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Abstract— Game environments tend to be highly responsive and demanding and thus provoke active learner involvement. Surprisingly, gaming and in the same line also serious gaming, still make little use of one of people's most common type of interactions i.e. natural language. Despite the presumed positive effect in e-learning of interactive online characters, the use of virtual characters or so-called Non Player Characters still seems in its infancy. In this work, therefore, we started to look at the use of relatively simple chatbots for serious games. We describe the first step of our exploration i.e. to extend EMERGO, an existing serious game environment, with a chatbot to enhance the interaction with the student. EMERGO is a toolkit and methodology that enables to develop new cases with relative ease and limited time. We will introduce EMERGO and give an overview of chatbot technology fitting our case. Next, we will explain the EMERGO case under development, and how it makes use of the chatbot selected and the technical architecture enabling the chatbot – EMERGO integration. We will conclude with a description of the evaluation planned.

Keywords: Serious Games; EMERGO; chatbots, natural language interactions, Non Player Character

1. Introduction

Games have a longstanding tradition in education and training, covering a wide variety of application domains: ranging from business (Angehrn and Maxwell, 2009), to medicine (Cabas Vidani, Chittaro and Carchietti, 2010), and language learning (Connolly, Stansfield and Hainey, 2011). Game environments tend to be highly responsive and demanding and thus provoke active learner involvement. They allow for exploration, experimentation, competition and co-operation, while requiring self-regulation, information skills, strategic thinking, anticipation and critical thinking (Pivec, 2007).

Nevertheless, gaming and in the same line also serious gaming, still make little use of one of people's most common type of interactions i.e. using natural language (Bertomeu and Benz, 2009). Interfaces are focused on giving access to control the parameters of the algorithmic or rule based processes behind the game (or at most to create scripts or personas). The required input per transaction (though itself potentially being complex given the interdependencies of the transactions, the complexity of the processes or principles behind the game and the stress connected to giving the desired input in terms of time or consequences) goes rarely beyond selections or simple (alpha)numeric input.

Notwithstanding the presumed positive effect in e-learning of interactive online characters (Reeves, 2004), the use of virtual characters or so-called Non Player Characters (NPC) still seems in its infancy. While there is increasingly attention of complex aspects of (natural language) interactions i.e. to try to sense and express emotions (see e.g. http://emotion-research.net/), the actual use in real practice in education and gaming of natural language interactions is very limited. Despite Gartner prediction that "by year-end 2013, at least 15 percent of Fortune 1000 companies will use a virtual assistant" (Van Lun, 2011), there are only few examples in the educational domain. An overview of 101 Dutch chatbots (www.chatbot.org), for instance, contains only one chatbot fitting the category education.

In this work we started to explore the use of a chatbot to enhance the interaction with the student in the context of EMERGO a serious games environment. In the remainder of this paper we will first present EMERGO; next we will introduce chatbots including an overview of available chatbot technology fitting our case; finally we will conclude with a description of the chatbot-EMERGO architecture under development and an example of how we plan to use a chatbot in an EMERGO case currently under development and our next steps planned.

2. EMERGO

EMERGO (Nadolski et al, 2008) is a toolkit and methodology for developing and delivering serious games. It aims to support the acquisition of complex cognitive skills. An EMERGO game typically consists of a case in which a student has to perform a set of activities to solve a given problem. Its methodology supports 5 phases starting i.e. the case idea (analysis), the case scenario (design), the case development, the case delivery (implementation) and the case evaluation. Tools are available to create cases, design locations, tasks, resources, selections and multiple choice items. A script is used to define the case flow and its dynamics. The case flow can be conditional based on the student's actions and input's but also on the other actor's actions or a state change of an object (Nadolski et al, 2009). In the study environment, students can conduct conversations, visit locations, use equipment or tools e.g. for making notes to record their impressions and progress (for a detailed description see www.emergo.cc). An important characteristic of EMERGO is the relatively ease and limited time, (a production ratio of 1:25) required to design and develop a new case (Nadolski et al, 2008). An illustration of EMERGO's versatility is the use of scripted collaboration. In this case students had to draw up an advisory report on water management for an authentic case. Students studied the case from either an ecological or governance perspective. During the collaboration they were confronted and had to reflect upon both perspectives (Hummel et al, 2011).

Figure 1: A screen copy of a video-expert interaction in EMERGO (source: www.emergo.cc). The student can ask a question to the expert by selecting one of the available questions.

An important interaction pattern in EMERGO is the use of videos. They are used to supply realistic background information based on interviews with experts. A student interacts with the expert by a selection list containing questions to the expert (figure 1). Student themselves have to decide if a question is valid and if they are going to ask it. If they select a question, a connected video fragment is started. Despite its clear merits, the interaction itself is limited. Offering a chatbot would be an interesting add-on to make the interaction more motivating and realistic.

3. Chatbots

Chatbots (also known as e.g. virtual assistants, conversational agents, virtual agents, dialogue systems) have been around for over 30 years. The first chatbot in history was Eliza, a program representing a psychologist (Weizenbaum, 1966). Originally, chatbots only responded to written text. In the last decade chatbots became more versatile and included speech synthesis and recognition, and affective state detection and responses. In this study, however, in line with the ease of use of EMERGO we decided first to look at relatively simple, rule based approaches for chatbots and to trial to what extent they can be used (e.g. strength and limitations) and are useful (e.g. motivating, improved learning outcomes). This as opposed to rather complex research software and prototypes

based on data driven methods or deep semantic parsing (Graesser, Jeon and Dufty, 2008; Dzikovska et al, 2008). Below a brief overview of available options:

- AIML interpreter. The Artificial Intelligence Markup Language has an open source specification (Bush, 2001) and there are many interpreters that can be found that implement the specification. AIML is a XML derivative.
- Verbot interpreter. There is a Verbot SDK which is open source (The Verbots Project: http://verbots.sourceforge.net/). Its knowledge base consists of a vkb file which is an XML document. Verbot offers a training tool which allows you to train your chatbot and build the vkb file. Pattern matching is based on using regular expressions.
- RiveScript interpreter. Rive stands for Rendering Intelligence Very Easily. RiveScript is not XML based (Petherbridge, undated). The original RiveScript interpreter was Perl based. The author is translating to other programming languages such as Java.
- Facade interpreter. Facade is a specific kind of chatbot engine. Facade pattern matches the user input into discourse acts such as agree, disagree, flirt, criticise, etc. It uses 50 discourse acts (Mateas and Stern, 2005).
- ChatScript interpreter. ChatScript is open source (The ChatScript project: http://chatscript.sourceforge.net/). It should be an improvement on both AIML and Facade (Wilcox, 2010) and won the last two editions of the Loebner Prize (http://www.loebner.net/Prizef/loebner-prize.html). Since ChatScipt is new there are only few interpreters for it.

From the above described chatbots we decided to start working with Program D, an AIML interpreter (Bush, 2002). The choice was motivated by the combination of the functionality offered, our choice for open technology, the fit with EMERGO and importantly, it is a well known and popular AIML interpreter. So there are plenty of examples and documents to support the development of our prototype. Façade and RiveScript are sparsely used and we estimated it would costs too much work to integrate it with EMERGO. Moreover, AIML has a good track record (c.f. http://www.loebner.net/Prizef/loebner-prize.html) and Program D technically fitted best with EMERGO, also being Java-based.

Concluding, our chatbot will be completely based on open source components starting with Program D and AIML. In addition we will use:

- Tomcat 7 as webserver.
- MySQL 5.25 as database engine.
- Java JDK and JVM 1.6 for development of the chat engine.
- Grails 2.0 is the web framework for the application development.
- Groovy 1.8.6 is the programming language of choice for application components.

We have chosen Groovy and Grails as development tooling for the application part. Groovy is a modern dynamic programming and scripting language that typically helps to achieve much higher productivity. It interoperates with Java and JDK 1.6. The grails framework facilitates easy setup of the web application and models and it can generate CRUD functions.

4. Chatbot requirements and Chatbot - EMERGO Integration

From a functional view there are the following high level requirements with regard to the chatbot and with regard to its integration with EMERGO:

- The user needs to be able to place questions through the chatbot and receive expert knowledge related to the case.
- The knowledge exchange with the user is based on stored knowledge in the chatbot and on forwarding the request to the EMERGO case that is providing the needed reply that is shown in the chatbot. In addition to the reply, the case can also start a specific video within the case. The start of the video or the redirection to a specific page or to a specific document is not part of the chatbot development. The reply that needs to be handled by the chatbot are:
  - a question is related to the functional domain of the case -> question is forwarded to the case. The reply is generated and provided to the chatbot by the case;
  - a question related to a different person -> reply based on local information within the chatbot;
  - a question not related to the functional domain of the case -> reply based on local information within the chatbot;

- a question is not understood -> a pickup reply, for example randomly suggesting another topic.

- The chatbot needs to log specific conversation details (like hits, interaction counts and elapse time of the conversation) and needs to provide this information to the case.
- It should be possible to integrate the chatbot also in other areas of EMERGO.

The EMERGO toolkit is designed in such a way that components can be added rather easily. In principle, the main update required is to extend the player environment with a player for the added component. In line with this, depending of the component, the author environment may have to be adjusted to be able to enter specific content. A component is software that is used to enter a specific kind of content and to play it. In EMERGO component definition, content and end user progress are saved as XML data. The toolkit is developed in Java using Eclipse based on two frameworks, i.e. ZK (http://www.zkoss.org/) and Spring (http://www.springsource.org/) (Slootmaker and Kurvers, 2010). In our case the additional component is the chatbot. Therefore the following two aspects need to be resolved:

- integration of the chatbot into the view layer of EMERGO, so the user is able to interact anytime with the chatbot;
- interface definition and integration into EMERGO to exchange information and knowledge.

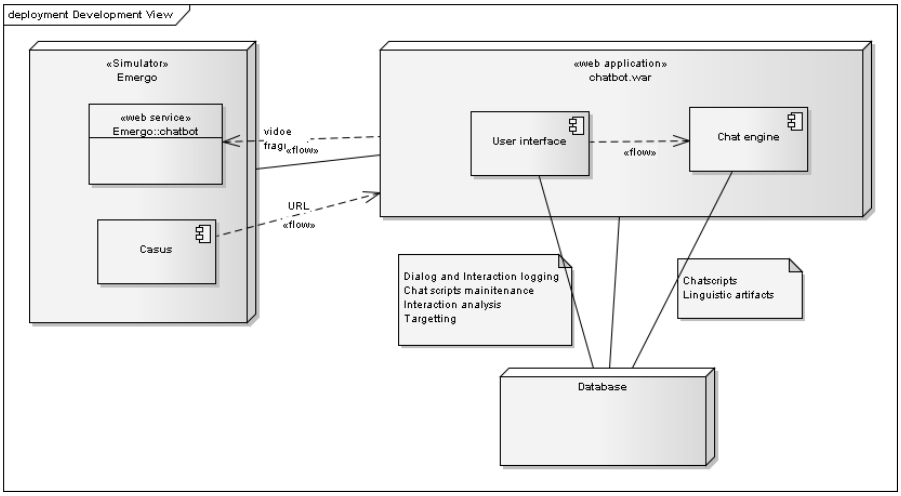

Figure 2: The EMERGO-Chatbot Architecture.

With regard to the first aspect, the chatbot is displayed within EMERGO with the help of an iframe. For the second aspect, in order to have a chatbot application that can be easily integrated into EMERGO, the chatbot needs to be an application that can be seen as a component with internal logic and knowledge. The chatbot application will provide an interface to exchange information between the chatbot and EMERGO. For the knowledge base the AIML files are used for the standardized knowledge, i.e. the knowledge required for the dialogue. For the expert knowledge, i.e. the EMERGO reply including the video, a web service interface is used to exchange data between the chatbot and the case within EMERGO. In more detail, the approach taken is that there is a chatbot component that can be used as part of the case development, as this follows the architectural approach of EMERGO. This component is responsible for the interaction with the chatbot application.

The chatbot application is split into two layers, the user interface and the chat engine. The chat engine will have a multilevel structure that is used for analyses the input, and determines the response. The levels are:

1. Lexical scanning. Text will be split in words. Chatbots typically ignore punctuation, this will be removed. Text will be normalized with regard to typos and alternative spellings.
2. Parsing (AIML level). The chatbot will try to recognize sentences.
3. Semantic level. Chatbot can use semantical structures for reply generation or improved handling of multiple abstraction levels.

Level 3 is an extension to a typical chatbot architecture, and part of our research. To have semantic information in a chatbot goes against the principal idea of keeping a chatbot as simple as possible.

However, it seems to us that a chatbot designed for a specific sub-domain could be improved by adding domain knowledge, and that this is an extra level above the parsing level.

5. Chatbot domain, role and initial test

In parallel with the selection of a chatbot, an EMERGO case has been designed to test the use of a chatbot. The case is part of a course on sexology. The course (a course in the psychology curriculum) is an introduction in sexology. It studies various perspectives of sexology including e.g. the history of sexology, sexuality viewed from a biological and psychological perspective, sexual diversity, sex and commerce, prevention of sexual risk, facilitation of sexual dysfunctions. An important module in the course is an e-practicum in which students, in the role of trainee, get acquainted with the various aspects of the profession of sexologist. In the first step, the students get acquainted with their supervisor. The supervisor, the chatbot, introduces them to an experienced colleague whom they are encouraged to question (box 1).

Chatbot Dialogue	Explanation
Chatbot Luctor >> Welcome Anne. You are here for your internship. Welcome to the poli sexology. My name is Luctor and I work here as a psychologist / sexologist. I am your supervisor for the next period. Take a seat, I now have time for a brief introduction about internships at our clinic……..…… As a first step, I will introduce you to my colleague Susan, an experienced sex therapist. You can use this opportunity to interview her to create a first impression of our work. Please confirm that it is ok if I introduce Susan to you now?	Introduction
Student Anne >> Ok.	The program starts a video introduction of Susan
Chatbot Luctor >> Thank you Susan for introducing yourself. Anne, you can now ask Susan questions on …… I will guide the conversation. You ask your questions by typing them in your window. If necessary, I will ask you for further clarification or I'll give you a suggestion. To show how it works, I suggest that you now type the following question. "How do you become a sexologist." Press "enter" to forward the question to me.	An explanation of the communication style
Student Anne >> "How do you become a sexologist" *Chatbot Luctor* >> Thank you for your question. Every time I think I recognize a question, I will repeat it in my own words. Next, if you type "yes" Susan will answer the question, …….. So, you want to know how Susan became a sexologist? *Student Anne* >> Yes	The program starts the video of how Susan became a sexologist
Luctor Chatbot >> Ok, now let's start with your interview Susan. I suggest that you start with questions that deal with how to become a sexologist, and any personal questions to Susan about her work and work experience. *Student Anne* >> ……	

Box 1: An outline of the start of the chatbot (supervisor) - student conversation.

Figure 3: A screen copy of the new video-expert interaction in EMERGO based on the chatbot. The student now actively has to think about and formulate questions.

The chatbot has been designed to 'understand' a total of approximately 90 questions divided over 14 categories ranging from e.g. the education required, diagnosis, personal attitudes, to personal questions and sexual complaints. The aim of the chatbot is to give the trainee, the student, at their first working day the opportunity to get acquainted with the work, activities and approach of a sexologist.

The questions, the chatbot relates to, have been designed by the e-practicum course team. Each of the members of the team was asked to formulate a set of questions that could have been asked by a student at their first day at work. They received the instruction to formulate at least 4 relevant questions and in addition 3 questions that could e.g. be out of scope or not detailed enough to be answered. The resulting set of questions were analysed and, subsequently, combined and sorted in 14 categories divided over the following 4 topics: (1) the education and training of a sexologist, (2) the work and co-operations (3) symptoms and treatments (4) professional attitude and general questions on sexology. At the end, for each of the resulting questions a brief video was created in which Susan, the expert, answered the concerning question.

In the e-practicum, the chatbot introduces Susan, the expert, and invites the student to ask questions to Susan (figure 3). The dialogue between chatbot and student is a basic version of a mixed initiative dialogue. The student can take the lead if (s)he knows what to ask. Alternatively, the chatbot can take the initiative and guide the direction of the conversation by giving a hint on 'what to ask', e.g. by referring to one of the 4 main topics or by directly suggesting a question (box 1). When the chatbot

recognises a question, the student gets the answer of the expert by means of a video. The dialogue ends when the student decides that (s)he is sufficiently informed. At that point the chatbot will summarize the conversation, listing the questions discussed, and offers the students a final possibility to select one or more questions from a subset of the most important questions, not asked yet.

To monitor and steer the development, a first release has been tested by a small group of 4 test users. The test version did implement approximately 50 questions. Since the main part of the e-practicum will first be available at the end of October, the test users were asked to read for preparation an overview of the situation modelled and the questions they were expected to ask. The test users were acquainted with (or introduced to) the regular interaction model (c.f. Figure 1) and were asked to grade the chatbot with respect to its usability and their experience with the interaction. More in particular, their opinion on the following statements was asked:

(1) It is possible to pose the questions planned being a trainee;

(2) The chatbot responds in a fairly natural and acceptable way;

(3) The interaction model is more challenging than the traditional one;

(4) Finally, they were asked an overall score on the chatbot's performance.

The respondents were unanimous with regard to statement 3. They agreed that the chatbot interaction model was definitely more challenging. With regard to the three other statements, one of the respondents did find it too difficult to pose questions and therefore she graded the statements low. The other respondents succeeded to pose questions and, taken as a whole, were positive. The comments given, however, also indicated that for the final release the chatbot should pay additional attention to guide the user to the topics and the questions when the user's question was not sufficiently articulated to be recognised.

6. Results and Conclusion

In this work we started to explore the use of a chatbot to enhance the interaction with the student in the context of EMERGO a serious games environment. Program D an AIML interpreter was selected to extend EMERGO with the desired chatbot functionality. It was selected because of its reputation, its functionality and its technical fit with EMERGO. In parallel, the development of an EMERGO case on sexology and its connected chatbot was started. For the chatbot a set of approximately 90 questions was designed which should enable a trainee to get acquainted with the work, activities and approach of sexologist and which should be a sufficiently large test set to allow for a realistic evaluation in the next stage. At the moment the technical implementation of the chatbot and its integration with EMERGO are realised successfully. The knowledge of the chatbot will be stored in AIML files. The integration is done by making use of the component-based architecture of EMERGO. A small trial with test-users indicated that the chatbot is seen as an improvement. Nevertheless, further technical development will be required to enhance the guidance of the students. Once the technical development and the development of the EMERGO case will be completed, the application developed will be evaluated in two steps (autumn this year). In the first step, the evaluation will focus on usability aspects of the application and we will try to identify if there any specific problems with the interaction. The second evaluation will focus on the user's experience with the interaction and on the effectiveness. This means if the students perceive the interactions with the chatbot as more motivating and challenging as compared to a standard EMERGO interface and if there is a positive effect on the learning outcomes. Finally, depending of the results of the evaluation, the chatbot will become an integral part of the EMERGO toolkit.

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