Integrating a Need Module into a Task-independent Framework for Modeling Emotion: A Theoretical Approach

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Abstract

This paper concerns emotion modeling for a task-independent agent by integrating a module of needs. Inspired by theoretical views with regards to human needs, we suggest that appraisals can be confined within various scopes of needs, and to demonstrate this, we propose an emotion framework which allows control over appraisals via pre-defined levels of needs, urgency or priorities.

1. Introduction

In biological systems, motivations are concerned with internal needs related to survival (Canamero, 1997) and psychological needs related to self-sufficiency. Motivation varies as a function of deprivation in a form of varying internal states, and the latter are postulated to explain the variability of behavioral responses (Canamero, 1997). But what is the relation between motivations and emotions? Thomkins (Tomkins, 1984) views emotions as the primary motivating mechanism. According to him, the affect system adds strength to drives as motives - "without its amplification, nothing else matters, and with its amplification, anything else can matter. It thus combines urgency and generality" (p.164). In another similar view, Zimmerman pointed out that the deficiencies of the various levels of need are actually experienced *emotionally* on a conscious level, but the individual may be unconscious regarding the *level of need* he or she is deficient of. In his words (Zimmerman, 2002)(p.3), "The deficiency in safety needs is experienced as *fear* by many people. When safety needs are met, fear disappears". As Maslow [(Maslow, 1999)] has pointed out, when a need is satisfied, a new 'higher' need emerges. In this case we might see the 'love needs' arise in which one needs to be *courageous*. In this sense, fear is replaced by courage". Thus, he coined the word "need-emotions" to relate need deficiencies as experiential emotions.

These theories served as inspiration to incorporate a need module in our affect model for a domain-independent multi-tasking agent. To demonstrate this, we propose an emotion framework which allows control over appraisals via pre-defined *levels of needs*, urgency or priorities. In other words, appraisal components derive information from the need components, implicitly computed, which results to the elicitation of a suitable emotion response, represented in the agent's behaviour. Any changes in appraisals are dependent on the need level, which underlies the reasoning techniques that support the framework's cognitive process. The motivation framework is based on literature by Abraham Maslow (Maslow, 1999), describing a renowned motivational hierarchy explaining human needs from the most basic to reaching self-actualization. According to Maslow, human beings first gratify the most basic needs, before they are motivated to move on to the next level, thus, each level takes precedence over others. What makes this approach different from other appraisal-based approaches is the addition of the need-layers that function as a decomposer of task-specific events according to their importance and urgency.

Most work in computational modeling of emotion focused on appraisal-based approaches (Gadanho, 2003; Gratch & Marsella, 2004; Marcella & Gratch, 2006). Although we are perhaps the first to introduce the integrated computational account of needs, a similar architecture was acquainted in the eighties for modeling behaviour-based robots by Rodney Brooks (Brooks, 1986). Though the idea of task-decomposition into different layers is similar, our architecture differs in the way the layers handle inputs.

2. Proposed Model of Affect

As a pilot study, we have restricted our agent to fit the scope of domesticity. This means the agent is able to perform simple tasks such as turning on or off the lights, providing weather information, cleaning the floor facilitated by a vacuum cleaner etc. The agent can also act as a game partner and play board-games. These tasks are carried out in two ways: established adaptation to changing surroundings (i.e.: modifying a room environment according to user preference – brightness level in the room, timely preferred TV channel) and by verbal instructions.

In the proposed architecture (Figure 1), each task has a pre-fixed relation with one or more levels of Maslow pyramid. The manipulation of these needs is based on the agent's causal interpretation influenced by both *task-specific* and *general* events. Task-specific events directly relate to the task modules. In other words, events are induced by the module involving a specific task (game module, vacuum cleaner module etc.) For example, in a game-playing task, events may be a good movement, a bad movement, agent cheating, partner cheating etc. General events are those that are task-independent, and those detected by the agent via speech and facial modalities - such as successfully detecting insults/threats by his partner, smile or frown or even something simpler, such as detecting words accurately. Simply put, these events are *inputs* that affect various needs 'satisfaction' in the scope of the Maslow pyramid, producing varying need values (termed M-values). As events change quickly, M-values vary on the same rhythm, also taking into consideration the values on *previous state*– producing dynamicity. These variations will be further taken as inputs by the Need Independent Features (NIF) Generator to appraise the needs in terms of *Relevance, Urgency, Desirability, Unexpectedness* and *Unfamiliarity.* Appraised needs are output as vectors, whereby each vector is mapped into an *emotion instance* of a specific type and intensity. To account for the prioritization of need (which indirectly projects the importance and urgency of a task), a constant-weight is added to each instance, depending on the need-level (lower level with greater weight). Finally, the dominating emotion obtained effects both the cognitive process and behavior-selection of the agent – similar to the conducts of humans. Our current model illustrates six types of emotions – Happiness, Sadness, Surprise, Anger, Fear and Neutral. These emotions are elicited via two modalities, speech and/or facial.

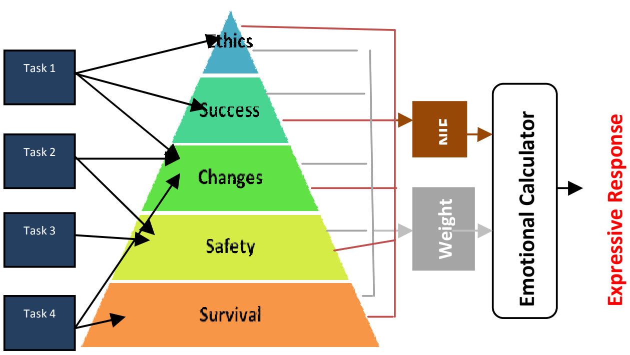

Figure 1 : Need-inspired Affect Architecture

2.1 Task Independency

As explained earlier, the agent's causal interpretation is influenced by both task-specific and general events. In the real sense however, the agent's interpretation is based on the *Maslow variation (M-values)* which is in turn modified by these events. He does not directly analyze the internal operations of each task. Thus, the behavior of the agent is *independent* of the existing task(s). Therefore the agent is made aware of his needs by connecting the cognitive module to the Maslow need pyramid rather than directly to the tasks and its situations. In this way, this module preserves the scalability of tasks, whereby the agent's tasks can be added or appropriately changed to suit applications in different domains.

3. Conclusion and Ongoing Work

The deficiency of needs is experienced by people emotionally. Their beliefs, goals and plans are influenced by their needs, and the progression towards satisfying their needs predict their emotions over time. Emotion on past, present and future events can be altered by altering their needs. These requirements lead us to a computational framework of emotion that is tied to a causal interpretation of an individual's needs. We argue that the use of the Maslow need framework, which is evident in the nature of human beings, is a suitable technique for problems of prioritization in multi-tasking agents. Apart from that, this way allows flexibility in adding or modifying tasks according to various application domains. An initial demo of our early work can be accessed here (Robonauta GTH, 2009).

Currently we are testing the proposed algorithm in an Excel simulation, and the next step is to transfer this simulation to a formal evaluation.

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