Chapter 1.7
Emotional Agent Modeling (EMAM)

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ABSTRACT

Artificial emotions play an important role at the control level of agent architectures: emotion may lead to reactive or deliberative behaviors, it may intensify an agent's motivations, it can create new goals (and then sub-goals) and it can set new criteria for the selection of the methods and the plans the agent uses to satisfy its motives. Since artificial emotion is a process that operates at the control level of agent architecture, the behavior of the agent will improve if agent's emotion process improves (El-Nasr, Ioerger, & Yen, 1998; El-Nasr & Yen, 1998). In this introductory chapter, our aim is to build agents with the mission "to bring life" several applications, such as: information, transaction, education, tutoring, business, entertainment and e-commerce. Therefore we want to develop artificial mechanisms that can play the role emotion plays in natural life. We call these mechanisms "artificial emotions" (Scheutz, 2004). As Damasio (1994) argues, emotions are necessary for problem solving because when we plan our lives, rather than examining every opinion, some possibilities are emotionally blocked off. We will try to investigate if artificial emotional control can improve performance of the agent in some circumstances. We would like to introduce the readers to our model, which is based on both symbolic and computational relations. Simulations are left for another publication. The space available is barely enough to give an overall picture about our model. The main contributions of this proposal model is to argue that emotion learning is a valid

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approach to improve the behavior of artificial agents, and to present a systematic view of the kinds of emotion learning that can take place, assuming emotion is a process involving assessment, emotion-signal generation, emotion-response and then emotion learning (LeDoux, 1996). To come across as emotional, an agent needs to incorporate a deeper model of personality, sensitivity, mood, feeling and emotions, and, in particular, directly connect these affective concepts. For agents to be believable, the minds of agents should not be restricted to model reasoning, intelligence and knowledge but also emotions, sensitivity, feeling, mood and personality (Nemani & Allan, 2001). We will propose EMAM (Emotional Agent Model) for this purpose. EMAM generates artificial emotion signals, evaluates and assesses events, takes into account the integration of personality, sensitivity, mood, feeling and motivational states then takes proper action or plans for actions (sequence of actions) (LeDoux, 1996; Gratch, 2000).

INTRODUCTION

In this subsection, a list of related works will be briefly described. We feel it is necessary to go through previous studies before we start introducing our work in the next sections. As shown in previous subsections, the topic of emotion was regarded as a very challenging topic, since it was hard to fully understand how we feel and why we do feel that way. Part of the reason for the so-called "mystery of emotions" is due to the fact that most emotions occur at the subconscious level. Moreover, it is still unclear how emotions transition from the subconscious to the conscious brain section. In fact, the complexity in the human mind lies in the complexity of the interaction between both the emotional and the cognitive processes. Searching for a better solution, researchers on agent's technology began working on artificial emotions. However, below is a quick review of some related works:

Magy Seif El-Nasr & John Yen (1998) proposed a model called FLAME – Fuzzy Logic Adaptive Model of Emotions. FLAME was modeled to produce emotions and to simulate the emotional intelligence process. FLAME was built using fuzzy rules to explore the capability of fuzzy logic in modeling the emotional process. Fuzzy logic helped them in capturing the fuzzy and complex nature of emotions. They try to point out the advantages of using fuzzy modeling over conventional models to simulate a better illusion of reality. They concluded that the use of fuzzy logic did improve the believability of the agent simulated. What makes the human mind so complex is the interactions between its emotional and cognitive processes. The cognitive process and the emotional process are not as separate as they use in their model. So they will have to further study the possible ways of interactions between the emotional and the cognitive module.

J. Bates (1994) was building a believable agent (OZ project) using the model described in *The Structure of Emotions* by Ortony, Clore, & Collins (1988). The model only describes basic emotions and innate reactions; however, it presents a good starting point for building computer simulations of emotion. The basic emotions that were simulated in the model are anger, fear, distress/sadness, enjoyment/happiness, disgust, and surprise.

Jean-Marc Fellous (1999) reviewed the experimental evidence showing the involvement of the hypothalamus, the amygdala and the prefrontal cortex in emotion. For each of these structures, he showed the important role of various neuromodulatory systems in mediating emotional behavior. He suggested that behavioral complexity is partly due to the diversity and intensity of neuromodulation and hence depends on emotional contexts. Rooting the emotional state in neuromodulatory phenomena allows for its quantitative and scientific study, and possibly its characterization.

Mannes Poel, Rieks op den Akker, Anton Nijholt, & Aard-Jan van Kesteren (2002) introduced a modular hybrid neural network ar-