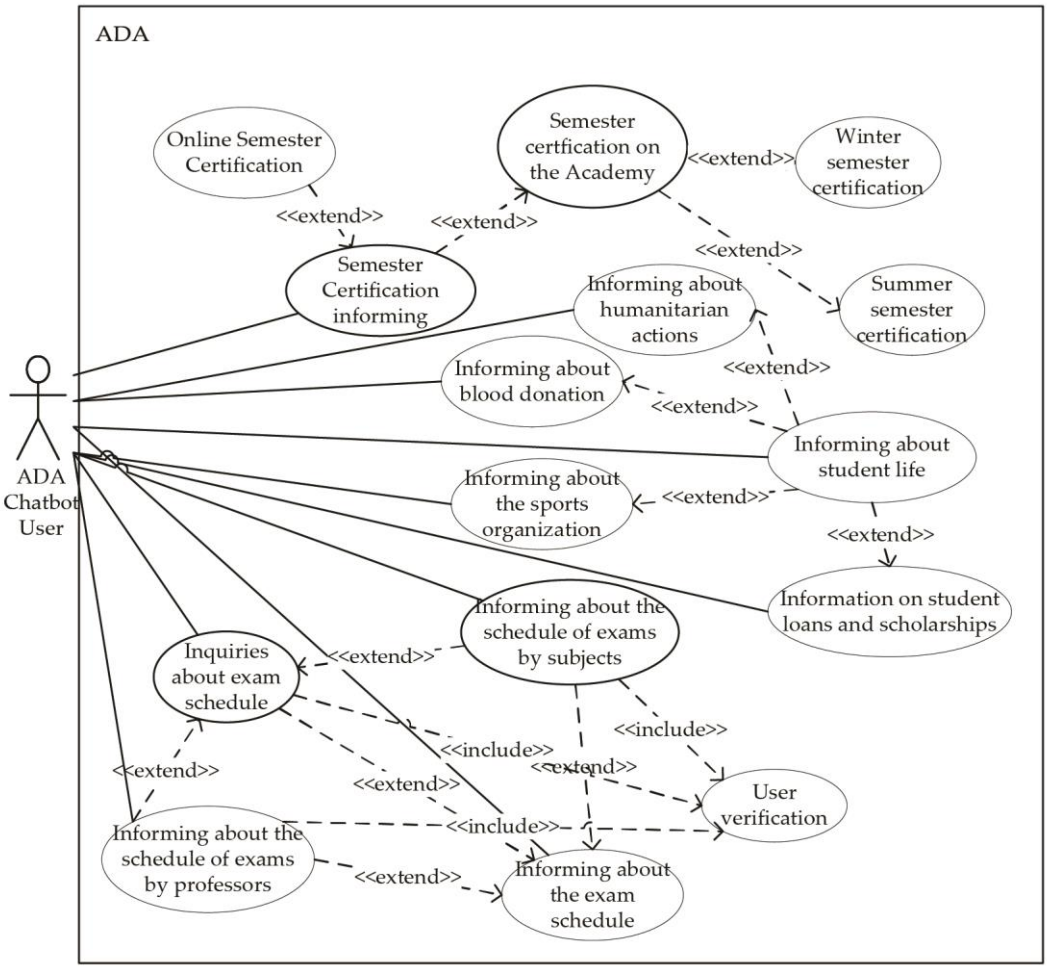

Figure 1. Use case diagram for semester certification and additional informations
Source: ADA chatbot

Activity diagrams are used to describe the logic of flows, business processes and scenario flows. Functional flows represented by use case diagrams are described by activity diagrams, which show all activities that take place within the observed functionality. A model of a chatbot scenario is shown in Figure 2.

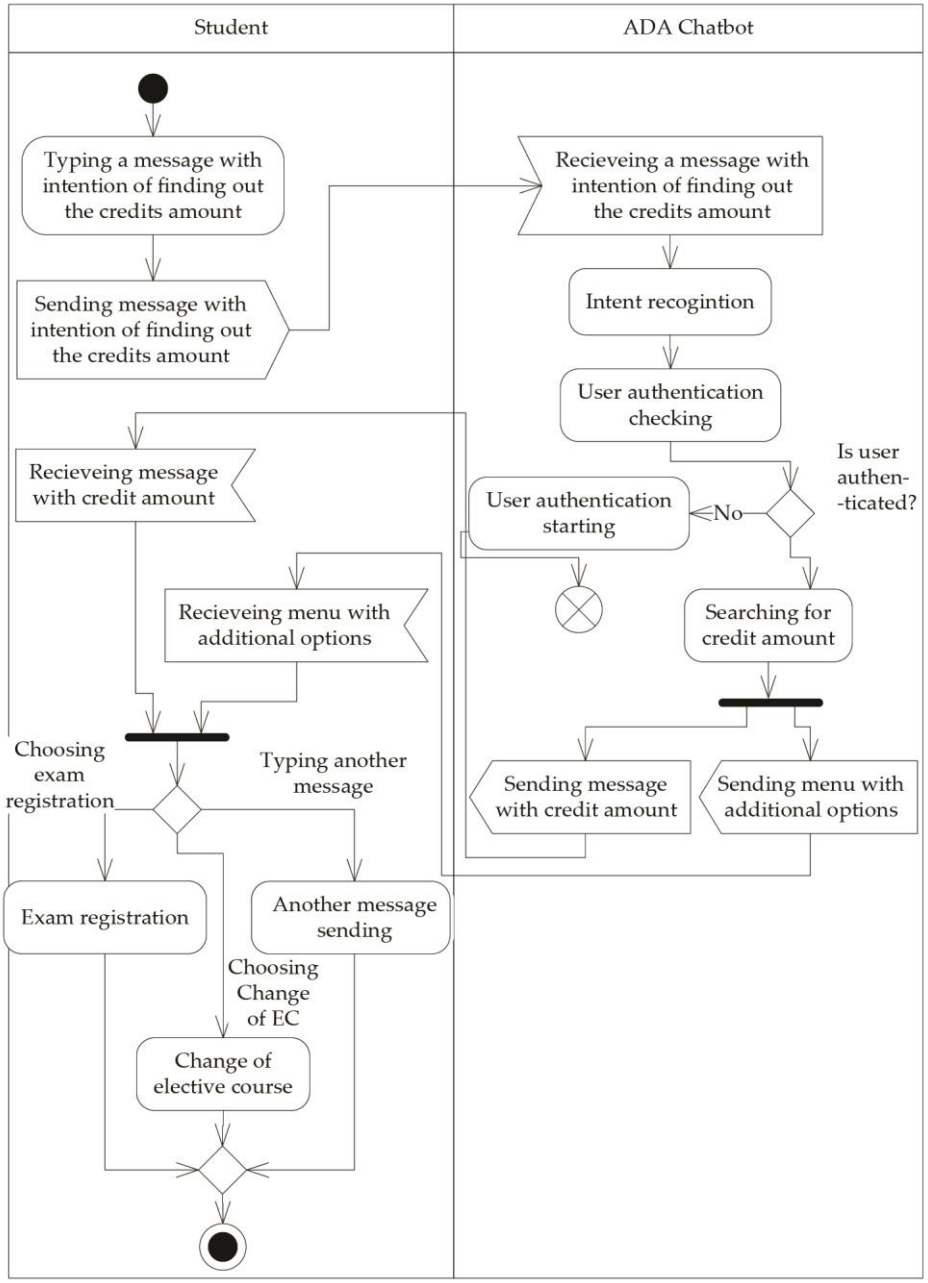

Figure 2. Activity diagram for finding out the credits amount
Source: ADA chatbot

4. Academic Digital Assistant (ADA) chatbot

The ADA chatbot project can be divided into two parts. The first part refers to the logical part of running chats, implemented using the Weaver platform (weaverbot.ai) in combination with machine learning technologies, which we explained in chapter 3. The second part is an external service implemented to integrate the chat with the educational institution's database.

The ADA chatbot is a very complex information system that requires a number of applications and services to run in the background each time a user makes a request so that the user receives the fastest and most accurate information, i.e., an answer to their question. For everyday questions from students, parents and other users, the team working on the chatbot

project ADA integrates up to 4 separate information systems into one technologically and conceptually modern solution for providing information and performing administrative tasks.

The four entities covered by the ADA are:

- Weaver platform,
- External API,
- Communication channels (Viber, FB messenger, Web site),
- BAPUSS Student Internet Service.

Depending on the complexity of the scenario, communication takes place between two, three or four services to send the response to the end user. The complexity of the scenario depends on whether the response we need to send to the user is static (text response stored in the Weaver platform) or dynamic, which means that we need certain information from other services to compose the response. In addition, dynamic scenarios can be divided into scenarios that provide only informational responses and scenarios that perform an action for a student or prospective student (e.g. registering for preparatory courses, registering for exams, paying tuition fees, etc.).

From all this we can derive the following categorisation of scenarios:

- Smalltalk - chat with chatbot scenarios that have nothing to do with their essence and basic purpose. Exclusively intended for entertainment;
- Static Q&A (Question & Answer) - simple scenarios designed to get information about specific things;
- Complex Q&A - scenarios that require communication with other services to provide appropriate information to the user;
- Scenario with integration and verification - scenarios that support students in carrying out administrative procedures related to their studies. Certain scenarios require a specific type of student verification to integrate a particular communication channel with the student profile.

When ADA is first launched via any communication channel (Viber, Messenger, Web), the user receives a welcome message that starts the conversation, as shown in Figure 3.

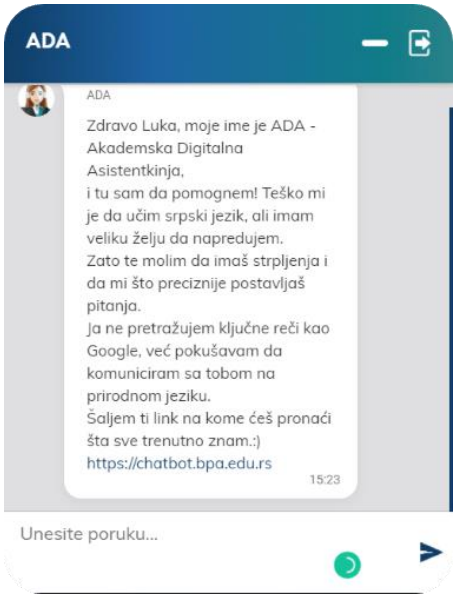

Figure 3. Start a conversation with the ADA chatbot
Source: ADA chatbot

We will introduce each of the previous categories by several things:

- Basic information,
- Use case diagram,
- Communication diagram,
- Activity diagram.

4.1. Smalltalk scenarios

As we have already said, this group of scenarios has nothing to do with administrative procedures and information about studies and similar topics, but is intended solely for chatting for fun. Some of the Smalltalk scenarios include:

- DialogHello
- DialogWhatAreYouDoing
- DialogHowAreYou
- DialogBotTellJoke
- DialogAreYouIntelligent

4.2. Static Q&A Scenarios

As we said earlier, static Q&A scenarios are simple QUESTION-ANSWER scenarios. They have essentially the same complexity as the scenarios from the previous group, except that we distinguish them in that these scenarios relate specifically to what ADA is for - informing students and other users about topics related to higher education. Some of the scenarios that belong to this group are:

- DialogAcademyContact
- DialogAcademyWorkinHours
- DialogAdmission
- DialogLibrary
- DialogStudentServiceContact

4.3. Complex Q&A scenarios

This group of scenarios is slightly more complex than the previous two. This is because in order to get an answer to a particular question, the user needs to provide additional information to the system, which is one or more steps in the interaction with ADA. Scripts can have one or more depths, depending on how much additional information we need to provide the user with an answer to their question.

Scripts work so that when a user asks a question about more complex scenarios, the ADA returns buttons or asks for specific input to know exactly what the user wants, as shown in the use case diagram and activity diagram. The user can directly guess the desired part of the scenario (action) with a specific sentence, and if ADA does not understand it or does not have the necessary information, it sends them buttons (options).

Scenarios that belong to this group, among others, are:

- DialogProcedureApplyExam
- DialogNewAdmission
- DialogStudentEnrollment
- DialogSemCertProc (SemesterCertificationProcedure)
- DialogStudentLifeStyle
-

4.4. Scenario with integration and verification

This is the most complex, but also the most useful group of scenarios for users. Since ADA was primarily introduced to help students with administrative and student processes, these scenarios are of utmost importance to students. With the help of scripts from this group, students can access information about online office hours, contact information and literature of professors, as well as verify the semester, pay tuition fees, register and deregister for exams, and so on. To fully understand the concept of this group of scenarios, the concepts of integration and verification must first be explained.

By integration we mean the connection of our system with external services and databases. Integration scenarios are therefore scenarios where you need to go to a specific external service to "pull" the answer to a question or specific information. The ADA chatbot is connected to the Belgrade Business and Arts Academy of Applied Studies (BAPUSS) website, the student internet service and the Academy staff portal. The most commonly used scenarios with integration are: Checking prices for services at the Academy, courses per professor, courses per programme of study, how many ESPB points each subject has, when consultations with a professor take place, where a particular room is located, etc.

Onboarding is the process of connecting a Student Internet Service Account (SIS) to Viber or Facebook Messenger. Through the verification process, the user 'unlocks' all scenarios that provide information and perform actions related to the student and their data. Verification means that the student sends the ADA an email (entered on their SIS profile) to which the ADA sends a four-digit code. When a user sends a four-digit code to ADA, they are verified and given the opportunity to use all scenarios. The user will be verified on each channel until they wish to cancel the verification. Each user can be verified and cancelled indefinitely, and no more than one user can be verified on a messaging platform. Some of the scenarios that require verification are: verification of student's grade point average, verification of account balance, verification of pass/fail exams, purchase of books, exam registration, verification of semester, payment of tuition fees, etc.

5. Results

The period of research on the use of ADA chatbot at BAPUSS was from July 2021 to June 2022. This chapter presents statistical indicators of usage of ADA chatbot. Figure 4 shows the number of new users and the number of return users for the chatbot ADA. The figure shows that the largest number of users appear during the exam months (September 2021, October 2021, January 2022 and June 2022). The number of new users ranges from 246 to 979 with an average value of 522. The standard deviation of new users is 276. The largest number of return users was registered in June 2022 (350 users).

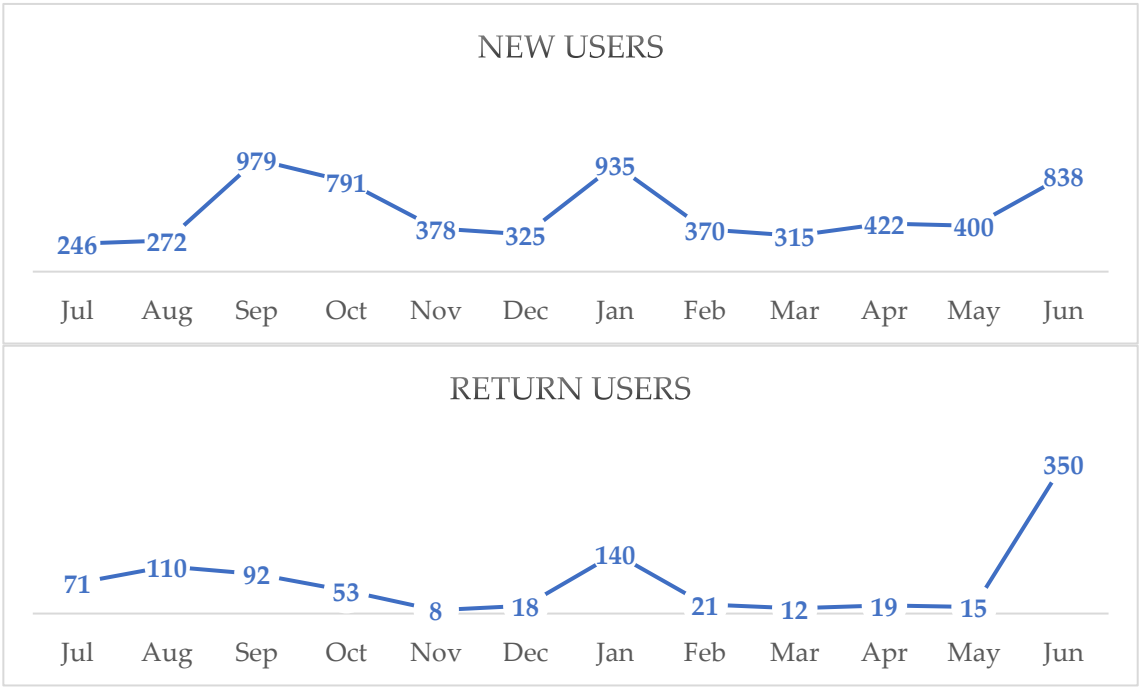

Figure 4. Number of users for period July 2021 -June 2022
Source: ADA chatbot

Table 1 presents data on the total number of unique users and the number of channel users during the study period. The number of channel users is greater than the total number of unique users, indicating that some users use the chatbot ADA on multiple channels. Testing of ADA chatbot on the Instagram social network channel is underway.

Table 1. Total unique users and number of channel users

Category	Number
Total unique users without web	4,225
Facebook	710
Viber	3,515
Web	4,505

Source: ADA chatbot

The number of users on the web channel is irrelevant because it is technologically impossible to determine the number of unique users due to public computers. Although the number of web users is large, it is inaccurate and cannot be used for comparison.

Figure 5 shows the most commonly used scenarios on ADA chatbot:

- getStarted,
- DialogExamRegistration,
- DialogPriceList,
- DialogExamSchedule.

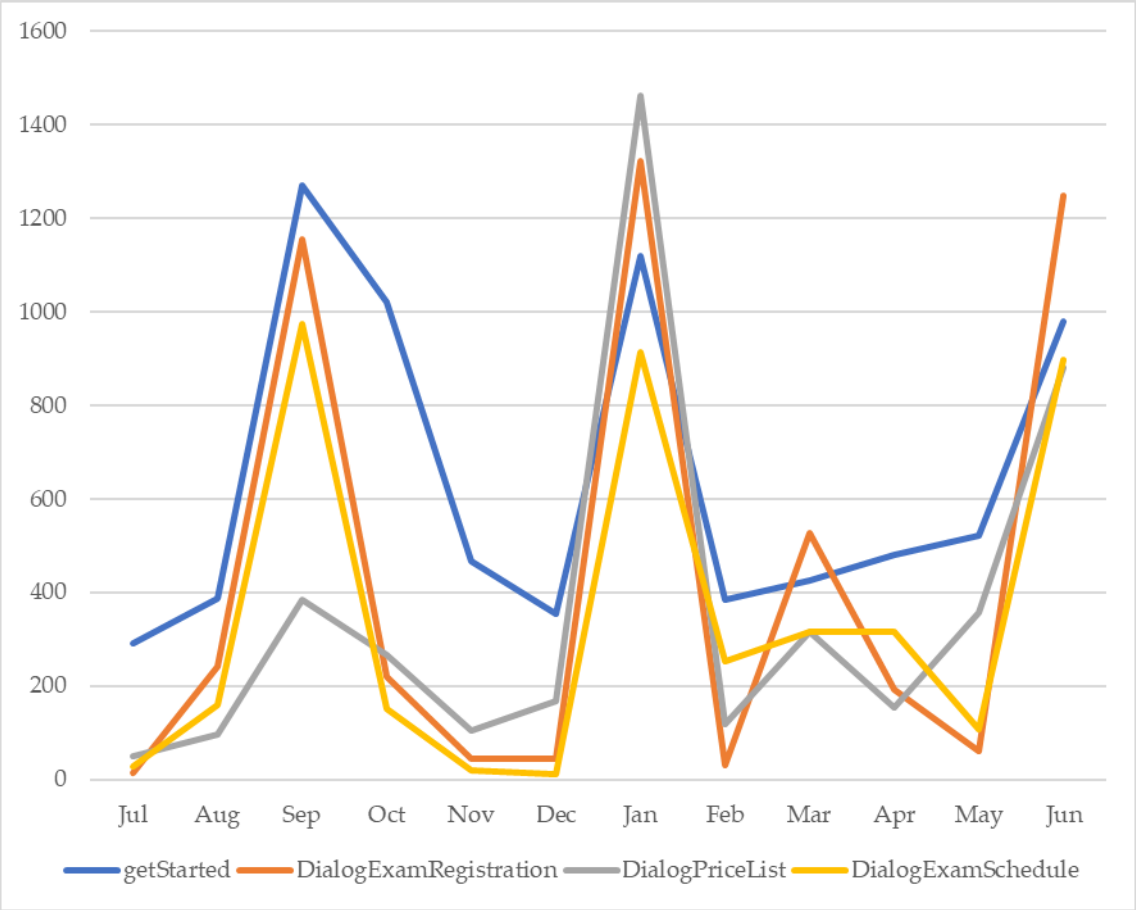

Figure 5. Chatbot ADA scenarios - number of conversations per story
Source: ADA chatbot

Table 2 shows data on conversations and messages on ADA chatbot during the study period. The most used channel is Viber with 80.15% of the total number of conversations and 83.87% of the total number of messages. During the study period, 81,962 conversations were started and 139,908 messages were exchanged or 1.71 messages per conversation.

Table 2. Conversations and messages on ADA chatbot

Channel	Conversations	Percentage	Messages	Percentage
Facebook	4,395	5.36	7,928	5.67
Viber	65,689	80.18	117,346	83.90
Web	11,848	14.46	14,593	10.43
Total	81,932	100.00	139,867	100.00

Source: ADA chatbot

The results of the research show that users accept the chatbot ADA as a communication channel. The development of chatbot ADA at BAPUSS has greatly facilitated the functioning of the institution during the Covid 19 period, as the professional services of the school were relieved and could devote their time to other tasks.

Conclusion

This chatbot has become a very effective solution for communication and service delivery, but also for e-learning administration systems, and it enables the relief of administrative staff and professors. We can say that ADA is an example of the next evolution in the interaction between student and educational institution, which aims to change and improve daily communication and information in the educational system. The essence of modernising information technologies is to get the information we want easier and faster, and that is what ADA offers us.

The first advantage of chatbots is that they are easy to use. You do not need to install or familiarise yourself with any new software to use chat, because everyone uses communication platforms (Viber, FB messenger, etc.). For example, you just need to scan the QR code from your Viber account and you can start communicating immediately. With the chatbot service, it's faster. There is no waiting for a free operator, no waiting for an answer by email, no searching on the website and no logging into the information system every day to get the information or service you need. The chatbot, unlike human resources, has no working hours and is therefore always available for students and teachers (availability 7/24/365). The services offered by the chatbot are visible on communication platforms used by a large number of users and therefore the quality of these services is better.

The current number of ADA users on BAPUSS is given as proof. This type of communication can bridge the gap between the large number of students seeking information and the limited resources they need for support. With a chat, it is easier to get students' opinions as it is easier to conduct a survey through a communication platform. The paper shows the number of current conversations and messages between ADA and users. The chatbot can be integrated into the existing information system. During the April 2021 exam period, the number of exam registrations via chatbots was more than 60% of the total number of registered exams. Calls to the switchboard and emails to teachers were reduced by over 60% at BAPUSS during the same period. Further research aims to turn the chatbot ADA into a tool that enables students to learn the material provided in the subject's curriculum.

References

Adamopoulou, E., & Moussiades, L. (2020). Chatbots: History, technology, and applications. *Machine Learning with Applications*, 2, 100006.

Allen, J. (1988). *Natural language understanding*. Benjamin-Cummings Publishing Co., Inc.

Bateman, J., & Zock, M. (2003). *Natural language generation*. In The Oxford handbook of computational linguistics.

Bates, M. (1995). Models of natural language understanding. *Proceedings of the National Academy of Sciences*, 92(22), 9977-9982.

Bhartiya, N., Jangid, N., Jannu, S., Shukla, P., & Chapaneri, R. (2019, July). Artificial neural network based university chatbot system. In 2019 IEEE Bombay Section Signature Conference (IBSSC) (pp. 1-6). IEEE.

Chowdhary, K. (2020). Natural language processing. *Fundamentals of artificial intelligence*, 603-649.

Cunningham-Nelson, S., Boles, W., Trouton, L., & Margerison, E. (2019). A review of chatbots in education: practical steps forward. In 30th Annual Conference for the Australasian

Association for Engineering Education (AAEE 2019): Educators Becoming Agents of Change: Innovate, Integrate, Motivate (pp. 299-306). Engineers Australia.

https://angular.io/ (09.06.2022)

https://chatbot.bpa.edu.rs/ (09.06.2022)

https://weaverbot.ai/ (09.06.2022)

Jiao, A. (2020, March). An intelligent chatbot system based on entity extraction using RASA NLU and neural network. In Journal of Physics: Conference Series (Vol. 1487, No. 1, p. 012014). IOP Publishing.

Kabiljo, M., Vidas-Bubanja, M., Matić, R., & Zivković, M. (2020). Education system in the Republic of Serbia under COVID-19 conditions: Chatbot - academic digital assistant of the Belgrade Business and Arts Academy of Applied Studies. *KNOWLEDGE-International Journal*, 43(1), 25-30.

Kerlyl, A., Hall, P., & Bull, S. (2006, December). Bringing chatbots into education: Towards natural language negotiation of open learner models. In International Conference on Innovative Techniques and Applications of Artificial Intelligence (pp. 179-192). Springer, London.

Matić, R., Kabiljo, M., Deretić, N., & Vukomanović, A. (2022). Application of Chatbot at a Higher Education Institution in Republic of Serbia. 41st International Conference on Organizational Science Development Society's Challenges for Organizational Opportunities (pp. 605-616). University Press, University of Maribor.

Motger, Q., Franch, X., & Marco, J. (2021). Conversational Agents in Software Engineering: Survey, Taxonomy and Challenges. *arXiv preprint arXiv*:2106.10901.

Muhammad, A. F., Susanto, D., Alimudin, A., Adila, F., Assidiqi, M. H., & Nabhan, S. (2020, September). Developing english conversation chatbot using dialogflow. In 2020 International Electronics Symposium (IES) (pp. 468-475). IEEE.

Nadkarni, P. M., Ohno-Machado, L., & Chapman, W. W. (2011). Natural language processing: an introduction. *Journal of the American Medical Informatics Association*, 18(5), 544-551.

Okonkwo, C. W., & Ade-Ibijola, A. (2021). Chatbots applications in education: A systematic review. Computers and Education: *Artificial Intelligence*, 2, 100033.

Radulović, J., Deretić, N., Vujanović, N., Matić, R., & Djurica, N. (2022). A Challenges and Perspectives for Remote Work. 41st International Conference on Organizational Science Development Society's Challenges for Organizational Opportunities (pp. 841-854). University Press, University of Maribor.

Ruane, E., Young, R., & Ventresque, A. (2020, March). Training a chatbot with Microsoft LUIS: effect of intent imbalance on prediction accuracy. In Proceedings of the 25th International Conference on Intelligent User Interfaces Companion (pp. 63-64).

Sigelman, B. H., Barroso, L. A., Burrows, M., Stephenson, P., Plakal, M., Beaver, D., Jaspan, S., & Shanbhag, C. (2010). Dapper, a large-scale distributed systems tracing infrastructure.

Tarek, A. I. T., El Hajji, M., Youssef, E. S., & Fadili, H. (2022). Towards highly adaptive Edu-Chatbot. *Procedia Computer Science*, 198, 397-403.

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.