pattern as a secondary response.

[0010] More especially, the agent or architecture emulating "social intelligence" should be adapted to expect a particular type of input in cases where its response is "appropriate" (or "successful" or "normal") from the point of view of external agents with which it interacts and, depending upon whether or not the expected input is received, to specialise its responses to adapt them to the circumstances.

[0011] The present invention seeks to provide an architecture meeting the above requirements (1), (2) and (3'). By meeting these three requirements, the architecture according to the invention both is self-conditioning, that is it has an internal driving force promoting conditioning, and it selectively performs this conditioning based upon whether or not its existing responses are "appropriate" or "normal".

[0012] More particularly, the present invention provides a system implementing self-biased conditioning, comprising: a plurality of sensors; at least one actuator; at least one primary response network receiving an input signal from at least one first sensor and an input signal from at least one second sensor and generating an output signal for activating an actuator, wherein the primary response network comprises: an activation node receiving the input signal from said at least one first sensor and, in response to a first value of said input signal, outputting a trigger signal, at least one motor centre receiving the trigger signal from the activation node and adapted to respond to the trigger signal by generating said output signal for activating said actuator, means for applying positive and negative reinforcement signals to the motor centre whereby to promote or inhibit the response of the motor centre to the trigger signal from the activation node, and at least one expectation node receiving the input signal from the at least one second sensor, said input signal from the second sensor being indicative of whether or not the generation of said output signal for activating the actuator is appropriate, and for generating an output signal indicating when the generation of said output signal for activating the actuator is not appropriate; means for determining, based on an analysis of at least signals output by the expectation node and motor centre of the primary response network, that the response of the motor centre requires promotion or inhibition; and an associative memory generating said positive and negative reinforcement signals based upon the determination made by the determination means.

[0013] It could be considered that the present invention has a learning mechanism having similarities with the above-discussed ACP networks, but associated with an internal driving force and a "focus of attention" mechanism. Moreover, in the architecture according to the present invention there is a separation of "innate" responses (primary response networks) from the "learnable" or "conditionable" part (the associative memory), which makes it possible to achieve an adaptive modular system. In effect, each primary response network is a building block of an adaptive system.

[0014] It could be considered that Brooks' subsumption architecture is an example of modularization for constructing behaviour-based adaptive systems. However, the composition of one behavioural layer in terms of very fine-grained units, known as FSAs produces a problem in terms of functional decomposition. More particularly, a single behavioural layer is not allowed to change its functional character. By way of contrast, in the self-biased conditioning architecture of the present invention there are primary response networks as basic units of instinctive behaviour. The units themselves do not change in run-time but their functional character changes over time. The nature of self-biased conditioning allows the system to develop a secondary response, which partly corresponds to a functional decomposition, based on a single primary response network. Thus the self-biased conditioning network serves as a better basis for developing adaptive systems, particularly modular ones.

[0015] Other advantageous features of embodiments of the invention are recited in the dependent claims appended hereto.

[0016] Further features and advantages of the present invention will become clear from the following description of preferred embodiments thereof, given by way of example, illustrated by the accompanying drawings, in which:

Figure 1 is a diagram illustrating the basic components of an architecture implementing self-biased conditioning, according to the preferred embodiment of the present invention;

Figure 2 is a diagram illustrating the structure of a primary response network used in the architecture of Fig. 1;

Figure 3 is a diagram illustrating the structure of a portion of the associative memory used in the architecture of Fig. 1;

Figure 4 is an example of a primary response network adapted to output an alarm signal;

Figure 5 is a series of graphs illustrating results of an experiment showing how self-biased conditioning affects the output of the primary response network of Fig.4, wherein Fig.5a) illustrates the output of an activation node X, Fig.5b) illustrates the output of an expectation node Y, Fig. 5c) illustrates the output of a motor centre M, and Fig.5d) groups the three outputs on a single graph;

Figure 6 is a set of graphs illustrating how values of positive and negative reinforcement signals develop during the experiment illustrated by Fig.5, wherein Fig.6a) illustrates the positive reinforcement signal, Fig.6b) illustrates the negative reinforcement signal, and Fig.6c) combines Figs.6a) and 6b);

Figure 7 illustrates how success in generating "eagle alarm calls" improves as the system learns during the exper-