Overcoming Information Overload with Artificial Selective Agents

(Extended Abstract)

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ABSTRACT

We describe an approach, based on artificial forms of selective attention, for overcoming the problem of information and interruption overload of intelligent agents. Inspired on natural selective attention studies, we propose a computational model of selective attention that relies on the assumption that uncertain, surprising and motive congruent/incongruent information demands attention from an intelligent agent.

Categories and Subject Descriptors

H.4 [**Information Systems Applications**]: Miscellaneous

Keywords

Information overload; Selective attention; Emotion; Interest; Value of information; Surprise; Uncertainty; Resource-bounded agents; Personal agents

1. INTRODUCTION

The advent of information technology is a primary reason for the abundance of information with which humans are inundated, due to its ability to produce more information more quickly and to disseminate this information to a wider audience than ever before. Surprisingly, a lot of recent studies confirmed that the overabundance of information instead of being beneficial is a huge problem, having many negative implications not only in personal life but also in organizations, business, and in general in the world economy. In fact, research proves that the brain simply does not deal very well with a multitasking process [5]. This explains why decision quality and the rate of performing tasks degrades with increases in the amount of information being considered.

A fundamental strategy for dealing with this problem of information overload [7] should include making devices that incorporate themselves selective attention agents in order to decrease the amount of information considered in their own reasoning/decision-making processes or decrease the amount of information provided by them to humans, preventing these from a number of interruptions.

In this paper we give an overview of an artificial selective attention mechanism that may be used by artificial agents so that only cognitively and affectively, interesting/relevant information is selected and forwarded to reasoning/decision-making units. Our approach relies on the psychological and neuroscience studies about selective attention which defend that variables such as unexpectedness, unpredictability, surprise, uncertainty, and motive congruence demand attention (e.g., [1]).

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2. SELECTIVE ATTENTION AGENT

We developed an architecture for a personalized, artificial selective attention agent. We assume: (i) the agent interacts with the external world receiving from it information through the senses and outputs actions through its effectors; (ii) the world is described by a large amount of statistical experiments; (iii) the agent is a Belief-Desire-Intention agent, exhibiting a prediction model (model for generating expectations, i.e., beliefs about the environment), a desire strength prediction model (a model for generating desire strengths for all the outcomes of the statistical experiments of the world that are known given the desires of the agent), as well as intentions; (iv) the agent contains other resources for the purpose of reasoning and decision-making.

2.1 Modelling Beliefs and their Generation

The representation of the agent's memory contents relies on semantic features or attributes much like in semantic networks or schemas. Memory elements are described by a set of attribute-value pairs that can be represented in a graph-based way. Each attribute, $attr_i$, viewed by us as a statistical experiment, is described by a probabilistic distribution, i.e., a set $A_i = \{< value_j, prob_j, desireStrength_j >: j = 1, 2, \ldots, n\}$, where n is the number of possible values of the attribute, $P(attr_i = value_j) = prob_j$, and $desireStrength_j$ is the desirability of $attr_i = value_j$.

2.2 Modelling Desires and Desire Dynamics

While the belief strengths are inferred from data using a frequentist approach and updated as new information is acquired, the desirability of the outcomes can be previously set up or learned based on the intentions and contexts of the agent on which it depends, suffering changes whenever the agent is committed with a new intention and/or in a new context. For modelling this dynamics, we make use of a desire strength prediction model (a model for generating desire strengths for all the outcomes of the statistical experiments of the world that are know given the desires of the agent, the intentions, as well as the context of the user (see [4, 3]). As described above, the desire strength is associated with each attribute together with the belief strength.

2.3 Modelling Feelings

The model of feelings receives information about a state of the environment and outputs the intensities of feelings. Following Clore [2], we include in this model affective, cognitive, and bodily feelings. The latter two categories are merged to form the category of non affective feelings. Feelings are of primary relevance to influence the behavior of an agent, because by computing their intensity the agent measures the degree to which the desires are fulfilled. In this paper, we highlight the feelings of surprise, uncertainty, and pleasantness/unplesantness described in the context of the selective attention model presented in the next subsection.

2.4 Modelling Selective Attention

We assume that each piece of input information of the agent, before it is processed by other cognitive skills, goes through several sub-selective attention devices, each one evaluating information according to a certain dimension such as surprise, uncertainty, and motive-congruence/incongruence – happiness. For this task, the selective attention mechanism takes into account some knowledge container (memory – preexisting information), and the intentions and desires (motives). While the dimensions of surprise and uncertainty are related to the value of information to the belief store of the agent, the dimension of motive congruence/incongruence is related to the value of information to the goals/desires of the agent (these dimensions are related to the concepts of cognitive and affective feelings of [2] and belief-belief and belief-desire comparators of [8]) (for more details about these models, see [6]).

The selective attention mechanism obeys to the following principle: a resource-bounded rational agent should focus its attention only on the relevant and interesting information, i.e., on information that is congruent or incongruent to its motives/desires, and that is cognitively relevant because it is surprising or because it decreases uncertainty.

We define real numbers α, β, and γ as levels above which the absolute values of motive congruency, surprise, and information gain (decrease of uncertainty), respectively, should be so that the information can be considered valuable or interesting. These are what we called the triggering levels of alert of the selective attention mechanism. Note that, making one of those parameters null is equivalent to removing the contribution of the corresponding component from the selective attention mechanism.

3. PRACTICAL APPLICATION

We developed a Selective Attention-based, Multi-Agent, Travel Information System whose architecture (see Figure 1) involves a master agent and personal agents. There is a personal selective attention agent for each registered traveler. Each personal agent models a user cognitively and motivationally and acts on his/her behalf, i.e., each personal agent has information about the expectations and desires of

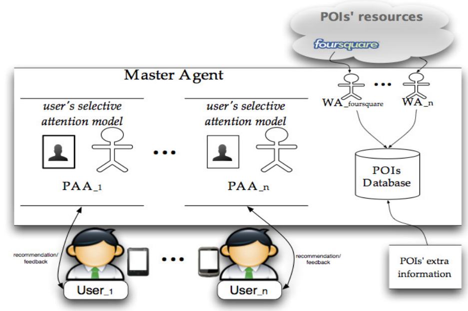

Figure 1: Architecture of the Selective Attention-based, Multi-Agent, Travel Information System.

its owner based on his/her travel history. The main role of the master agent is collecting information from several information sources and sending it to the personal agents so that they can selectively deliver travel information to the several mobile devices owned by humans.

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