On Realizing a Multi-Agent Emotion Engine

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ABSTRACT

Emotions have always been a complex phenomenon and research on their causes and effects have been fraught with debates. Though a reasonable and unified theory seems lacking, there have been many attempts at building models that emote. This paper describes a multi-agent approach that aids robot emotion. Emotions are grounded on percepts from sensors and generated by dedicated emotion agents that work concurrently with others – the positive suppressing the negative and vice versa while stimulating their own kinds. Each agent forms a metaphor of an emotion-generating entity that has a replenishing capability. Both the replenishing of an emotion resource and the sampling of the environment are based on fuzzy logic. Sampling of the percepts from the sensors is based on an adrenaline-like effect. Stimulations, suppressions, emotion resource, and a look-back before decay feature embed a deep and dynamic emotional milieu into a machine. The paper presents and discusses how three emotions churned from percepts gathered by a robot act as an emotional control juice capable of governing the manner of its motion along a path.

Keywords: Affective Computation, Agents, Emotions, Fuzzy Logic, Robotics

INTRODUCTION

Emotions, which by themselves are a complex phenomenon exhibited by living beings, have been attributed to bodily changes that either tend to excite, diminish or impede action. They seem to be generated as an attempt at self-preservation and are partly based on the being’s past experiences. Comprehending the process of emotion generation has always been difficult mainly because the associated sub processes are dynamic and have a degree of uncertainty attached to them (Chandra, 1997). A survey can reveal that very many theories have been pronounced on these complex emotional processes ever since the days of Plato (Scherer, 1995), yet a concrete understanding of their working still remains elusive. Older models were more inclined towards emulating the structure of emotions. More recent models of emotions emphasize on their functional aspects, such as their role in communication (human-machine interface), decision making (Schwarz, 2000; Izard, Kagan, & Zajonc, 1984), general body homeostasis (Craig, 2003) and environmental adaptation as in autonomous robots (Gadanho

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Emotions have also been known to contribute to the intellectual level of the being but this aspect has been debated at different levels. Strange et al. (2003) report that emotions also seem to increase the strength of a person’s memory. Reisberg (2003) points out that memory is formed and shaped through emotions. Experiencing and remembering traumatic events can rake up an emotional imbalance leading to memory disorders.

Newell (1994) has attempted to propound a unifying theory of cognition to explain the phenomena of emotion, cognition and intelligence using the Soar architecture. Sloman (2001) argues that emotions are mostly side-effects of some mechanisms within the being but at the same time agrees to the fact that emotions do cause a change in the being’s search strategies – a vital requirement in large search spaces of high dimensionality where it may not be possible to attempt an exhaustive search. He further proposes a theory distinguishing emotions as primary, secondary and tertiary, to produce a coherent theory of emotions.

Evolutionary theories suggested by Darwin (1872) propose that emotions have evolved due to their adaptive value. Accordingly fear evolved as a mechanism that enhanced chances of survival. The theory also suggests that facial expression changes are innate and allow one to read and make a judgment on whether or not a person is friendly or hostile. Of late, evolutionary theories (Hammond, 2006) consider emotions as innate hardwired responses to stimuli that are not essentially influenced by learning or thoughts. Such theories also maintain that a set of emotions including happiness, anger, fear, sadness and disgust form primary emotions common to all human races and cultures while the rest are merely the effect of the intermingling of their intensities.

Duchaine and Tooby (2001) and Cosmides and Tooby (2004) portray the evolutionary perspective by stating that the mind is like a collection of domain-specific programs that have evolved over a period of time. These programs perform specialized functions and are capable of solving problems adaptively. Finally a master program coordinates to fix them up at the right moment in the right configuration to generate the emotional effect. Tooby et al. (2008) have mentioned that the adaptive functions of some emotion programs of a person even tend to recalibrate the internal regulatory variables within his/her brain. Niedenthal et al. (2005) introduce the concept of embodiment and maintain that embodied emotional states are used for the acquisition of knowledge. This knowledge is then used to enact the very same states again.

Embedding emotions into machines takes the degree of their interactions with human beings to a higher dimension. The absence of emotions makes these interactions monotonous and the machine seems more like a passive device. Emotions also improve the feel-good factor of the human being who communicates with such machines and at the same time enhances learning within the system (McCauley & Franklin, 1998). In the following sections we present a brief report on the status of computational models of emotions, the use of agents in such models and then describe our multi-agent emotional model together with its dynamics and implementation.

COMPUTATIONAL MODELS OF EMOTION

Computational models of emotion (Marinier & Laird, 2007) provide an important tool for understanding the complex mechanisms involved in emotion generation. Early researchers were involved with the development of symbolic architectures (Minsky, 1985) with little mention and detail about the underlying brain mechanism and mental processes. The attention later shifted towards cognitive modeling and subsequently to a study and focus on the contribution of appraisal and cognitive processes to emotion (Scherer, 1993). Researchers have commenced the study of how the brain processes emotional situations (Armony, 2005) without the need for
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