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A simple curious agent to help people be curious

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A Simple Curious Agent to Help People be Curious (Extended Abstract)

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ABSTRACT
Curiosity is an innately rewarding state of mind that, over the millennia, has driven the human race to explore and discover. Many researches in pedagogical science have confirmed the importance of being curious to the students' cognitive development. However, in the newly popular virtual world-based learning environments (VLEs), there is currently a lack of attention being paid to enhancing the learning experience by stimulating the learners' curiosity. In this paper, we propose a simple model for curious agents (CAs) which can be used to stimulate learners' curiosity in VLEs. Potential future research directions will be discussed.

Categories and Subject Descriptors
I.2.11 [**Computing Methodologies**]: Distributed Artificial Intelligence - *Intelligent Agents*.

General Terms
Design.

Keywords
Curious agent, human computer interaction, virtual learning environment, intelligent learning companion.

1. INTRODUCTION
Retention of interest in the learning activities and motivation to explore are two of the most important forces driving in-depth comprehension of the knowledge and concept [1]. These outwardly qualities of a person are internally driven by the level of curiosity. Over the long term, a healthy dose of curiosity in a learner has been found to result in the development of capabilities and, more importantly, creativity [2], [3].

As e-learning systems evolve into the current landscape, online virtual worlds emerge to be one of the most likely candidate platforms for future large scale collaborative learning [11]. This new platform – the virtual learning environment (VLE) – should provide good support for stimulating learner curiosity to enable them to reap the benefit of possessing a curious mind. As intelligent agents are increasingly being infused into VLEs [4], new virtual agents to that incorporate curiosity inducing human computer interaction mechanisms into VLEs can be a valuable enhancement to alter the way people learn in these novel learning environments. However, there is current a lack of virtual agent models which focus on fostering curiosity in the users of VLEs.

In psychological studies, the concept of curiosity in human being can be divided into two dimensions [10]: 1) *diversive curiosity*, which is aroused when people are bored or hungry for information to drive them to explore widely about the topics of interest; and 2) *specific curiosity*, which is aroused when new information are surprising or conflicting with one's existing understanding to drive people explore a certain topic of interest in an in-depth way. From these definitions, curiosity is partially determined by a person's innate characteristics and the external stimuli he/she receives from the environment. The innate urge to be curious about one's sphere of influence and beyond is primarily driven by his/her personality - more specifically, the propensity to be curious [12]. This characteristic is found in psychological studies to determine the intensity of diversive curiosity and one's attention to novelty which, in turn, drive the process of novelty discovery in the information one receives. The novelty that has been discovered in this process will likely be the external trigger for specific curiosity in the subject matter and may cause further in-depth exploration in this specific domain. The resulting enhanced understanding gained from this exercise will make subsequent encounter with the same concepts appear less novel to the person. We propose a simple curious agent model that focuses on stimulating the specific curiosity in learners.

2. RELATED WORK
Designing curious agents has been a research problem that has attracted attentions from many researchers. However, the primary aims of previous research work on CAs have mainly been on making curiosity as an intrinsic drive for the agents to explore. For instance, Schmidhuber [5] has demonstrated the effectiveness of curiosity in directing the agents to explore dynamic environments. Reinforcement learning and intrinsic rewards were used in that study to direct the curious agent to refine its model of the environment. Marsland et al. [6] incorporated curiosity into robots to equip them with novelty seeking behaviors which help them with exploration. Macedo and Cardosa [7] infused the concept of surprise into CAs to induce further exploration into the surprising areas. Saunders [8] uses CAs to study the use of computational curiosity modeling to help software agents explore for novelty in creative works (e.g. image patterns).

While these works all confirm the important relationship between curiosity, motivation, learning and creativity, they do not aim at

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developing these qualities in human users to enhance their learning experience and long term cognitive development.

3. A SIMPLE CURIOUS AGENT MODEL

Depending on one's knowledge and past experience, what appears to be novel or surprising to one learner might be a familiar fact for another. Therefore, a CA must tailor its stimulation condition to the learning progress of different learners even if the underlying concepts being taught are the same. In addition, whenever curiosity stimulation is decided to be necessary, the level of stimulation that a learner can tolerate must be taken into consideration. If the stimulus issued by the CA is too complex, too novel or too irritating, anxiety or revulsion might be aroused from the learner instead of the desired curiosity.

As an open-ended environment, a VLE provides ample time for exploration by the learners once their curiosity is aroused. In such an environment, exchanging questions with a large number of peers is much easier for a learner than in a classroom. As text chatting is the prevailing medium of message exchange in VLEs, discussion is made even easier for people who are shy to speak up before other (which is quite a common phenomenon in oriental cultures). The novel virtual objects and the sense of immersion (sensory, actional and symbolic [9]) provide a readily available intrinsic reward for exploration and discovery by the learners. These opportunities offered by the VLEs make it an ideal platform for studying the use of CAs to stimulate learners' curiosity and develop their creativity over the long term.

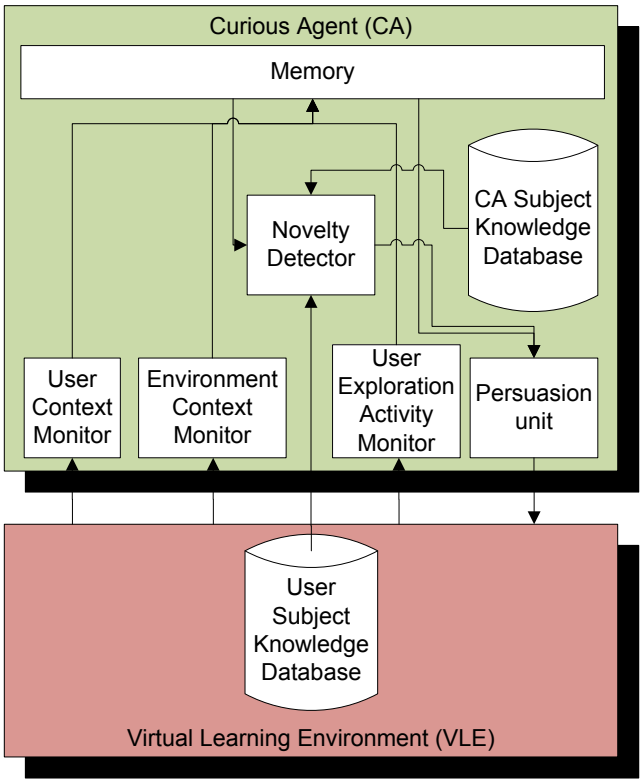

Figure 1. The Proposed Curious Agent Model.

The aforementioned considerations are summarized into a simple curious agent model as shown in Figure 1. Its functional modules can be divided into three generic categories: 1) a perception module, which is responsible for sensing the necessary domain of interest and collect relevant data to support the subsequent decisions made by the CA; 2) a cognition module, which contains the main algorithms for achieving the design objectives of the CA; and 3) a curiosity stimulation module, which is responsible for interacting with the learner.

4. CONCLUSIONS AND FUTURE WORK

In this paper, we proposed a simple curious agent model primarily aimed at stimulating curiosity in the users of virtual learning environments. We have discussed important design considerations that should be taken in order to make the CA practical.

In our subsequent studies, we will look into making the CA more aware of social signals that can be implied from the actions the users perform with in a VLE to make the agent more understanding and unobtrusive.

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