

Proposal of conversational chatbots for educational remediation in the context of covid-19

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Abstract— This paper presents a conversational chatbots solution allowing, in the context of covid-19, to support, detect and reduce deficiencies and bring students to self-training in order to develop their skills. The chatbot intervenes during formative evaluations and identifies the student's misunderstandings and directs him/her at the end of the test towards the parts of the course dealing with the concepts that have not been mastered.

In the context of covid-19, one of the barrier gestures being social distancing, face-to-face classes have been suspended. Many higher education institutions that were not prepared for e-learning suddenly switched to online courses in order not to lose the academic year. Students no longer have the follow-up that they had when they were learning face-to-face. The chatbot proposed in this work could help reduce the negative effects of the covid-19 pandemic on the students' level.

To allow learners to have a standardized learning environment, we have developed a plugin of the Moodle learning environment using the chatbot based on the Natural Language Processing (NLP) of Artificial Intelligence.

In this work we show how our conversational chatbot is used for pedagogical remediation by indicating to the learner which chapters of the course to revise according to the gaps highlighted by the chatbot.

Keywords— educational remediation, covid-19, chatbot, NLP, AI

I. INTRODUCTION

The covid-19 pandemic that has been raging around the world since the end of 2019 has led the Senegalese authorities to close universities and schools for 6 months. Many institutions of higher education that were not prepared for e-learning suddenly switched to online courses so as not to lose the school year. Institutions that did not have the experience and expertise to switch to e-learning could not guarantee the same quality of teaching and others could not complete the entire program. This situation exacerbates the decline in student achievement as described by authors Silva de Souza et al [1].

The objective of this contribution is to propose, through formative evaluations, a pedagogical remediation solution during and after covid-19 in order to situate the learners on their level, redirect them to appropriate contents and give

teachers elements of appreciation of the real level of each student.

In most previous research, simple chatbots solutions are widely used in many fields such as medicine, products and services industries. However, the use of chatbots in the educational context is still limited [2][3].

Efforts have been made by the scientific community for the use of chatbots in science, technology, engineering, and mathematics (STEM) but they are quite often limited to simple chatbots. A chatbot is said to be simple if the scenarios are preset and does not automatically integrate natural language processing.

The solution developed is a conversational chatbot that uses NLP to make the learning process fun and motivate learners to practice because they do not feel judged. Indeed, the understanding of the lessons and the detection of gaps can be improved by the students' questions. However, due to the fear of making mistakes and the anxiety of being mocked for wrong answers, students are increasingly reluctant to ask questions as described in [4][5].

To facilitate the use of our solution we have integrated it as a Moodle plugin.

The rest of this paper is organized as follows: Section II describes the state of the art, Section III describes the approach of our solution, Section IV presents the results obtained and Section V is reserved for discussion and conclusion.

II. RELATED WORKS

A. Teaching in the context of covid-19

By the beginning of 2020 the Coronavirus pandemic had affected most countries of the world. Faced with this disease not yet under control, the containment of populations was implemented as a solution. In Senegal, on March 14, 2020, the President of the Republic announced the closure of schools and declared a state of emergency throughout the country on March 23, 2020. Examination classes were closed from March 16 to June 25, 2020.

Classroom classes were suspended and e-learning was the last resort for teaching. Some institutions had to :

- subsidize computers for students to facilitate online courses;
- provide cheaper connection kits for students;
- use solutions such as Zoom, Google Meet, Microsoft Teams, WhatsApp, Bigbluebutton, Slack for teaching.

This widespread introduction of e-learning has caused a lot of difficulties. Teachers could no longer follow students correctly and students who were not used to this teaching method could not follow correctly

As in Senegal, in other countries of the world, the pedagogical program was not followed correctly, some lessons could be continued online and others that required practical work activities were not carried out [6].

We are concerned that the failure to carry out these activities, which are important for the acquisition of knowledge, could have negative effects on the development of learners' skills.

According to Canadian researchers, the impact of covid-19 could range from a loss of learning outcomes to an increase in drop-out rates if no action is taken [7].

In concert with the various university stakeholders, the Senegalese authorities have decided to reopen the universities on September 1, 2020, while giving the heads of the various university institutions a two-month period to catch up and complete the pedagogical program.

In order to determine the impacts of covid-19 on the level of students it would be relevant to carry out formative evaluations in order to guide pedagogical remediation.

The purpose of a formative evaluation is to promote learning progression and to inform the student and the teacher of what has been learned or what needs to be improved [8]. It is aimed at specific learning outcomes and is based on one or more pedagogical interventions. It is carried out during the activity and aims to report on the students' progress and allow them to understand the nature of their errors and the difficulties they encounter. It can be facilitated by the teacher, but can also take the form of self-evaluation or peer feedback. There are no scores, grades or percentages associated with it.

However, given the university calendar and the high student population, teachers are not able to assess students in the traditional way to detect personal shortcomings. There is a clear need for modern formative assessment techniques such as the MCQs built into the LMS. However, researchers Xu et al [9] have shown that MCQs, while appropriate for formative assessment, have some limitations namely :

- take a lot of time to construct
- test knowledge and recall only
- never test literacy, or ability to analyse

- never test creativity, or unique thinking
- encourage students to take a surface approach to learning

Hence the need to associate the concept of chatbot with the MCQs, which offers many opportunities to dialogue and receive advice in real time.

B. Conversational chatbots

Artificial intelligence (AI) chatbots have gained popularity over time and have been widely used in e-commerce, online banking and digital health and wellness, among others. Today, most chatbots are dedicated to customer service management in enterprises [10].

The use of chatbot, in general, is gaining popularity in several sectors. However, in the field of education, chatbot as a learning tool to improve teaching is still in its infancy [11]. Most studies on chatbot in education are based on online foreign language learning [12][13]. It has been identified that a chatbot can help learning with the same advantages as those obtained from a "real" interview [14]. In addition to making the learning process fun, conversational chatbot could make students more inclined to evaluate themselves and improve their level, because they do not feel judged.

Our approach is to assess students through the conversational chatbot in order to follow each student individually, directing them according to their deficiencies to the appropriate content, and finally to allow the teacher to direct their remediation based on the results of the assessments.

III. DESCRIPTION AND ARCHITECTURE OF THE SOLUTION

A. Approach to the solution

In all the countries of the world and particularly in Africa, the resumption of classes after confinement was done in conditions where students did not achieve the pedagogical objectives. To determine the level problem of each student and to find a solution, it would be difficult if not impossible because the number of teachers and their availability does not allow to exchange with each student. To solve this problem, we have chosen an institution of higher education in Senegal, Ecole Centrale des Logiciels Libres et des Télécommunications (EC2LT) specialized in the fields of free software and telecommunications in order to carry out our experiments.

At EC2LT, there are several scenarios where students from other institutions who have only taken one semester of courses are involved. Before starting classes, the EC2LT passes formative evaluations to the students through our chatbot solution to determine their level and remedy their problem independently.

The EC2LT has a Moodle platform for online training. Moodle offers several options for evaluating students at the end of chapters or courses. MCQs are one of the most widely used options for knowledge assessment. They are often limited in terms of interaction, are linear and the same for all students.

With the integration of our conversational chatbot, the multiple choice questions become interactive, fun and can be customized to each learner's answers.

B. Architecture

Fig. 1 describes the architecture of our solution allowing to have a conversation with students by detecting their intentions based on Natural Language Understanding. Our solution is based on the open source version of the Machine Learning Rasa framework [15]. This version is composed of Rasa NLU which manages the language comprehension part and Rasa Core which takes care of the information storage, the choice of the answer to send to the learner and the connection with the discussion interface.

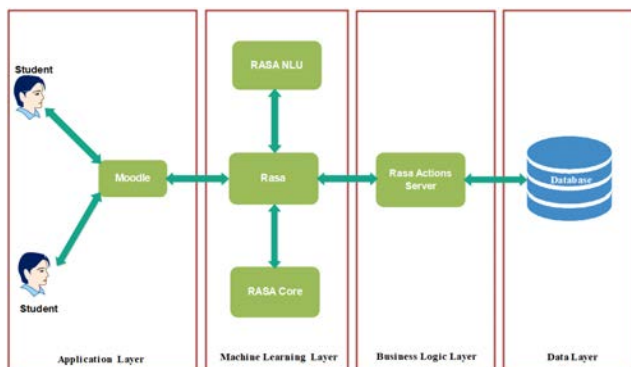


Fig. 1 Architecture of the solution

As described in Fig. 2, when the student sends a message in Moodle, the plugin transmits it to Rasa who tries to understand the received text by associating it to an intention using the RASA NLU template. Once the intent is detected, an action to be performed is chosen using the Rasa Core template. All actions are coded in Python and hosted by the action server. It is at the action server level that questions and answers are processed, the student's level is detected and a remediation is proposed to the student. The action server saves all this information and data in a database. The level of all students who have passed the assessments are therefore available to the teachers.

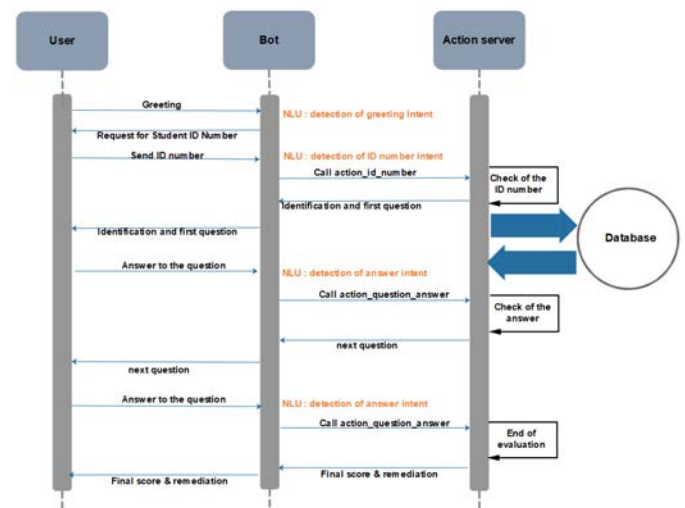


Fig. 2 Interaction between the different components

IV. RESULTS

As Fig. 3 shows, to identify the student, the chatbot greets the student in step 3.1 and asks for the student's ID number in step 3.2. When the student provides it (step 3.3) the chatbot calls the action server which looks in the database to validate the student's ID number and identifies the student (step 3.4).

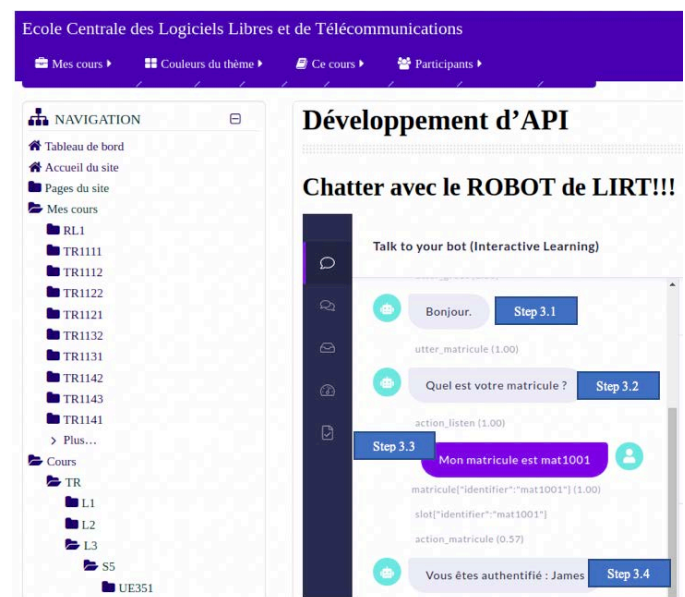


Fig. 3 Student Identification

After validation, the chatbot starts asking the student questions from the assessment (step 4.1) with the associated choices (step 4.2). The student answers them (step 4.3) by making sentences or giving the options (R1, R2, ...) as shown in Fig. 4 below.

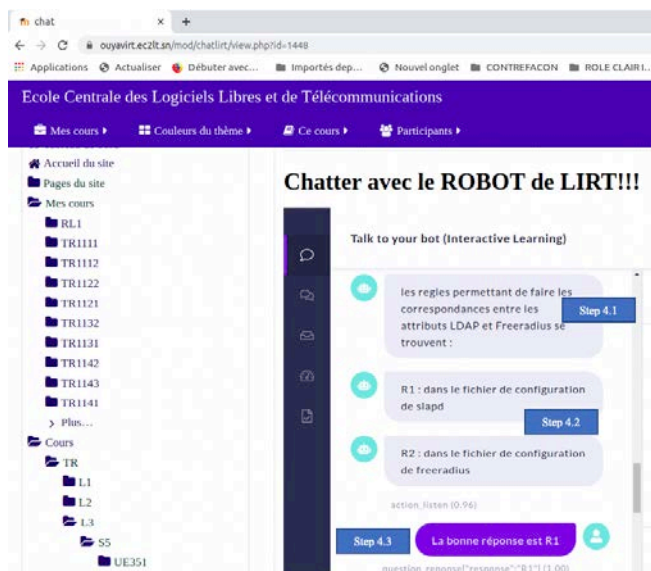


Fig. 4 Formative Evaluation

As described in Fig. 5, at the end of the assessment, the student gets his/her grade (step 5.1) and the chatbot makes recommendations for chapters where he/she did not get the average (step 5.2). Then the student receives links from the course related to the chapters to be reviewed and the result of the test is stored in a database accessible to the teacher.

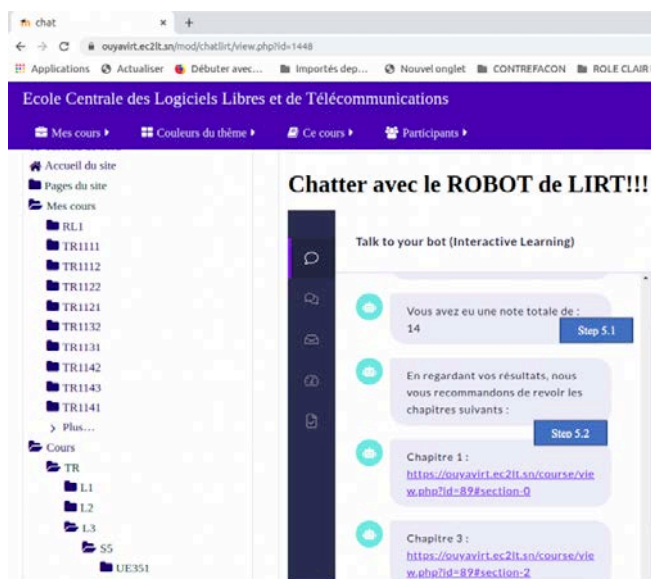


Fig. 5 Student Remediation Proposal

V. DISCUSSION AND CONCLUSION

The problem addressed by this paper is to reduce the negative effects of the covid-19 pandemic on student achievement. To do this we proposed a conversational chatbot solution based on formative evaluation.

Apart from students used to working online before the confinement, who did not change their methodology and teachers [16], the authors are unanimous on the negative effect of covid-19 on the students' academic year. The results of the studies revealed that there would probably be a decrease in the success rate in secondary education for the exams of this academic year [17][18]. Silva de Souza et al [19] estimate the decrease in student productivity at 50% given the home study environment. Authors Blizak, Djanette, et al [20] have also shown that students have a poor perception of e-learning.

Our proposed solution could change this perception and encourage students to onboard in this new way of learning online.

Other empirical studies by Hasan et al [21] have confirmed that some students suffer from psychological distress due to the inefficiency of e-learning systems, and the fear of losing a school year. They offer a psychological follow-up of these students.

All the initiatives aimed at remediation have remained at the recommendation stage [22] for some or have been done in the traditional way with limited means for others. Compared to these studies which reveal the impacts of covid-19 on the level of students and which only make recommendations, our approach goes further by proposing a solution for remediation during and after covid-19.

Another advantage of the solution is that we have designed it in such a way as to integrate it into a plugin of Moodle, which is one of the most widely used teaching platforms in the world and in Senegal.

The dashboard exploiting the database of evaluation results allows teachers to have an idea of the level of mastery of the prerequisites for the new academic year. The use of this dashboard also allows the teachers to adapt the content of their teaching to take into account the students' deficiencies so that the deficiencies can be quickly resolved to enable the pedagogical objectives of the current year to be achieved.

In conclusion, our solution through the proposed remediation system allows to raise the level of the students. Our solution not only allows teachers to detect students' deficiencies as early as possible in order to remedy them, but also allows students to improve without fear of being judged and ridiculed.

The proposed solution's areas for improvement would be based on a learner's shortcomings that the chatbot acts as a tutor to remind the learner of the key concepts related to these shortcomings before sending them to the appropriate parts of the course.

At the end of the year, we plan to put in place a mechanism to measure the real impact of our solution on reducing the negative effects of covid-19 on the level of the learners

through a comparative study of their skills compared to those of learners of the same level in previous years.

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