Application of Chatbot Technology in the Study of the Discipline «Quality Management»*

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Abstract. An automation system based on two technologies is considered: automation of business processes using software robots (RPA) and the technology of automating a dialogue with a user Chat-Bot. The possibility of using these technologies in teaching students is analyzed. An example of training in the discipline "Quality Management" is given. The situation is considered when it is not enough just a chatbot created based on a well-thought-out algorithm and prepared answers to possible questions in advance. For high-quality learning and communication, you need a chatbot with artificial intelligence, a chatbot with an analytical component, and an intelligent assistant based on RPA (Robotic Process Automation) systems. The article presents the advantages of using robots in the educational process: the ability to repeat explanations to complete student tasks, save information on previous requests, and choose the best program for training. Robots are emotionless and will never scold a student. The example shows the interaction of a system of robots with the resources of the university for the implementation of the training system. The possibilities of using big data in such a system are analyzed for such tasks as collecting information about students and disciplines, statistics on student logins in the system, time spent in the system, about files used, lectures passed, assignments completed, coursework, and laboratory work completed and faulty tests. To implement the project of such a training system, the following six stages are required: collecting requirements for the chatbot, robot training, and testing, collective programming, a publication of a pilot chat-bot, verification of the developed system, completion, and development of the project.

Keywords: Chatbot, Software Robots, Artificial Intelligence, Learning Automation.

Introduction

Chatbot technology involves the use of special computer applications for automated and personalized dialogue between the computer system and the user. The use of Chatbots is becoming increasingly widespread in all areas of human activity. From ordering goods online and choosing dishes in a restaurant to consulting cosmonauts or pilots in difficult situations. Virtual robots are also increasingly used in higher education. Currently, students spend most of their time in various messengers and social networks, communicating through messages. It is natural to use these technologies to improve the effectiveness of the educational process. With the transfer of the educational process to a distance format in many universities, this trend has increased, which has affected the desire of students to receive advice and explanations for tasks in disciplines during hours that are not tied to the class schedule [1,4,7]. Getting advice in groups and communities using chatbots, they are already ready for this technology in the learning process. On the other hand, the teacher can't answer all the questions of each student directly at the moment when the student has this question. Teaching practice shows that when studying traditional subjects, most student questions are repeated and have a standard character. This allows you to pre-think and structure scenarios for answering questions that can be uploaded to computer systems with chatbots.

At the same time, it should be borne in mind that the market for computer applications with chatbots tends to grow significantly in the next few years. At the same time, in 2019, its volume in Russia amounted to 1.5 billion rubles [4]. This is primarily due to the widespread development of automation of business processes of enterprises [11].

1 Chatbots, Robotic process automation, Big data

Considering a chatbot as a complex program that implements a dialog with the user, it is necessary to understand that it primarily processes lexical data to form the correct logical response. Such systems belong to the class of intelligent learning systems that mimic the behavior of the teacher. To do this, first, you need to teach the robot to correctly answer the questions posed by the student. This is not enough for the "Quality Management" discipline. The problem is that when studying this discipline, you need to perform mathematical calculations. Based on this, a distance learning system with chatbots for the discipline under consideration should have at least the following four types of software robots:

1. Chatbots were created based on a well-thought-out fixed algorithm and pre-designed answers to possible standard questions. Such simple chatbots have limited use, but they can be used to solve some simple tasks.

2. Chatbots with artificial intelligence. These robots use a logical processor, the knowledge base of the discipline, and methods of machine learning. In practice, these are expert systems with a developed dialog subsystem.

3. Chatbots with an analytical component, that is, robots based on a dialogue with a person carried out using a linguistic processor, have additional opportunities to perform some mathematical calculations and simulations.

4. Intelligent assistant systems based on the RPA (Robotic Process Automation) [13]. In such systems, automation of the entire process of studying a discipline in a complex is considered. The technology of modeling and managing business processes, which has found wide application in business, is used.

In Fig 1 the advantages of using robot systems in training in comparison with traditional technologies are systematized.

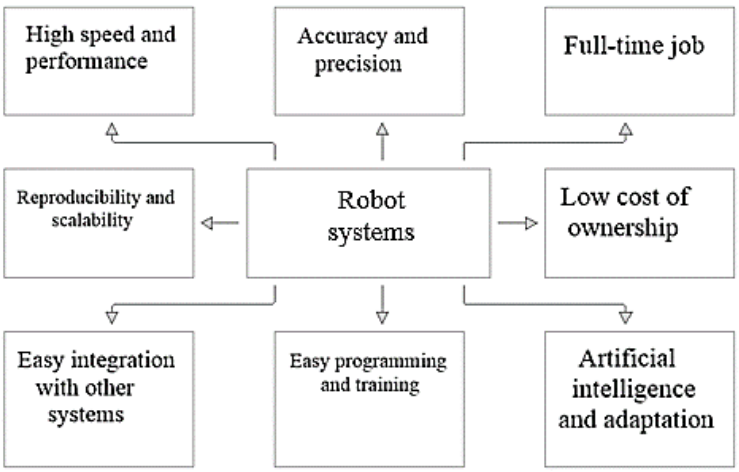

Fig. 1. Advantages of using software robots for training.

Using chatbots is not a substitute for live communication with the teacher, but it can be a good auxiliary tool to support the learning process due to some of its advantages:

- robots never lose patience and can endlessly try to explain to the student how to solve a problem;
- robots save the history of communication with the student in the database, which allows the teacher to constantly improve the learning process and strengthen individual components of the educational process, if necessary;
- robots can make the learning process more efficient by offering student-specific training programs. Adaptive learning systems bring mass higher education closer to personal learning;
- robot systems can change the way the material is studied depending on the student's motivation and abilities. At the same time the learning process becomes more extensive with many decision-making nodes and cycles;
- robots are not subject to emotions and will never scold a student.

The use of intelligent robots saves time not only for students but also for teachers, allowing them to more effectively use their time for developing educational materials and in-depth personal work with students. Individual tasks and tests take a significant amount of time for the teacher to check, and the options are often repeated in them. This is especially important for mass open online courses, where the bill goes to hundreds and thousands of students, which makes individual feedback almost inaccessible.

To be used in the educational process, the proposed technology should be used in conjunction with other information systems used at the University. So in Fig. 2 shows the structure of an automated system with intelligent robots, which is proposed to be used for teaching the discipline "Quality Management".

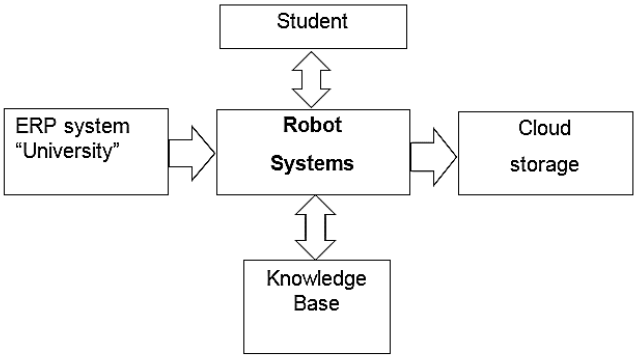

Fig. 2. Diagram of an automated training system with intelligent robots.

The proposed system performs the following functions:

- interacts with the student by answering questions and sending messages on the subject;
- retrieves up-to-date data from the task completion database with daily or weekly results for sending notifications about task completion dates and deadlines;
- extracts data from a database and knowledge base for answers to questions on the topics of discipline;
- records sent tasks to the cloud storage.
- if the task is standardized, it evaluates the task completion;
- uses the analytical capabilities of the DBMS to perform analytical calculations using machine learning methods;
- manages the learning process based on a WorkFusion-type business process automation system [12] or another [8];
- interacts with the University's information and management systems.

The system is also supposed to use Big Data technology, which, in particular, is supported by the database management system. Figure 3 shows the main parameters that the Big Data system must meet [10].

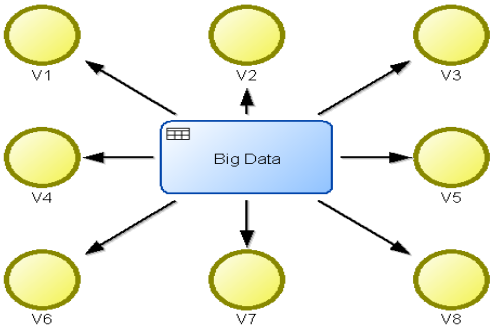

Fig. 3. Big data system parameters.

This figure shows the following parameters:

- V1 (Volume) – the ability to store a large amount of information;
- V2 (Velocity) – data processing speed sufficient for the user's requirements;
- V3 (Variety) – the ability to store and interact with unstructured data;
- V4 (Variability) – availability of tools for analyzing multidimensional and multi-factor data (usually using machine learning methods);
- V5 (Value) – storage and selection of up-to-date and economically valuable data;
- V6 (Veracity) – data must be adequate to the tasks being solved, and not contain erroneous or false information;
- V7 (Validity) – data storage must comply with laws and national requirements;
- V8 (Volatility) – data should reflect the variability, dynamics, and volatility of the subject area.

The database should contain large amounts of information accumulated within the University: for example, data about students, the educational process, plans and programs, and literature. This data should be collected, structured, analyzed, and studied as much as possible. This helps you analyze the course of the educational process, students ' behavior, and understand what processes can be automated.

Academic departments and departments can collect information about students and disciplines and use it to set up databases and knowledge. Even statistics on conventional inputs of students into the system of interest. But there is still a lot of data about the time spent in the system, about the files used, lectures passed, tasks completed, course and laboratory work, passed and erroneous tests.

2 The Project of Automating the Educational Process

To complete the project of automating the educational process using a robot system, you need to perform several stages of work.

Stage I - collecting requirements for the chatbot.

The goal of this stage is to understand and analyze potential chatbot scenarios that could be used in the study of the discipline. This phase involves a teacher and a specialist in robot programming. The teacher must provide scenarios for conversations. However, he needs to answer the following questions:

- What problem should solve the chatbot?
- What steps should be automated in the context of the conversation?
- Which external systems should be integrated with?
- What analytical calculations should be performed using a machine learning system?
- What are the endpoints of the algorithm that the chatbot will use?

When developing a scenario, you need to define expressions, specific sentences, and phrases or keywords that should be used in the conversation. All necessary checks or restrictions must be taken into account. The teacher must provide a list of questions and answers that are intended for the chatbot. The list should strive to be complete. Minor changes in the following stages are acceptable.

Figure 4 shows a fragment of the interaction scenario with a student for the “Quality Management” discipline.

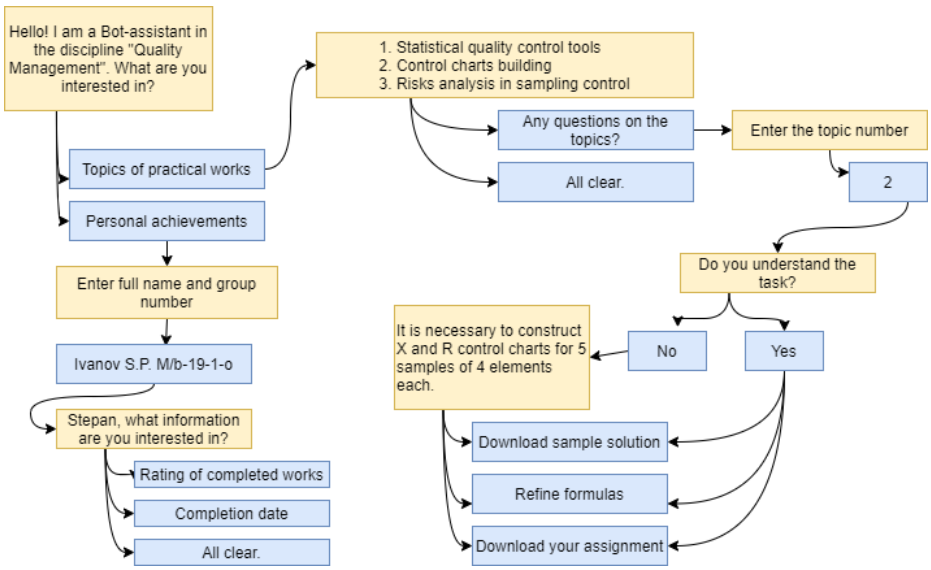

Fig. 4. Fragment of the chat-bot script for the "Quality Management" discipline.

This fragment describes only the dialog part of the robot system operation, without affecting the analytical part that requires calculations. Here it would be possible to use the automation system to generate questions. A good overview of these methods is given in [2].

Stage II – robot training and testing.

At this stage, specific software products are selected to support the training system with robots. For example, the NativeChat system for organizing a dialog, the Vertuca system for supporting databases, and others. The work at this stage involves a teacher of the discipline and a technical expert on software robots. The following questions are studied: an overview of possible systems and their components, creation of accounts, system management technologies, creation, and management of robots, organization of cognitive flows, robot learning process.

At this stage, a tutorial or video training on working with the robot is created for teachers. The main focus should be on the features and concepts that are relevant to the chatbot scenario for a specific subject, such as the "Quality Management" discipline. Here you can also use machine learning methods to process the received data to test and verify the system [9].

Stage III - collective programming [13].

At this stage, a team of technical experts and teachers work together to implement the selected flow of dialogues using the method of collective or pair programming. Developers remain in constant contact through the online exchange of software screens or other forms of communication (Slack, Microsoft Teams). As a result of this stage, at least one conversation thread on the subject must be completed. At this stage, there is no need to implement all conversation flows for the subject. If time permits, the technical expert and the teacher can work on additional questions and answers on the subject.

The main task of collective programming at this stage is to create a high-quality program scenario that should contain a minimum of errors. At the same time, programmers work in the same team as teachers. The team of programmers and teachers copes with the task more effectively when they work together. The result is a software bot that meets the requirements of the discipline and effectively answers the student's questions.

It should be noted that this stage also provides effective training for programmers and teachers themselves. They ask each other "uncomfortable" questions, try to take into account more nuances in the algorithm, and look for alternative solutions.

Phase IV - publication of a pilot chat-bot.

The developed and accepted chatbot should be published on one of the chat publishing channels available at the University. To do this, you can use software applications for smartphones and computers such as various types of messengers, such as Viber, Telegram, WhatsApp, or various social networks. Of particular interest is the use of systems for mobile learning, for example, for training in the workplace, in the field, at the enterprise.

Stage V – verification of the developed system.

At this stage, there is a check developed by the conversation in the study of discipline students. Students are actively involved in testing the system. This usually further encourages students to study the discipline, as they can show their creative abilities and see the results of their work. During the test, the system's shortcomings are analyzed and ways to improve it are determined.

Stage VI – completion and development of the project.

At this stage, the project is demonstrated to the University management and the system's knowledge base continues to be filled. The issue of all real channels for implementing chatbots is being resolved [3,5].

3 The Education Chatbots System

A chatbot for automating training in the discipline "Quality Management" should not only increase students' interest in learning, since they will be able to ask questions at any time convenient for them and receive notifications about the grades received and the time of completion of work but also actively perform laboratory work.

Considering a chatbot as a complex program that implements a dialog with the user, it is necessary to understand that it primarily processes lexical data to form the correct logical response. To do this, you need to teach them how to answer the questions correctly. This is not enough for the discipline "quality management. The problem is that when studying this discipline, you need to perform mathematical calculations.

Figure 5 shows an extended diagram of the system for automating the training process in the discipline "Quality Management".

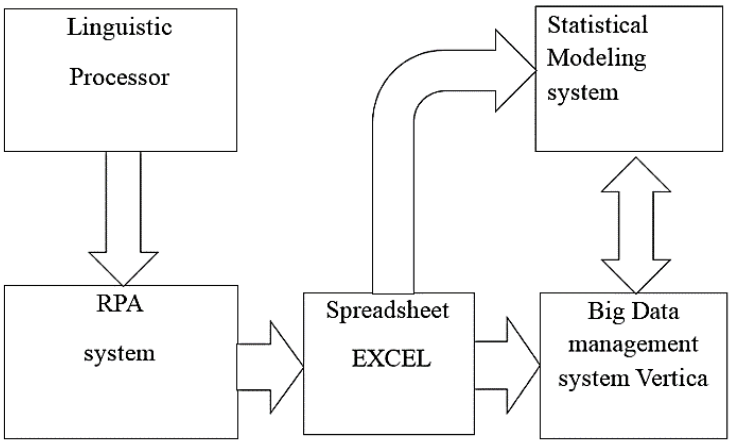

Fig. 5. Analytics subsystem for automating training in the "Quality Management" discipline.

It also uses spreadsheets and statistical modeling systems with machine learning. Machine learning here refers to a type of artificial intelligence technology that allows computers to learn themselves and use methods for optimal forecasting of future events. The main idea is that the computer constantly selects the best model for the forecast using additional information.

In the developed system, the linguistic processor [6] plays an important role, the algorithm of which is shown in Fig. 6.

The figure shows the main actions of the dialogue process with the student. It is necessary to perform the tasks of morphological analysis and synthesis, syntactic analysis and synthesis, semantic analysis and synthesis.

Morphological analysis algorithms match individual words and user forms to a given dictionary system. At the same time, grammatical characteristics of words are extracted from existing dictionaries. Here it is important to pre-configure the vocabulary of algorithms to the vocabulary system of the discipline being studied. In the process of morphological analysis, specific questions of the student are embedded in the system structure of the discipline being studied.

At the next stage, based on the morphological analysis of words in the process of syntactic analysis, the language sentence is parsed. During parsing, the source text is transformed into a formal network structure, which is formalized in various ways. In particular, neural networks can be used here. Information structures in the form of a tree are also often used.

At the stage of semantic analysis, semantic relations are extracted from the sentence and the semantic representation of the text is formed. In General, a semantic representation is a graph or semantic network that reflects the relationships between semantic units of a text.

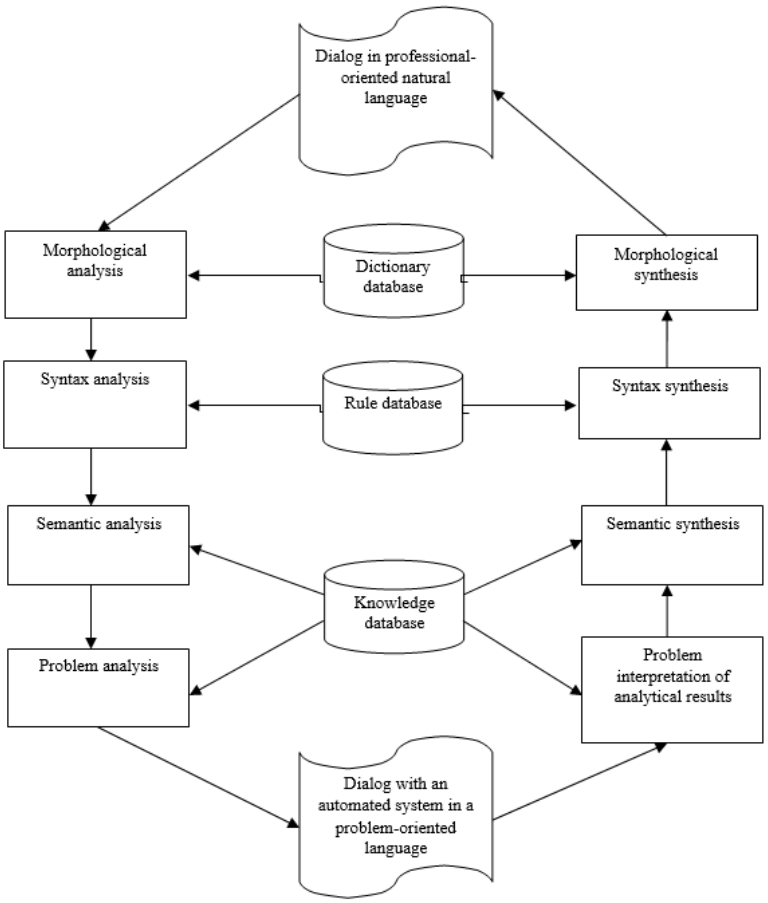

Fig. 6. Generalized scheme of the language processor operations.

For the discipline "Quality Management", the analysis of the problem, its mathematical solution, and interpretation are of conceptual importance. In particular, it is necessary to perform statistical calculations based on real or simulated data. It is important to interpret the results obtained for specific areas of business or production.

The use of intelligent robots and bots in the educational process is not without its drawbacks. It is necessary to note the following:

- students prefer to communicate with the teacher, not with the robot;
- when communicating, the student may make mistakes that the robot may misinterpret;
- students are used to working with websites, and they don't like working with a bot;
- students are used to working with certain social networks, such as Facebook, and the transition to other networks where the learning system works causes some resistance;
- the student may be annoyed by a certain stupidity of the chatbot and the inability to stop it.

4 Conclusions

Research has shown the possibility of using intelligent bots to develop automated training systems.

- The use of a prototype of an automated system for the discipline "Quality Management" revealed some difficulties for the implementation of the proposed technology.
- For this class of subjects, in addition to dialogue with the teacher, it is necessary to use technologies for modeling and processing statistical data.
- Machine learning methods can be used not only for processing statistical data but also for analyzing the learning process itself.
- To create automated training courses, it is necessary to use the technology of modeling and optimizing business processes together with monitoring and selection of business processes.
- The effectiveness of projects for creating automated disciplines can be significantly improved if a team of teachers and engineers works on each discipline, not just one person.
- One of the main difficulties in creating automated disciplines is the development of a language processor. To solve this problem, you need to have a team of experienced developers or involve software manufacturing enterprises.
- Research in this direction can continue through the wider use of machine learning, mathematical modeling, and artificial intelligence methods.

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