SPA Device as a Partner to Navigation in Virtual World

[0066] Another implementation of an SPA (situated personal assistance) device serves as a partner for a human user navigating in a three-dimensional virtual world. VRML 2.0 is a protocol which has been developed to allow different human users to interact with one another in a "virtual world". Typically, the human user will use a general purpose computer to access such a "virtual world" via a telecommunications network. The "virtual world" is managed by a remote computer and can be observed on the user's computer screen as if it were a three-dimensional world. Typically, the user interacts with other human users by using mobile three-dimensional characters.

[0067] Fig.9 illustrates a case where two human users are interacting in such a virtual world by the intermediary of three-dimensional characters (or avatars) here represented as cones. Each of the human users has an SPA device which gives rise to a representation (avatar) in the virtual world (here shown as a cylinder).

[0068] In this case it is useful if the SPA device has at least two primary response networks, the first of which implements a tracking function enabling it to track the avatar of its human partner through the virtual world, as well as to track avatars of other human users and their SPAs, whereas the second primary response network generates "avatar alarm" signals. At first, the "tracking" primary response network is adapted to approach only the avatar of its human partner. If other avatars are detected as being within a certain distance of the avatar of the SPA then the "avatar alarm" primary response network generates an "avatar alarm" call. Moreover, a signal indicating "undesirable proximity of others" is generated and fed to the tracking primary response network. If the human partner of the SPA does not respond to the "avatar alarm call" then the SPA becomes conditioned to suppress this call and to suppress generation of the signal indicating "undesirable proximity of others". Thus, the "tracking" primary response network becomes conditioned to approach other avatars as well as that of its human partners. Experiments in such a virtual world have demonstrated that this is indeed the way in which the behaviour of the SPA device adapts.

System Optimising Probability of Receiving Appropriate External Aid

[0069] Fig.10 illustrates the structure of a primary response network 91 used in a system which optimises an output so as to maximise the likelihood of receiving a remedial external input in the case where the system has an unfulfilled operational requirement (or "need"). Besides optimising its chances of having its operational requirement met as swiftly as possible, such a system also is likely to create sympathy in a human user. The primary response network 91 illustrated by Fig.10 can be used to implement the architecture proposed by the present inventor in "Innate Sociability: Sympathetic Coupling" in the Proceedings of the AAAI Fall Symposium on Socially Intelligent Agents, 1997, pages 98-102.

[0070] The primary response network 91 of Fig. 10 has a single activation node X, triggered by an internal sensor indicating the existence of some unfulfilled operational requirement system (e.g. low battery voltage) within an application module of the system (e.g. a voltage regulator). When triggered, the activation node X activates two motor centres, a first motor centre M_1 which produces an audio alarm signal C indicating the existence of an unfulfilled operational need in the system, and a second motor centre M_2 which regulates the application module via an internal regulator D.

[0071] This network has two expectation nodes, a first node Y_1, receiving an input from an acoustic sensor B_1, and a second expectation node Y_2, receiving an input from a sensor B_2 indicating normal behaviour of the application module in question. These two expectation nodes are activated when the activation node X is triggered.

[0072] The associative memory once again functions as described above with reference to equations (2) to (5). Weight update signals for components of the positive and negative reinforcement signals generated for motor centre M_1 are based on output signals from X, Y_1 and M_1, whereas weight update signals for components of the positive and negative reinforcement signals generated for motor centre M_2 are based on output signals from X, Y_2 and M_2.

[0073] When an unfulfilled operational requirement arises in the application module this is detected by the activation node X which triggers internal regulation via the motor centre M_2. In view of the fact that external intervention will be necessary in order to fulfil certain operational requirements, the activation node also activates the motor centre M_1 to generate an output C perceptible to external agents.

[0074] The expectation node Y_2 is adapted to expect that this internal regulation will lead to satisfaction of the operational requirement and so, if this does not occur, it will indicate "abnormal" operation. The expectation node Y_1 is adapted to expect to detect at least the output C.

[0075] The system runs, while outputs from other sensors are also being monitored (via the associative memory 2). While the operational requirement rests unfulfilled, the system acquires some active sensor inputs as negative factors tending to inhibit internal regulation, eventually this will bring the internal regulation by motor centre M_2 to a halt. However, the halting of this internal regulation by motor centre M_2 will itself represent soon "abnormal" behaviour and positive reinforcement will begin. Positive and negative reinforcement run simultaneously and continue to change the weights of nodes corresponding to "active" sensors. This continues until the operation of the system normalises. At which time, the system has learned a critical set of sensor inputs that results in normalisation (that is, fulfilment of the operational requirement of the application module).