

How chatbots can be involved in the education process

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Abstract—Chatbots become more and more popular in the human-machine interactions, because they enable to communicate with the system by the human language, which is a very intuitive and user-friendly. Moreover, chatbots can provide information without time-demanding searching and hide its complexity. Three chatbots were developed for supporting education on the Department of electronics and multimedia telecommunications. First one is the KEMTbot, which is a bot located on the department web page. It provides information from the web and about department staff. The second chatbot is a bot that supports students during the exercises from the subject “Databases”. The last one is a chatbot-like Amazon Alexa skill, which answers questions about the department on Amazon Echo devices.

I. INTRODUCTION

Britz defined chatbots as computer programs capable of conducting conversations similar to those between people [1]. They become very popular and they look promising to support business and industry. They aspire to be an alternative to human support on the web. They can provide useful information and in the case of more complicated requests they can move the interaction to the human expert. Surprisingly they occur after the success story of the virtual assistants as are Siri or Alexa, while the reverse order was commonly expected. Virtual assistants popularized human-machine language interaction and shows the direction of effective information providing. Virtual assistants, chatbots and other language-based HMI provide information without time-demanding searching. Moreover, they hide complexity and size of information behind.

Kayla Matthews in [2] writes: “No matter what chatbot is used in the classroom, it’s obvious that integrating them in educational environments is a must.” The importance of the topic illustrates more than 3800 topics since 2015 on Google Scholar [3]. Authors in [1] concludes that “These programs (Chatbots) already offer a native communication channel for the Z generation. Kim et al. in [4] introduced the chatbot in a role of foreign language teacher. In [5] COLA (a COnTent-based Learning Assistant) chatbot was introduced to suggest optimal educational paths, along with a persuasive and empathic coaching.

The work presented in the paper focus on initial integration of a set of chatbot-like tools to support information sharing and learning of students. Our motivation was to bring most modern technology that can help students easily to find information and to create more attractive learning-supporting tools for them.

II. KEMT CHATBOTS

A. KEMTbot

KEMTbot is a chatbot system, which provides information about the department, its staff and their offices. We decided to integrate the chatbot, which is an expert on the locations (offices) of the department employees, because such information was not available on the web. Then, we gradually added other information about department, fields of study etc.

KEMTbot is located on the main page of the department (<http://kemt.fei.tuke.sk/>) and it is a result of the student project (see [6]). It communicates in Slovak language, but can easily be extending to communicate also in English.

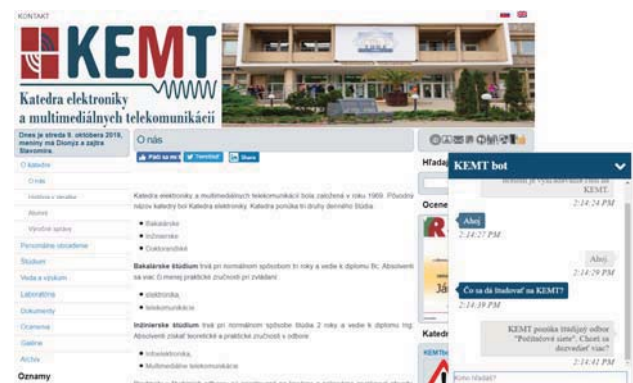


Figure 1. KEMTbot on the main webpage of KEMT department

To create a chatbot, Google DialogFlow technology was used. We use functionalities, which are provided for free (standard edition).

At the beginning, user intents, which will chatbot be able to understand, need to be prepared. Training phrases need to be written, which relate to the particular intent. The developer writes few utterances, which can serve as patterns for the particular intent. These utterances are used by machine learning techniques to enable similar phrases to be written by the user. In our chatbot, 13 intents were included. Main intents are: *welcome*, *search*, *thanks*, *fields_of_study*, *jokes*.

The system can automatically detect entities in the training phrases, if they were defined earlier. Entities can be seen as parameters, which can be extracted from user utterance with an appropriate value. Each entity is defined

by its name, reference value and its synonyms. Main entities in our chatbot are: @name, @surname and @contact, @field_of_study.

After definition of intents and entities, the system is able to recognize goals of the user, but he don't know how to react. The simplest way, how to set the answer on intents is not suitable for our application, because it forces data to be directly included in the chatbot flow definition. To keep data up to date, we decided to put them into the database, where can be modified. Dialogflow supports such solution by the "Fulfillment" functionality. This tool enables to run the code in one of the supported languages and implement more sophisticated NLG – Natural Language Generation algorithms [7]. To access database, we use JavaScript language and the Firestore database solution.

The block diagram on Fig. 2. shows the process of the main flow in the interaction.

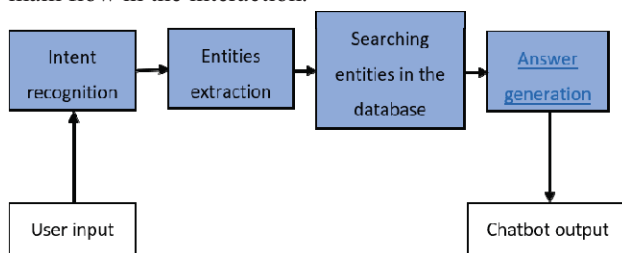


Figure 2. Chatbot processing flow

Firestore is a NoSQL database, which is based on documents and collections. As is shown in Fig. 3, we created a Firestore database, where "zamestnanci" (employees) are the main collection. Each employee is represented as a document with several fields.

B. Department information skill for Amazon Alexa

The idea to prepare a special skill about our department was to increase visibility of the department and to show the direction towards most modern technologies. Designed skill can imagine a very effective and easy for use tool, which can deliver information about the department by voice service through various Amazon Echo devices.

The mechanism of providing extra voice services through Alexa Skills is shown in Fig. 2. The new Alexa skill can be developed using Amazon Developer Portal, and needs to be hosted on web service as AWS. The skill is basically a JSON script which helps to identify the request and checks the actual information on the department website. After successful certification of the skill, it could be publicly available for all Amazon Echo devices, but the certification process failed because of not adequate department website load balance for required traffic.

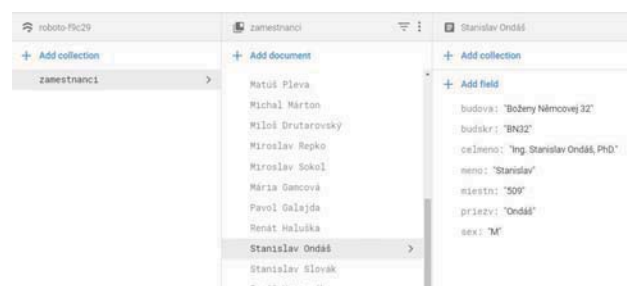


Figure 4. Data in the Firestore database

Designed skill enables users of Amazon Echo device to ask Alexa questions in English language about KEMT department and to deliver information from the English version of the department web page. Designed service

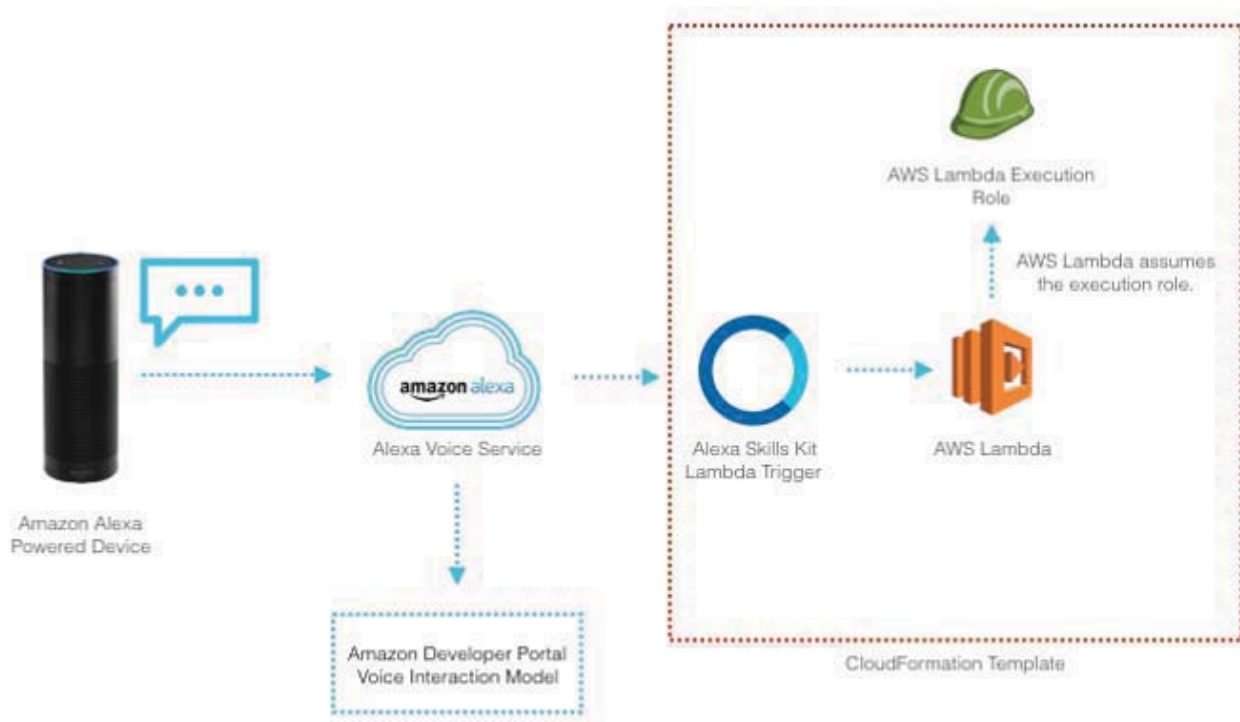


Figure 3. The mechanism of Alexa skills deployment

enables interaction in English in a question-answer manner.

Designed skill is a result of the student project and it is still in development to have it more useful and reliable and certified for public usage (see [8]).

C. The concept of the chatbot as a teacher

Educational materials have often large size, which can demotivate students to start learning. In range of the subject “Database systems”, we were usually using a set of tutorials for exercises, which contain explanations, examples and set of tasks.

Tutorials for exercises can look, for the first sight, as too long and to difficult to perform. We believe that, we can increase the motivation of the student to start to perform exercise, when we will be able to provide him knowledge and tasks sequentially.

We believe that using the chatbot as a teacher can decrease the cognitive load of the student, because they do not need to track large amount of content. The concept “chatbot as a teacher” enables easily to search, to jump back or forward, to interrupt the process of learning or to have fun during the learning (which can positively influence memorability). Another advantage of the “chatbot as teacher” concept is that chatbots can be accessible through several ways. They can be implemented on web pages, on Skype, on social networks (e.g. in Facebook Messenger) or on the modern devices with virtual assistants (e.g. Amazon Echo or Google Home).

We decided to use Dialogflow platform for creating chatbot in a role of the teacher. To store the data, which chatbot use, Heroku platform were used, where PostgreSQL database were prepared.

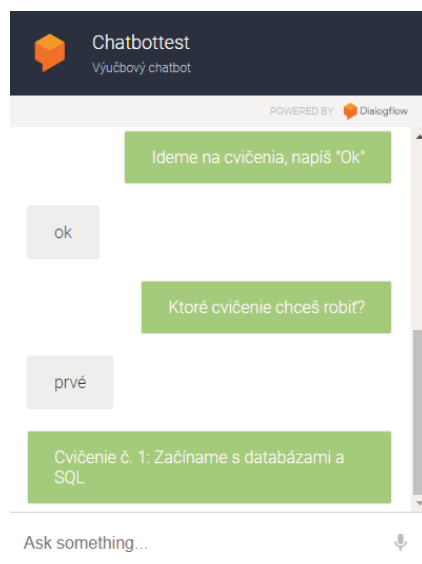


Figure 5. Chatbot as a teacher for Databases subject

Intents and entities were designed in a similar way as in case of KEMTbot. For each exercise a separate intent was defined, which can start the exercise. An example of the interaction is shown in Fig. 5. Described chatbot is a result of the student work (see [9]).

III. RESULTS

Two of designed services (KEMTbot and Amazon skill) were evaluated by measurement statistics or using subjective evaluation methods.

A. KEMTbot

Statistics on Dialogflow platform are available only for last 30 days. Extracted statistics from September 22. to October 21. 2019 can be found in Appendix 1. 64 sessions were performed by the chatbot, where the average number of queries was 3.97 per session. Chatbot runs since April 2018. During 18 months he performed approximately 1200 interactions.

The Appendix II. shows the session flow diagram of the same period of the last month. Session flow diagram provides a view of the common paths taken by users during the interaction with the chatbot. We can observe that after proposing of the default Welcome intent by the chatbot, in 59% of interactions users leave the interaction with chatbot. The most probable reason is that they were only trying, whether chatbot really works, but they didn't need any information.

The next most often category was selection of the “hladať” (search) intent, which serve for searching employee's workplace (office) at the department according their name and surname. 18% of users selected as a next step mentioned intent. Approximately 45% of them obtained required information.

“No match” was the second most often category (13.1%) after default Welcome intent. “No match” means that the system was not able to understand the particular user utterance. Misunderstandings were caused mainly because users type words and phrases that are not covered by any intent. E.g. user type “rytmus” instead of the name of the department member.

There were also interactions, where “no match” was thrown due to the incompleteness of intent definitions, what is the case of example in Fig. 3.

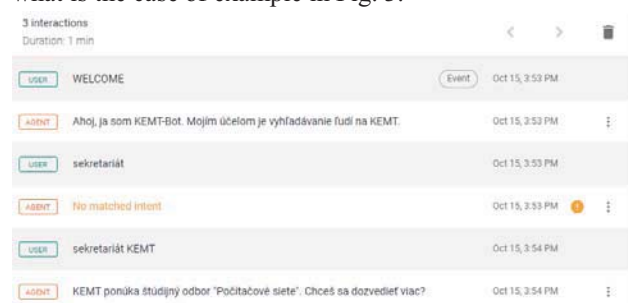


Figure 6. Interaction with unmatched intent

In the situation from Fig. 3, the user ask for the location of “sekretariát” (secretariat), but required phrase is not covered in search intent. Therefore, the system was not able to answer.

The next example shows a successful interaction, where the search intent was invoked by typing the surname of the department employee Dr. Hládek. The input was recognized and the user obtained required information.

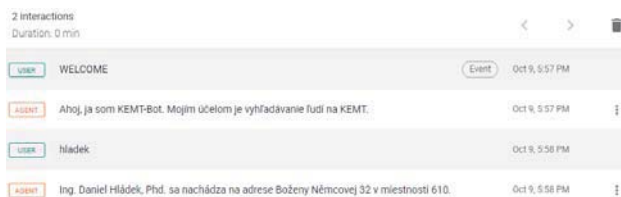


Figure 7. Example of the successful interaction

B. Amazon skill

Designed skill with information about department was evaluated using subjective evaluation method in a form of fulfillment of questionnaires after the interaction.

Evaluation questionnaire consists of 8 questions and was prepared using Google Forms web service. Three questions required to choose one of the options. Written answer was required in case of other five questions. The questionnaire focuses on the user opinion about usefulness of the service and the perceived quality.

Nine users tested designed skill on the real devices.

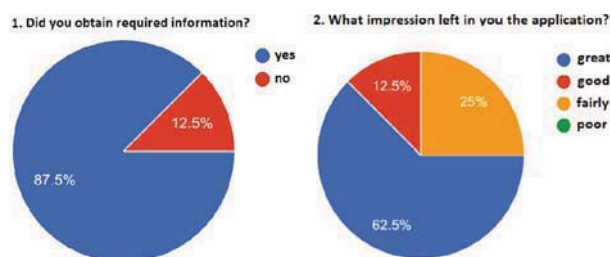


Figure 8. Questionnaire results

Next questions requested textual answer and were focused on the perceived quality of the service.

Question 3.: Could you describe the situation when the application could be helpful?

The most often answers were that the Amazon skill give them an advantage that they do not have to search for the information on the web. They referred that this application saves their time. Application was helpful in searching the actual information about the department.

Question 4.: How the app helped you?

Answers were similar as in case of question 3. Moreover, there were few interesting answers:

"I learned a lot of information that I did not have time to read on the webpage."

"When I was tired at evening, and I didn't want to sit behind the computer, I liked to hear over Alexa about the department."

From the obtained answers we can conclude that providing information through Alexa make obtaining information or learning more comfortable and enable to learn also in situation, when we are too tired to use computer or other devices (e.g. smartphone).

Question 5.: Are there any features you'd like to add?

We obtained answers with following features:

- instructions on how to use the Skill
- information about subjects taught at the department
- more information, e.g. when are the consultation hours or the latest updates of the department, grants, etc.
- information about other departments.

The next question was: *"Would you recommend this app to your friends?"* Figure 4. shows obtained results.

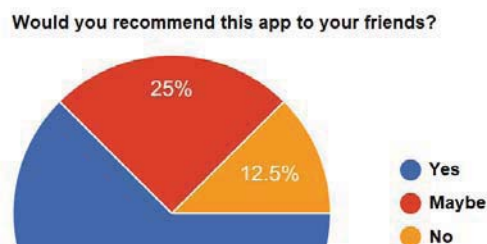


Figure 9 Results

IV. CONCLUSIONS

The proposed paper presents a modern approach, in a form of dialog-like interaction, for accessing information implemented to support education. Spoken/written dialogue imagine very intuitive interface, where human language serves for information exchange. Chatbot-like services become more and more popular. Their main advantage is that they provide information without time-demanding searching.

Three services were developed for supporting education on the Department of electronics and multimedia telecommunications. KEMTbot is a chatbot located on the department web page. It provides information from the web and about department staff. The second chatbot is a concept that will support students during the exercises from the subject "Databases". The last one is a chatbot-like Amazon Alexa skill, which answers questions about the Department on Amazon Echo device.

Obtained results shows, that students consider such services as attractive and helpful. The main reasons are that this form of obtaining information saves their time, enables them to find information without searching the web and makes obtaining of information more comfortable. We believe that this is the way how to bring more attractiveness into the education and increase motivation of students.

In the future, we plan to consider emotion analysis to enhance the interaction and learning. In case of the chatbot for exercises sentiment analysis from text similar to technique proposed in [10] can be implemented.

In case of Amazon skill, which is available only in English, first, we plan to integrate Slovak interaction using speech synthesis (see [11]), speech recognition [12] and other technologies as emotion and speaker recognition (e.g. [13]).

ACKNOWLEDGMENT

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APPENDIX I. KEMTBOT STATISTICS FOR THE LAST SESSION

Sessions ?

Sessions last 30 days

64



Queries per session last 30 days

3.97



Intents ?

Intent	Sessions	Count	Exit %	Agent response time
Default Welcome Intent	62	66	57.58%	
hladaj	15	21	38.10%	
lenMeno	6	12	16.67%	
Pozdrav	5	6	0%	
studijne odbory	5	5	40%	
Vtipy	2	3	0%	
studijne odbory - custom	2	2	0%	

