ISSN: 2347-6540

International Journal of Latest Research In Engineering and Computing (IJLREC)
Volume 11, Issue 1, Page No.86-91, 2024
www.ijlrec.com

# A REVIEW PAPER ON CHATBOTS AND THEIR IMPLEMENTATION

**Daksha Kr Pathak[1], Ansh Pathak[2], Alok Verma[3], Ujjwal Prashar[4] ,Meenu Rana[5]**
Computer Science, Shivalik College of Engineering, Dehradun, Uttarakhand, India, anshpathak851113@gmail.com
Computer Science, Shivalik College of Engineering, Dehradun, Uttarakhand, India, dakshpathak762@gmail.com
Computer Science, Shivalik college of engineering, Dehradun, Uttarakhand, India, ujjwalyash2006@gmail.com
Computer Science, Shivalik college of engineering, Dehradun, Uttarakhand, India, alokverma7389@gmail.com
Computer Science, Shivalik college of engineering, Dehradun, Uttarakhand, India, meenu.rana@sce.org.in

**Abstract :-Chatbots are extensively used in many applications, especially in systems that provide intelligent consumer support. Several systems use Chatbots to streamline assistance by reading customer inquiries and delivering prompt and precise responses. This article outlines the creation of a prototype chatbot intended to aid college students in certain courses like AI ML, data science within the educational field.The main focus has been on creating a specific architecture and model to manage communication and efficiently provide precise replies to the learner. A system has been developed to recognize questions and provide answers to students by using natural language processing methods and domain ontologies. Following the execution of the proposed model, an experimental campaign was carried out to showcase its enforceability and efficiency.**

**Keywords:** : Chatbot, intelligent support system, Natural language processing

## I. INTRODUCTION

A chatbot, sometimes known as a chatterbot, is a software program that engages in conversation with a user, often a person, functioning as a virtual assistant capable of responding to various user inquiries with accurate answers. Recently, there has been a rapid increase in the use of Chatbots across several sectors like Health Care, Marketing, Education, Support Systems, Cultural Heritage, Entertainment, and more. Leading corporations have created several Chatbots for both commercial applications and academic exploration, with notable examples being Apple Siri, Microsoft Cortana, Facebook M, and IBM Watson. These are a selection of the most widely used systems. The next chapter will explore various lesser-known chatbots of significant importance for research and applications.

OneofthemostchallengingresearchtasksisthedevelopmentofeffectiveChatbots. Theemulationofhuman dialogues, in fact, is a really difficult task andinvolves problems related to the NLP (Natural LanguageProcessing) research field [1]. Thanks to NLPalgorithmsandtechniques,itispossibletounderstand what the user is writing and whathis requests are. Generally, this task represents the core of the system, but there are some problems: it is not possible to map all user requests, and the current chatbots do not show remarkable performance because of the unpredictability of user thoughts during a conversation [2]. The correct design of conversational flow plays an important role in developing a Chatbot. In fact, for a successful conversation, it is important to handle all user requests and provide the right answers. In the literature, we find several examples and research works on the management of conversational workflow. Most of these works use ontologies, based on the knowledge base of the domain, that can be used to interpret the user's intentions and solve the problem of interpretation of sentences written by the user [3].

As previously said, one Chabot field of application is education. Recently, there has been an increase of Chatbots for e-learning platforms to support student learning [14]. Chatbot technology can be considered an important innovation for e-learning: in fact, they have turned out to be the most innovative solution in filling the gap between technology and education. Chatbots imply that they create an interactive learning experience for the students, such as one-to-one interaction with the teacher. From testing the student's behaviour and keeping track of their improvements, bots play an essential role in enhancing an individual student's skills. Moreover, they can also serve a major role in encouraging a student to work by sending regular reminders and notifications. There are several other cases of use of Chatbots for e-learning, for example is possible to provide a system for a personalized learning experience: each student earns and

absorbs things at a different pace. Using Chatbots is possible to adapt the speed at which a student can learn without being too pushy. Chatbots can also be used as a source of social learning, in fact students from different backgrounds can share their views and perspectives on a specific matter while the bot can still adapt to each one of them individually. This technology can improve engagement among students and encourage interaction with the rest of the class by assigning group work and projects like teachers usually do. Chatbots can help teachers with their work routine, answering students' questions or even checking their homework. Often, they are used as online assessments: if there are many students in a class, giving attention to each one of them becomes very demanding for teachers, while Chatbots can work with multiple students and groups simultaneously. They can also support teachers by identifying spelling and grammatical mistakes, checking homework, assigning projects, and especially keeping track of the progress and achievements of each student.

This paper presents the realization of a Chatbot prototype for supporting students during their learning activities. Chatbot aims to be an e-Tutor for students. The aim of this paper is the introduction of a framework for:

- The automatic identification of the students' needs thanks to the adoption of Natural Language Processing Techniques.
- The selection of the best answer thanks to the use of the ontological representation of the knowledge domain

An experimental campaign has been developed to evaluate the system's performance. In the next section, the related works are presented.

## II. LITERATURE REVIEW

As previously said, an e-learning chatbot has been made: its architecture is shown in Fig. 1.The architecture of our model is composed of:

- Front-End
- Back-Office
- Knowledge Base Module
- E-learning BOT Module

The first module represents the presentation layer (front end) through providing a user-friendly interface: it consists of different kinds of devices like tablets, smartphones, PCs and so on.The back office is used to manage operations that are not seen by the end user. This module works in the background to better satisfy user demand: it handles business logic and data storage, working in collaboration with the knowledge base.The Knowledge Base Module is a special type of database where data is processed by a server for the management of knowledge and information: in particular, "Users", representing all users of the application (Students, Professors, etc.); "Learning object" is a collection of content items, practice items, and assessment items that are combined based on a single learning objective.The E-learning BOT Module is the main engine of the proposed system. It's composed of the following components.

- **Interaction Quality Tracker**: This module monitors interactions between users and chatbots, evaluates conversation logs based on quality indicators, and highlights critical aspects of human-machine interactions.
- **Human-Computer Interaction Supervisor**: it supervises dialogue, tracks interaction times, identifies ambiguous questions, recognizes non-convergent interaction sessions, and indicates the need for community support if it is not possible to give a correct answer.
- **Context-Aware Information Manager**: This module allows the dialogue to be driven based on contextual parameters (for example, user profile, user position, etc.). The goal is to provide a dynamic and automatic invocation mechanism of information considering the context through the Context Dimension Tree [9] [10].
- **Inference Engine:** it is designed to provide the right answer to the user through a Latent Dirichlet Allocation Algorithm and Workflow Manager. In particular, the design of a Workflow Manager is divided into two main phases. The first phase is the definition of an ontology for the description of a certain knowledge domain: in this case, the E-learning domain. It's obtained thanks to the support of domain experts and the adoption of pre-existing ontologies. The second phase is related to the definition of a workflow navigation module. In this way, according to the conversation (through word analysis), this module can surf the ontology and select the more appropriate sentences. So, a way for the description of the workflow is needed: an effective way is the Petri Net [11].



Copyright © IJLREC

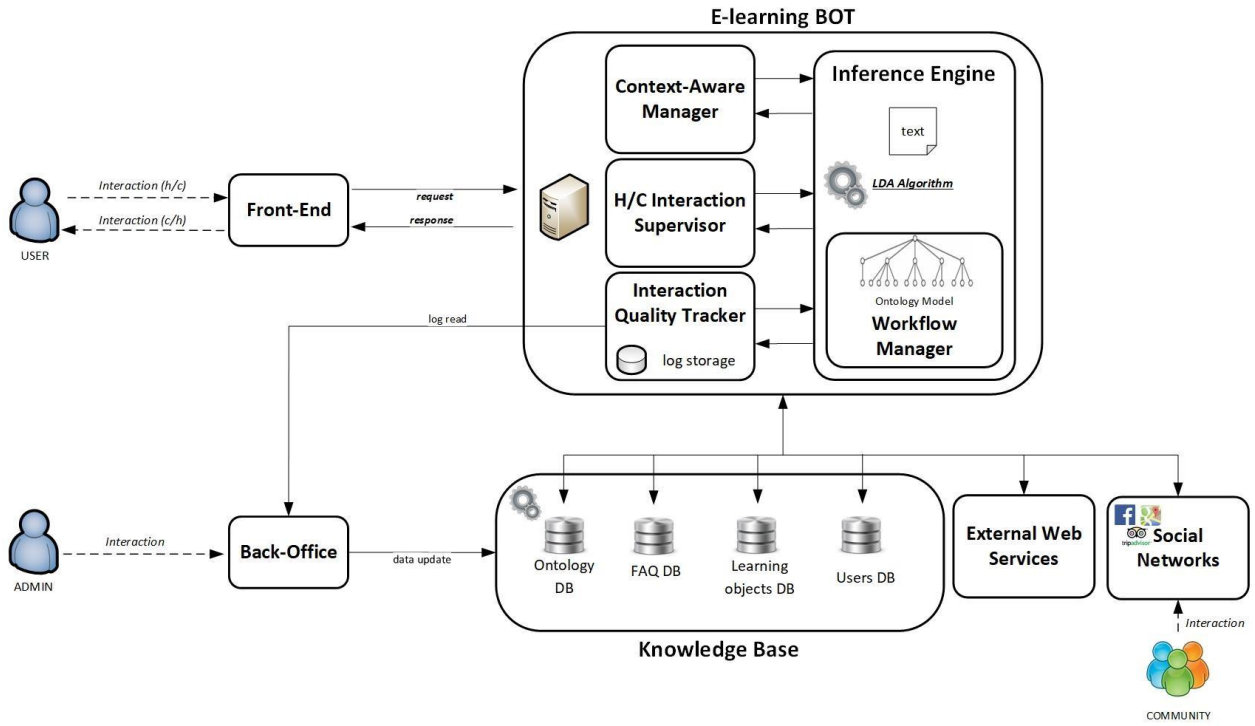


Figure 1: Architecture of the Chatbot

As previously said, a surfer is needed to navigate the ontology. Therefore, an approach based on the Petri Nets could be effective. In particular, the aim is to describe a typical workflow that involves the adoption of a Petri Net. Each phase of the conversation is modelled as a node of a Petri Net, while the transaction is obtained thanks to some structures that are identified in the sentences. The aim is to identify the right intent/request of the end user.Therefore, in this scenario, the first aim has been to build an ontology, shown in Fig. 2, to describe the reference taxonomy.

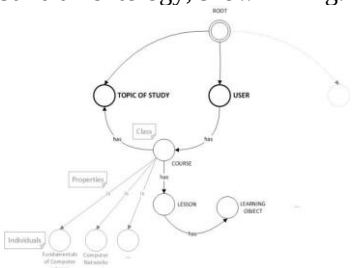


Figure 2: Components of chatbot

The ontology model is composed of:

- Topic of Study: it represents a field of study for a set of subjects (for example, Computer Science);
- The user is a student or a professor.
- The course is an instance of a specific Topic of Study (for example, Fundamentals of Computer Science or Computer Networks).
- The lesson is a didactic module, of course;



Copyright © IJLREC

- Learning Object is a modular resource, usually digital and web-based, that can be used and re-used to support learning activities.
  We propose a framework by applying ontology technology to the e-learning environment, and e-learning systems can be more intelligent, powerful, and adaptive; it is shown as in Fig. 3.

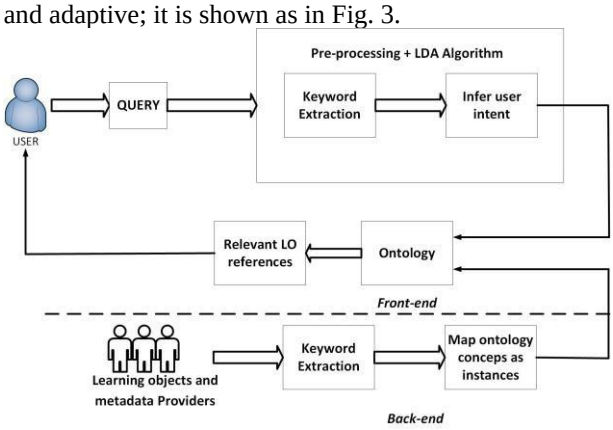


Figure 3: Proposed framework

The main purpose of using ontological representation is to gain the ability to infer a user's intention, even though the user may not know what he/she wants exactly.In our model, the following are the key works to reach the goal:

- **Build an e-learning ontology**. The ontology described above can address therelationship and evaluate the semantic distance between learning objects and of inferring a user's intention and disambiguating the query.
- Manage queries. The aim is inferring a module for constructing user intention. There are two operations: keyword extraction and inferring user intention. The main idea of this research is to provide a semantic inference engine that connects the user query and learning object metadata and provides semantic inference capability. The solution employs the Latent Dirichlet Allocation (LDA) algorithm [12][13], which is based on some standard operations in most natural language processing technologies: process the user query, remove stop words and stemming, and extract keywords.
- Map learning object metadata (LOM) instances into ontology. A LOM description will be distributed into the ontology as the instances of concepts. Indexing the LOM description into the ontology is the key step for instantiating the relations between learning objects.

Moreover, as can be seen from Fig. 3, in our framework, there is a back-end and a front-end. The backend is the learning object provider. Each learning object metadata will be pointed to one or some ontology concepts. The frontend receives queries from users and then enters the inference procedure to infer users' intentions. In Fig. 4 there is an example of this system

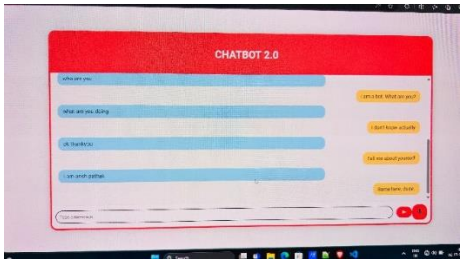


Figure 4: Sample of Chatbot

For instance, a student from the University's Computer Science Fundamentals courses uses our e-learning system to request a detailed study on a specific topic like CPU. The bot processes the request and responds to the student by sending the attached material or providing textual insights on the subject. The aforementioned example is illustrated in Fig. 4.



Copyright © IJLREC

## III. EXPERIMENTAL RESULTS

An experimental campaign was conducted to assess the performance of the proposed system. The experimentation aimed to evaluate the system's effectiveness in recognizing students' requests. Moreover, the usability of the system has been evaluated. In this experimental analysis, we evaluated the performance of a chatbot platform utilized by students enrolled in two study courses: Fundamentals of Computer Science and Computer Networks. The aim was to assess the effectiveness of the chatbot in providing correct suggestions to users. First of all, the chatbot's performance in providing the correct suggestions to the user has been evaluated. In particular, three different situations have been considered:

- The chatbot provides accurate recommendations.
- Chatbot furnishes a correct suggestion, but it does not fit with the real needs of the student
- Chatbot furnishes a wrong suggestion. The obtained results are the following:

A) Correct Suggestion: 133 - 71,15%
B) Accurate recommendation, yet not tailored to the student's requirements: 30 - 16.04%
C) Incorrect Calculation: 24 - 12.85%

Analyzing the Wrong Suggestion case, it's possible to see that the system fails when students talk about an argument that has various meanings because the bot proposes a response that is not what the student was looking for. Another critical aspect occurs when the system does not understand what kind of language the student is considering: it happens, for example, when it's not clear if the student is considering a C or a C++ language programming. In the case of Correct Suggestion but not suitable for the needs of the student, the main problem is the identification of the real user needs; for example, when the student asks a question about an argument on a specific book, the system fails to identify the correct one. From the point of view of usability, a questionnaire about his/her interaction with the chatbot has been submitted to each student: generally, they find the chatbot easy to use and user-friendly. Comparing it with other chatbots (for example, Messenger Chatbot or similar), students say that it is more simple and effective.

## IV. CONCLUSIONS

This paper presents a novel approach to a Chatbot. The proposed system is centred around an e-learning platform designed for students. An actual case was examined involving the creation of a Chatbot for students. The results obtained by the experimental campaign are satisfying and show a good perspective of this kind of approach. The proposed approach will be applied in different contexts, and the e-learning platform will be enhanced.

## REFERENCES

[1] M. Yan, P. Castro, P. Cheng, V. Ishakian, "Building a chatbot with serverless Computing," in Proc. the 1st International Workshop on Mashups of Things and APIs Article No. 5, 2016.
[2] Y. Bi, K. Deng, and J. Cheng "A Keyword-Based Method for Measuring Sentence Similarity," in Proc. the 2017 ACM on Web Science Conference, pp 379-380, 2017.
[3] L. Lin, L. F. D'Haro, R. Banchs "A Web-based Platform for Collection of Human-Chatbot Interactions," in Proc. the Fourth International Conference on Human Agent Interaction, pp. 363- 366, 2016.
[4] M. Farhan, I. M. Munwar, M. Aslam, A. M. Martinez Enriquez, A. Farooq, S. Tanveer, and P. A. Mejia "Automated reply to students' queries in e-learning environment using Web-BOT," Eleventh Mexican International Conference on Artificial Intelligence: Advances in Artifical Intelligence and Applications, Special Session - Revised Paper, 2012.
[5] M. Niranjan, M. S. Saipreethy and G. T. Kumar "An intelligent question answering conversational agent using naïve Bayesian classifier," International Conference on Technology Enhanced Education (ICTEE), 2012.
[6] S. Satu, H. Parvez, and Shamim-AI-Mamun "Review of integrated applications with AIML based chatbot," First International Conference on Computer and Information Engineering (ICCIE), 2015.
[7] Ø. Nordhaug, A. S. Imran, Al. Alawawdeh and S. J. Kowalski "The forensic challenger," International Conference on Web and Open Access to Learning (ICWOAL), 2015.



Copyright © IJLREC

[8] N. Nenkov, G. Dimitrov, Y. Dyachenko and K. Koeva "Artificial intelligence technologies for personnel learning management systems," Eighth International Conference on Intelligent Systems, 2015.
[9] M. Casillo, L. Cerullo, F. Colace, S. Lemma, M. Lombardi and A. Pietrosanto, "An adaptive context aware app for the tourism," The 3rd Multidisciplinary International Social Networks Conference (MISNC), 2016.
[10] M. Casillo, F. Colace, M. De Santo, S. Lemma, M. Lombardi, A. Pietrosanto, "An Ontological Approach to Digital Storytelling," The 3rd Multidisciplinary International Social Networks Conference (MISNC), 2016.
[11] F. Colace, M. De Santo, S. Lemma, M. Lombardi, F. Pascale "BotWheels: a Petri Net based Chatbot for Recommending Tires," in Proc. the 3rd edition of Special Session on Knowledge Discovery meets Information Systems: Applications of Big Data Analytics and BI - methodologies, techniques and tools (KomIS), within the 6th International Conference on Data Science, Technology and Applications (DATA), 2017.



Copyright © IJLREC