

Recommending Moodle Resources Using Chatbots

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Abstract—Recommending the most suitable educational resources has always been a challenge in the field of E-Learning. This challenge has pushed educators and researchers to implement new ideas to help learners improve their learning and their knowledge. New solutions are using Artificial Intelligence (AI) techniques such as Machine Learning (ML) and Natural Language Processing (NLP). In this paper, we propose and describe a new recommendation approach, centered primarily on the use of a custom chatbot which can be linked to Moodle's platform using a web configuration. A chatbot is an automated communication tool, based on intents and designed to emulate communication capabilities and conduct a conversation with individuals. The proposed system should be able to answer learner's queries in real-time and able to provide a relevant set of suggestions according to their needs.

Keywords—Moodle, e-learning, recommender system, recommendation, e-learning chatbot, artificial intelligence

I. INTRODUCTION

In a traditional classroom, whenever a learner needs help or seeks additional information, he must always contact the educator for more clarification or ask his fellow neighbors or colleagues. The educator may, depending on the case, give explanations or provide several suggestions (lessons, exercises, references, etc.) that can help him during his learning. In an e-learning environment, this form of aid can be found on forums or given through the platform's messaging system. The fact of receiving help over a subject or suggestion about something is called "recommendation". A recommendation is a suggestion that can best satisfy the needs of a particular user. It is given by a more experienced person on a specific subject and considered generally as suitable for a known purpose. According to [1], a recommender system in an e-learning environment has the potential to assist learners in discovering relevant learning actions that match an individual learner's profile, and thus, provide learners with personalized contents "at the right time, in the right context and in the right way".

However, the educator is not able to provide real-time recommendations, either because of the number of learners, as each request needs appropriate time for reflexion and decision, or because of his availability. For an instructor, as far as the human-related recommendation is considered, the higher the number of resources and learners is, the harder and the more complicated it gets. This is the reason behind building an easygoing system that is capable of processing complicated queries and provide relevant resources to learners in need. Thus, the best candidate for this task is an intelligent conversational tool. In this article, we aim to introduce a real-time Moodle chatbot, which will address the tutor's

availability issue, answers the learner's questions, and automate the recommendation process.

A chatbot is a new form of automated contextual communication between users and machines or systems, that exploits a conversational approach based on natural language. S. Valtolina [2] stated that the term "chatbot" indicates a software system, also called a conversational agent, because it interacts with the user turn by turn, through written messages. It is one of the technologies that simulate human conversation by providing feedbacks and can intelligently interact thanks to machine learning and artificial intelligence [3].

E. Paikari et al. [4] stated that some chatbots monitor what users type, others can make contributions, and complex ones are designed to engage in meaningful conversations. While interacting with users using text, voices, or even signs in a similar way to imitate a human agent, a successful chatbot system can analyze user preferences, predict collective intelligence, and provide better user-centric recommendations in most cases [5].

The remaining of this paper is organized as follows: In Section 2, we present an overview of chatbots following recent literature. Section 3 describes some of the related works that use chatbots as a form of recommendation. The proposed approach will be the object of Section 4, and Section 5, will be dedicated to the conclusion and future works.

II. CHATBOTS OVERVIEW

Due to the increased number of messaging services found on the internet and the advancement of Natural Language Processing and Understanding (NLP & NLU), chatbots have become more and more popular for assisting users with their queries and activities or during information acquisition, even if they cannot replace a human in real.

Chatbots are simple computer programs that interact with users using natural language. These so-called interactive agents are modeled on various techniques, such as knowledge-based and machine learning-based [6]. They are deployed on the web for many purposes (seeking information, site guidance, FAQ answering) in different domains such as customer service, education, website help, and entertainment. Following these facts, they can be identified and classified based on their usage, learning capacity, how they interact with the user, and the context of their application. For instance, they can be used for sensitive data, home automation, or public administration [2].

A. Categories and types

Authors in [7], state that chatbots may have different names such as virtual agents, dialogue systems, or chatterbots,

and there are two basic types: Intelligent and Unintelligent. Unintelligent chatbots use predefined conversation flows written by people and intelligent AI chatbots apply machine learning instead. They can also be informative, meant for contest participation or order placement [5].

V. Hristidis [8] presented the difference between conversational chatbots that rely on applying deep learning techniques on large chat logs and transactional chatbots, which are defined manually by a domain expert in the form of a flow diagram. The first is based on a combination of two Long Short Term Memory (LSTM) neural networks, while the second is based only on Information Extraction.

According to a survey made by M. Nuruzzaman and O. K. Hussain [9], chatbots come into two groups: task-oriented and non-task-oriented. Task-oriented chatbots aim to assist customers in completing certain tasks using short conversations and are meant for service and commercial purposes. Non-task oriented chatbots focus on conversing with customers and providing advisory or entertainment. Moreover, these authors divided the chatbots into four categories:

- Goal-based: focuses on the primary goal to achieve (chatbots are designed for particular task).
- Knowledge-based: focuses on the knowledge they access (chatbots are designed to access and get data).
- Service-based: focuses on facilities provided to the customer (chatbots are designed to offer personal or commercial services).
- Response generated-based: focuses on what action they perform in response generation.

Authors in [10] have put another good classification of chatbots:

- Chitchat systems: which are designed to conduct a conversation using audio or text.
- Task-completion systems: which are designed to accomplish specific tasks
- Intelligent Personal Assistants (IPA): which provide reactive and proactive assistance to users to accomplish a variety of tasks
- Social chatbots: which are designed to serve users' needs for communication, affection, and social belonging.

B. Advantages

Chatbots have quickly become the main means of communication, thanks to several advantages. They are easy to use since they work as an instant messaging application and can replace humans and overcome the availability issue. The implementation of chatbots is neither expensive nor time-consuming. These intelligent tools are fast and always available, ensuring quick and easy answers related to different problems [2].

As mentioned in [6], chatbots can, especially in businesses, automate the customer support part and can increase the profits by decreasing the resources strain and reducing the workload of humans.

With the advancement of artificial intelligence techniques, chatbots are willing to be more social. While responding to users' varied requests, they can establish an emotional connection with users to better understand them and therefore help them over a long period [10].

C. Limitations and barriers

The current state of chatbots shows that they are still far from being perfect. They cannot imitate a human being with the same kind of thoughts and actions. They are still being taught to grasp contextual meanings, human emotions, and understand customers' true intentions and needs.

Authors in [4], proposed a framework for studying chatbots, based on six dimensions, namely type, direction, guidance, predictability, interaction style, and communication channel. According to the results, most of them do not support software development and are still simple in their conversations.

Social chatbots cannot understand or even change the voice's tone following the user's mood, and not all people can get used to talking to bots. [2]. They should be able to communicate through different modalities, suggest or encourage new topics to extend the conversation further and need to develop empathy, social skills, and personality to gain users' confidence and trust [10].

Other limitations are described well in details in [9]. The authors reported that recent chatbots:

- Are built with a fixed set of rules and answer questions only on closed-domain.
- Do not recognize the sentence making structure or its meaning and grammatical errors.
- Are incapable of learning new patterns of speech or words and tend to suddenly generate unpredictable responses.
- Do not process structure data and do not have an interactive user interface.
- Cannot understand human emotions from the text pattern and are unable to write questions based on previous answers (as a form of recommendation).

III. RELATED WORKS

According to [11], Chatbots have become more popular and distinctly famous as an intuitive and successful open communication framework between humans and machines. They were designed to be the ultimate virtual assistant. The authors have developed an interactive chatbot for University-related Frequently Asked Questions (FAQs), which provides an efficient and accurate answer and suggestion for any query based on the dataset of FAQs using Artificial Intelligence Markup Language (AIML) and Latent Semantic Analysis (LSA).

Authors in [12] designed an intelligent voice-based travel chatbot, which takes into account the necessary inputs from the user (through Amazon Alexa enabled device) to predict the relevant and accurate answer to his query (using NLP techniques), and provides a hybrid recommendation. The proposed suggestion is based on the user's preferences, the past travel history, and user's ratings collectively.

Within the same context, M. Atzori et al. [13] proposed a recommender system with an innovative interaction approach for planning travels. Since many users are already familiar with messenger applications, they have created a chat-based client for recommendation and focused on its user interface, which should be able to exploit contextual information sensed through mobile devices, react to context changes, reply to questions, ask and support users in inserting missing contents through a guided dialogue.

With the fact that a chatbot can serve many people at the same time with the same topic and without getting bored, authors in [14] implemented a medical consultant system called “MedBot”, a doctor like agent which uses medical information of the symptoms and treatment records gathered from the “DoctorMe” which is an application commonly used in Thailand. This medical chatbot can give suggestions and provide medical advice to patients or recommend the patients to visit a real doctor if the input symptoms are somehow unknown.

T. Quan et al. [15] proposed an automated chatbot in the real estate industry, to reduce the human efforts in gathering property and customer details or in dealing with all administration papers. The system is capable of asking leading questions to clarify initial queries and dive deeper into clients’ requirements to recommend a list of suitable real estate.

According to [16], academic advisement in China is an essential learner support service in higher education, but it is not always accessible for learners due to missing sensitive information, advisor’s availability, or other financial constraints. To overcome these issues, the authors have proposed an interactive chatbot called “EASElective”, dedicated to serving many learners at the same time and at any time of the day and complementing existing academic advising. The implemented chatbot offers the same expected advising service for all learners. Additionally, it provides them with available official course information, shared seniors’ opinions, advice regarding course selection and personalized recommendations for their program completion.

Other implementations have confirmed that chatbots can be virtual companions to users meant to solve availability issues, provide customer support and assistance, and offer recommendations powered by artificial intelligence.

IV. PROPOSED APPROACH

Among all Learning Management Systems (LMS) available on the internet, Moodle is the most popular one, as it is free under the GNU General Public License. It is written completely in PHP and always up to date since it is continually under review and is improved following new evolving needs of its different users. Moodle is a flexible and secure web-based e-learning platform that can be adapted and extended for a variety of possibilities for creating personalized learning environments. It has a library of plugins or add-ons which can be used to implement specific functionalities. Additionally, Moodle can even run on mobile devices.

The purpose of our approach is to implement an interactive chat interface in Moodle that can communicate with learners and provide guidance or assistance, through a set of suitable recommendations. There are many bot-building tools and chatbot frameworks that can be used to achieve this goal and are written in different languages (Java, Python, PHP, etc.). Since they were designed for better customer service, they can

support different platforms like Facebook, Skype, Slack, and others. The top listed frameworks are Microsoft Bot Framework, Wit.ai, DialogFlow and BotPress.

Fig. 1. shows the architecture of the proposed system. Using one of the PHP based available frameworks on the internet, our chatbot can be integrated into Moodle’s platform either as a custom menu item or as a widget inside an HTML block. During a conversation with the chatbot, the recommendation engine is triggered upon request, which has access to Moodle’s database and stores the computed suggestions in a separate recommendation database (**Rec**), which will be used for further analysis.

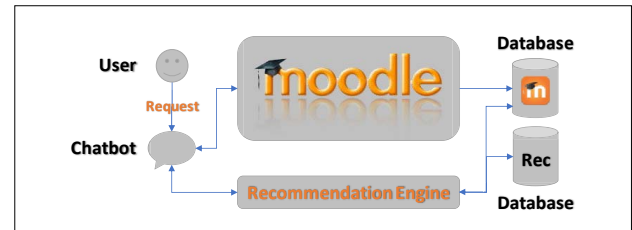


Fig. 1. Architecture of the proposed approach

As shown in Fig. 2, once the chatbot is started, the owner of the current session is already known via a user ID, which is used for access and data extraction purposes. The chatbot offers a variety of services, which include greetings, receiving requests, user interactions, file sharing, and automatic feedbacks (suggestions, recommendations, assistance, etc.). These replies can either be taken from predefined flows or based on intents and entities, powered by machine learning algorithms. Predefined feedbacks are programmed and sent following specific rules, while intelligent responses are provided by understanding and acquiring new keywords. Our first implementation will be a rule-based chatbot. The system follows a set of commands, and the general recommendation process starts by first, fetching data from the database (F), then suggesting relevant learning resources or asking for missing feedbacks (R) and finally, keeping traces of computed recommendations for further analysis or similar queries (T).

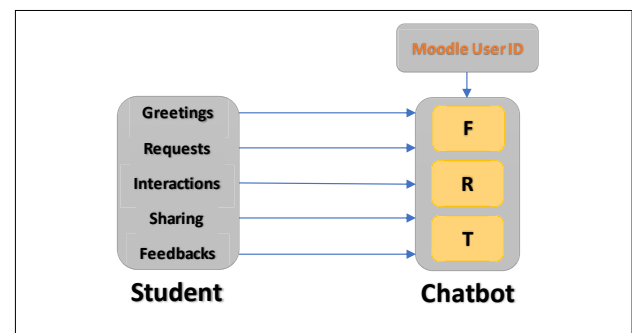


Fig. 2. Chatbot services and general command

All chatbots have the same basic functionalities. They work as following:

- Read incoming messages
- Identify keywords and commands
- Search for matching intents or expressions
- Execute functions accordingly
- Reply and send answers

In general, recommendations can be either content-based or knowledge-based, collaborative or hybrid, since the latter can have several benefits and overcome the drawbacks of traditional filtering systems. In this paper, we combine both content-based and collaborative approaches with a novel traceability approach previously explained in [17].

The recommendation is performed following three different steps (Fig. 3).

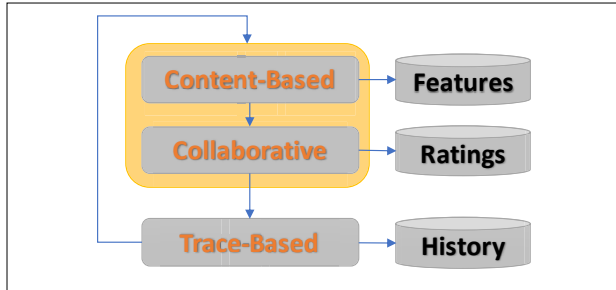


Fig. 3. Chatbot services and general command

The first recommendation phase is content-based and is done by computing feature similarities between available learning materials in Moodle (courses, tips, books, etc.), according to the learner's preferences. Once this phase is finished, the resulted selection is then filtered based on assigned ratings, to select the most relevant ones which are very likely to satisfy the learner's needs.

The trace-based recommendation checks the historical records. It can be applied either at the beginning to look for similar queries, or at the end to check if one or more of these suggested resources were already ignored or rejected.

The chatbot will then reply to the user by displaying a list of recommended resources, one by one, or simply sending a link containing all suggestions with their related information. It will also prompt the learner to fill in missing data or ask for ratings regarding newly added matching resources.

V. CONCLUSION

Chatbots are intelligent virtual agents and are widely used in several domains and applications, as they offer a new way of communication through different modalities, including text, speech, and vision, and provide a fast way of assistance and task completion. They must remain simple to use, with the purpose of not distracting the user or proposing redundant features.

Even if they were designed to imitate humans, there is still a long way for social bots to reach that position, considering the advancement of machine learning and natural language processing. They must be able to recognize emotion and track emotional changes during a conversation. As stated in [10], they must indeed converse like a human, presenting results, offering perspectives, prompting new topics to keep the conversation going.

In this paper, we have presented a literature review on dialogue systems and proposed a new recommendation approach in Moodle, based mainly on the use of an integrated chatbot. As the implementation of this chatbot is ongoing, future works will focus on testing and studying the overall performance. Through this study, we are hoping to render the

recommender chatbot able to support other applications, apart from the e-learning platforms.

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