

Towards a Game-Chatbot: Extending the Interaction in Serious Games

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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 relatively 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 stimulus response based, so-called triggers and responses. RiveScript is not XML based (Petherbridge, undated).
- 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 ChatScript 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, the suitability for Dutch. Façade and RiveScript were too specific. 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, and the requirement for Dutch.

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 -> reply based on local information within the chatbot.
- 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.

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 japi 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.

Note.: This paragraph was difficult for me to write with the available information and with my technical knowledge. Please check/correct the above and if possible elaborate further on the implementation currently build and e.g. add a diagram illustrating the EMERGO-chatbot architecture. The number of words for this section should be between approximately 600 – 1000 words.

5. Chatbot domain and role

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
<p><i>Chatbot Luctor</i> >> 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.....</p> <p>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.</p> <p>Please confirm that it is ok if I introduce Susan to you now?</p>	Introduction
<p><i>Student Anne</i> >> Ok.</p>	The program starts a video introduction of Susan
<p><i>Chatbot Luctor</i> >> Thank you Susan for introducing yourself. Anne, you can now ask Susan questions on</p> <p>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.</p> <p>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.</p>	An explanation of the communication style
<p><i>Student Anne</i> >> "How do you become a sexologist"</p> <p><i>Chatbot Luctor</i> >> 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,</p> <p>So, you want to know how Susan became a sexologist?</p> <p><i>Student Anne</i> >> Yes</p>	The program starts a video introduction of Susan

<p><i>Luctor Chatbot</i> >> 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.</p> <p><i>Student Anne</i> >></p>	
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Box 1: An outline of the start of the chatbot (supervisor) - student conversation.

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.

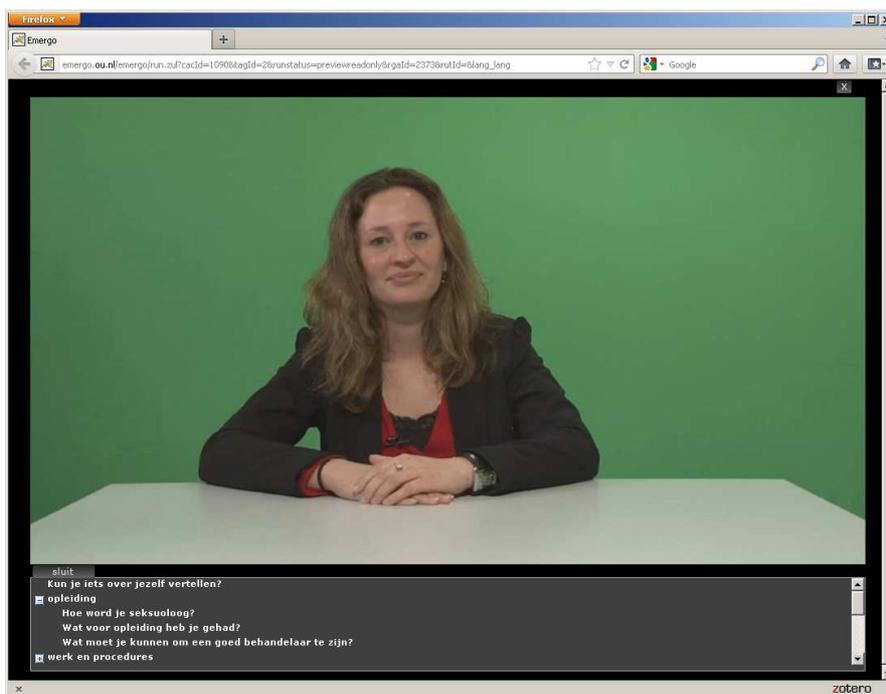


Figure 2: A screen copy of the new video-expert interaction in EMERGO based on the chatbot. The student now actively has to think about and formulate questions. [??? Is it possible to make a screen dump of the new system with the chatbot below the video ???]

In the e-practicum, the chatbot introduces Susan, the expert, and invites the student to ask questions to Susan. 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.

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 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. 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. Once the technical development and the development of the EMERGO case will be successfully completed (autumn this year), the application developed will be evaluated in two steps. 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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References

- Angehrn, A.A. and Maxwell, K. (2009). EagleRacing: Addressing Corporate Collaboration Challenges Through an Online Simulation Game. *Innovate, Journal of Online Education*, vol 5., Issue 6, Aug/Sept 2009.
- Bertomeu, N. and Benz, A. (2009). Annotation of Joint Projects and Information States in Human-NPC Dialogues. In *Proceedings of the First International Conference on Corpus Linguistics*, May 2009, Murcia, Spain.
- Bush, N. (2001). Artificial Intelligence Markup Language (AIML) Version 1.0.1, [Online], <http://www.alicebot.org/TR/2001/WD-aiml/>
- Bush, N. (2002). Getting Started with Program D, [Online], <http://www.alicebot.org/resources/programd/readme.html>
- Cabas Vidani A., Chittaro L. and Carchietti E. (2010). Assessing nurses' acceptance of a serious game for emergency medical services. In *Proceedings of VS-GAMES 2010: 2nd International Conference on Games and Virtual Worlds for Serious Applications*, IEEE Computer Society Press, Los Alamitos, CA, USA, March 2010, pp. 101-108.
- Connolly, T.M., Stansfield, M. and Hainey, T. (2011). An Alternate Reality Game for Language Learning: ARGuing for Multilingual Motivation. *Computers and Education*, Volume 57, Issue 1, August 2011, pp 1389-141.
- Dzikovska, M. O., Campbell, G., Callaway, C. B., Steinhauser, N., Farrow, E., Moore, J., Butler, L. and Matheson, C. (2008). Diagnosing natural language answers to support adaptive tutoring. *Proceedings of the 21st FLAIRS Conference*, 38-45.
- Graesser, A.C., Jeon, M. and Dufty, D. (2008): Agent Technologies Designed to Facilitate Interactive Knowledge Construction, *Discourse Processes*, 45:4-5, 298-322
- Hummel, H.G.K., Van Houcke, J., Nadolski, R.J., Van der Hiele, T., Kurvers, H. and Löhr, A. (2011). Scripted collaboration in gaming for complex learning: Effects of multiple perspectives when acquiring water management skills. *British Journal of Educational Technology*, 42(6), 1029-1041. doi:10.1111/j.1467-8535.2010.01122.x
- Mateas, M. and Stern, A. (2005). Procedural Authorship: A Case-Study of the Interactive Drama Façade. In *Digital Arts and Culture: Digital Experience: Design, Aesthetics, Practice (DAC 2005)*,

- Copenhagen, Denmark, [Online], <http://users.soe.ucsc.edu/~michaelm/publications/mateas1-dac2005.pdf>
- Nadolski, R. J., Hummel, H. G. K., Van den Brink, H. J, Hoefakker, R., Slootmaker, A., Kurvers, H. and Storm, J. (2008). EMERGO: methodology and toolkit for efficient development of serious games in higher education. *Simulations & Gaming*, 39(3), 338-352.
- Nadolski, R., Kurvers, H., Slootmaker, A., Van den Brink, H., Storm, J. and Hummel, H. (2009). Gebruikershandleiding EMERGO-toolkit Versie 1.01 (User Documentation: partly Dutch, partly in English), [Online], <http://emergo.ou.nl/emergo/community/download/GebruikersHandhandleidingEmergoToolkit15Maart2009v09.pdf>
- Petherbridge, N. (no date) RiveScript versus AIML, [Online], <http://www.rivescript.com/aiml>
- Wilcox, N. (2010). Beyond Facade: Pattern Matching for Natural Language Applications, [Online], http://www.gamasutra.com/view/feature/6305/beyond_fa%C3%A7ade_pattern_matching_.php?print=1
- Pivec, M. (2007). Editorial: Play and learn: potentials of game-based learning. *British Journal of Educational Technology*, 38: 387–393.
- Reeves, B. (2004). The Benefits of Interactive Online Characters. The Center for the Study of Language and Information. Stanford University, [Online], http://www.sitepal.com/pdf/casestudy/Stanford_University_avatar_case_study.pdf
- Slootmaker, A. and Kurvers, H. (2010). EMERGO toolkit architecture, [Online], http://emergo.ou.nl/emergo/community/download/EMERGO_toolkit_architecture.pdf
- Van Lun (2011). Blog post: <http://www.linkedin.com/groups/Gartner-predicts-huge-future-artificial-1994157.S.47691379>
- Weizenbaum, J. (1966). "ELIZA— A Computer Program For the Study of Natural Language Communication Between Man And Machine", *Communications of the ACM*, 9 (1): 36–45.