BEHAVIOR OF HOME CARE INTELLIGENT VIRTUAL AGENT WITH PRE-ThINK ARCHITECTURE

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Keywords: Intelligent virtual agents (IVA), Architecture, Ambient intelligence, Behavior, Emotions, Needs, Rationalities, Knowledge, Ambivalence, Choice.

Abstract: This paper considers the architecture and the behaviour of an intelligent virtual agent, taking care of the cosiness and the health-related features of a family house. The PRE-ThINK architecture is proposed and its components are considered. The dynamics of the decision making process in problem situations arising with the implementation of this architecture is shown. It is assumed that an agent, capable of taking the best possible decision in a critical situation will win the family members' trust.

1 INTRODUCTION

A great amount of contemporary neurophysiologic research confirms the main role of emotions in rational behaviour (Damasio, A. R., 1994). According to Turing, if a device that could "think" as the human brain does is to be designed, then it has to "feel" as well. Since 1979 this idea has been the basis of the emotional computers and emotional intelligent agents.

Ortony, Clore, and Collins (OCC model) define a cognitive approach for looking at emotions. This theory is extremely useful for the project of modelling agents which can experience emotions. The cornerstone of their analysis is that emotions are "valenced reactions." The authors do not describe events in a way that will cause emotions, but rather, emotions can occur as a result of how people understand events.

The first modification to the OCC model is to allow for the definition of different emotions with respect to others, which is known as social emotions. Social emotions can be defined as one's emotions projecting on or affected by others.

According to (Benny Ping-Han Lee et. al., 2006) mixed emotions, especially those in conflict, sway agent decisions and result in dramatic changes in social scenarios. However, the emotion models and architectures for virtual agents are not yet advanced enough to be imbued with coexisting emotions (Benny Ping-Han Lee et al., 2006).

The PRE-ThINK architecture, presented here, will contribute to some advance in this direction, we believe. The PRE-ThINK architecture allows for modelling an IVA, having capabilities to detect and analyze conflicts. Problem situations evoke conflicting thoughts, accompanied by mixed emotions and they are related to a number of different ways of action. The agent considers in advance (Pre-Think) in what way each possible action in a critical situation would reflect over all individuals concerned by it. The originated thoughts are assessed from emotional, rational and needs-related points of view in accordance with the knowledge, priorities and principles of the agent. Agent's behaviour motivators are its needs according to Maslow's theory. (Maslow A. H., 1970).

The rest of this paper is organized as follows: Section 2 gives examples of application and details on the topic; Section 3 considers existing agent architectures; in section 4 the PRE-ThINK architecture is presented; Section 5 describes an experimental setting and the structural scheme of the program system; the algorithm for defining the condition of a flower grown by the user is discussed here as well as behavioral rules for the IVA are considered; in section 6 an experiment conducted with the system is presented, IVA's capabilities to take a decision in an invented scenario are described, and the way of influence of the action/passivity/non-intervention on the side of an IVA over the object under observation is investigated and presented here;

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Section 7 contains a graphical visualization of the results of this experiment; the last 8th section is a generalization of the results of this project also discussing certain directions for future development.

2 BACKGROUND

The software agents that know the interests, habits and priorities of the user will be able to actively assist him with work and information and, personalizing themselves, to take part in the activities in his leisure time (Picard, R. S, 1998).

Users trust virtual fitness-instructors (Zsófia Ruttkay et. al., 2006) to recover from traumas or just to do some exercise, listen to virtual reporters (Michael Nischt et. al., 2006) and rely on IVA teachers (Jean-Paul Sansonnet et. al. 2006) to clarify difficult parts from the school subjects. Some users prefer medical assistants – IVA – to explain the results from their patients' medical checks (T. W. Bickmore et. al.) etc.

The more serious the role of the agent in the application and the more useful for the user it is, the better it is perceived. (D.Budakova et. al., 2010).

Many researchers model IVA behaviour aiming at establishing a trust-based relationship between the user and the IVA (Celso M. de Melo et. al. 2009, Jonathan Gratch et. al 2007, Timothy W. Bickmore et. al.2007, Radoslaw Niewiadomski et. al. 2008). Thus IVA-s are modelled, having capabilities to express so called moral emotions (pity, gladness, sympathy, remorse) (Celso M. de Melo 2009), and the way in which the frequency and the moment of sending a positive feedback from the user to the IVA (Jonathan Gratch et. al.2007), influence the trust between them, is investigated. Agent's behaviour is modelled so that it follows the user's behaviour (Jonathan Gratch et. al.2007).

A hypothesis has been derived (Budakova D. et. al., 2010), that agents with subjective behaviour could be well accepted among users, if this behaviour is a well grounded and fair subjective behaviour. Only in this case it will lead to users' reactions like sharpening their attention, increasing their trust in the agent and more natural perception of the IVA. An option for the user to try to meet the requirements of the IVA and gain its approval exists as well.

It is assumed that an intelligent virtual agent (IVA), capable of detecting a critical situation, of analyzing it and choosing the best possible option to take care of all individuals concerned, would easily gain trust. Such a behavioural model is presented in this paper with the help of the PRE-ThINK architecture.

The IVA presented in this paper is supposed to take care both of the desired and of health-related features of the environment in a family house. These two goals could be in conflict if a family member sets environment features which are not healthy. This evokes mixed, conflicting and social thoughts as well as emotions in the agent. It has to choose whether and until when to continue maintaining the pre-set features or to change them into more appropriate ones.

An IVA is not only able to follow the user's behaviour and desire but after preliminary consideration (PRE-ThINK) it can also choose the best possible action. The purpose of the agent is to possibly take the best care of the family and the inhabitants of the house even if the undertaken action does not precisely correspond to their will. It is assumed that such a type of subjective behaviour would help in establishing trust between the IVA and the family members.

3 AGENT'S ARCHITECTURES

In order for the principles of intelligent behaviour to be shown and examined, there have been a number of models, introduced recently, that include virtual world and emotional software agents, inhabiting it (Franklin, S. 2000, Wright, I. P., Sloman, A., 1996, Reilly, W. S., 1996, D. Budakova, L. Dakovski, 2005). In a number of models there has been shown how emotions are used as primary reasons and means of learning (Gadanho S. C., 2003). In others, the emotions are defined as an evaluating system that works automatically on perceptive and cognitive level through measuring importance and usefulness (McCauley L., Franklin Stan, 1998).

In the architectures of intelligent agents with clearly expressed emotional element, the components are grouped as follows: behavioral system, motive system, inner stimuli, generator of emotions (Velásquez, J. D. 1997); meta-management subsystem, consultative subsystem, subsystem action (Wright, I. P., Sloman, A., 1996); synthesis of phrases in natural language, understanding phrases in natural language, sensations and conceptions, inductive conclusions, memory, emotions, social behavior and knowledge, physical state and face expression, generator of actions (Reilly,W.S., 1996).

The cognitive cycle of IDA architecture (Franklin, S., 2000, 2001, 2004) comprises nine steps: perception, summarized perception, local associations, competition for awareness, spreading the awareness, recovery of the resources, hierarchical aims defining, choosing an action, implementing an action. Emotions play a central part in the perception, memory, consciousness and choice of an action in the IDA architecture.

In (Benny Ping-Han Lee, 2006) an improved emotion model integrated with decision making algorithms is proposed to deal with two topics: the generation of coexisting emotions, and the resolution to ambivalence, in which two emotions conflict.

The SEEM architecture (Simultaneous Emotion Elicitation Model) considered in (Benny Ping-Han Lee, 2006) is based on the OCC model. The emotions are evaluated from the point of view of an emotion set, action set and goal set, and the conflict between contradictory emotions is solved by IVA undertaking actions for weakening the negative emotions and strengthening the positive ones.

A type of architecture for an emotional agent is used in (Dilyana Budakova, Lyudmil Dakovski, 2006), which is a previous version of the architecture considered here. Its basic components are emotions, needs, rules, meta-rules, knowledge of oneself, knowledge of places from the world, actions. This type of architecture is used to model the behaviour of an IVA, intended to inhabit a virtual world and to be able to visit places around the world depending on its own state. If, for example, the IVA needs money – it goes to work for a company; if hungry and has money at disposal - goes to a restaurant, if ill – goes to a hospital etc. New places can arise in the virtual world. The agent receives information about their characteristics and evaluates them in accordance with its knowledge and principles. Depending on its principle for choosing the better place among a number of alternatives, the IVA can change its habits and start visiting more frequently a new restaurant instead of the ones it used to visit earlier.

A cognitive-emotional analysis model and behaviour in the terms of Generalized nets (Atanassov K., 1991) has been presented in (Dilyana Budakova, Lyudmil Dakovski, 2005).

The IVA architecture presented here is named PRE-ThINK an abbreviation from the initial letters of the basic components making it up - **P**rinciples, **R**ationalitis, **E**motions, **Th**oughts, **I**nvestigations, **N**eeds, and **K**nowledge. New components to the architecture have been proposed. The priority of the needs in critical situations is defined in a new way. Both IVA's state and the evaluation of each situation are also defined in a new and better way. The process of decision making in conflict situations is new as well. A new and more useful practical application of the PRE-ThINK architecture is suggested.

4 THE PRE-ThINK ARCHITECTURE

The PRE-ThINK architecture (fig.1) consists of the following components: **P**rinciples, **R**ationalities, **E**motions (+/-), **Th**oughts, **I**nvestigations, **N**eeds and **K**nowledge. The possibility for each component to be influenced by and to have an impact on each of the others is shown in the figure below.

The architecture can be implemented in various virtual and real worlds.

The situations, conditions, objects, places and events, belonging to these worlds are represented by their characteristics.

These characteristics can be evaluated by the IVA; they can originate thoughts in it and activate some of its action rules.

The IVA takes its decisions based on its principles. The following IVA principles have been modelled: "Choose the better possible action"; "Neglect the basic needs until reaching a definite threshold of dissatisfaction, giving priority to the highest-order needs", "Take care of the plants in the family house", "Observe the characteristics of the home environment set by the family members".

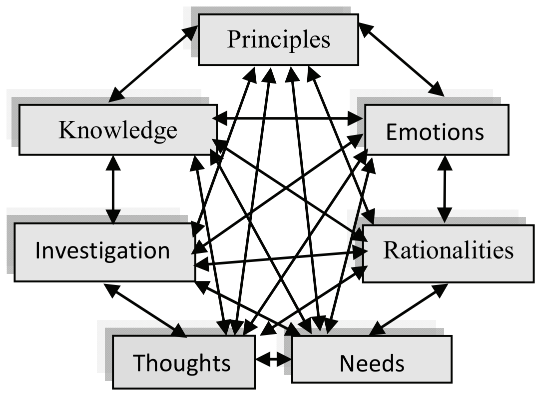

Figure 1: The PRE-ThINK Architecture.

New principles and behavioral rules can be formed based on the accumulation of observations and their generalization. This is realized by means of the subprograms of the architecture component named Investigations.

The basic groups of emotions according (Goleman D., 1995) are: anger (a), sorrow (s), fear (f), joy (j), love (l), surprise (sr), disgust (d) and shame (sh).

In case we denote the emotions in the corresponding groups by E_a, E_s, E_f, E_j, E_l, E_{sr}, E_d, E_{sh}, then they will have the value of ±X depending on their place in the hierarchy of the OCC model. A scale of values for measuring emotions is introduced. Each thought of the agent and each characteristics of a situation, object, action or condition receives an emotional value of either positive (+) or negative (-) sign.

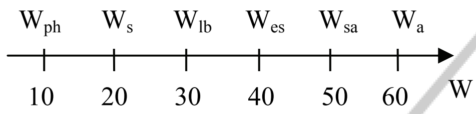

Figure 2: Needs arrangement and their weight at a normal state of the agent in a calm situation.

An IVA, just like people, uses the needs as motivators for its actions. According to Maslow's theory the needs in normal human development are arranged as follows: physiological (ph), safety (s), love and belonging (lb), esteem and self-assessment (es), self-actualization (sa), aesthetics (a). In the architecture suggested here the needs are associated with weights W_{need} corresponding to their priority. W_{ph}, W_s, W_{lb}, W_{es}, W_{sa}, W_a. Each thought of the agent and each characteristic of objects, events, places or actions are related to a certain need and they receive the weight of this need.

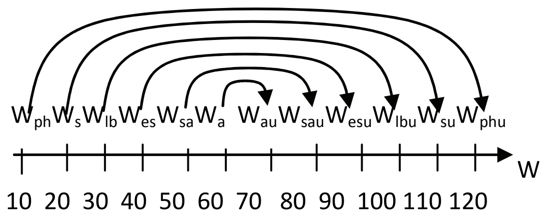

Figure 3: Arrangement of the fulfilled and unfulfilled needs in a crisis situation and their weight.

Exemplary values for the need weights used in the experiments are given in Fig. 2.

When, because of the occurrence of an event, one or more needs prove to be unfulfilled, i.e., there is a crisis situation, then the needs rearrange so that the unfulfilled ones receive first priority. The unfulfilled needs are arranged in an order, opposite to the order of needs weights in a normal state of the agent. The unfulfilled needs are denoted by W_{phu}, W_{su}, W_{lbu}, W_{esu}, W_{sau}, W_{au}, and an exemplary scale of their weight values is given in fig. 3.

A number of needs can prove to be unfulfilled at a particular moment and then a specific arrangement of the agent's priorities occurs.

The rationalistic components are, for example, importance, practicality, usefulness etc. A scale for rationalistic assessment of the characteristics is introduced. Each thought, characteristic, pre-requisite, conclusion or action is assessed by the values on this scale.

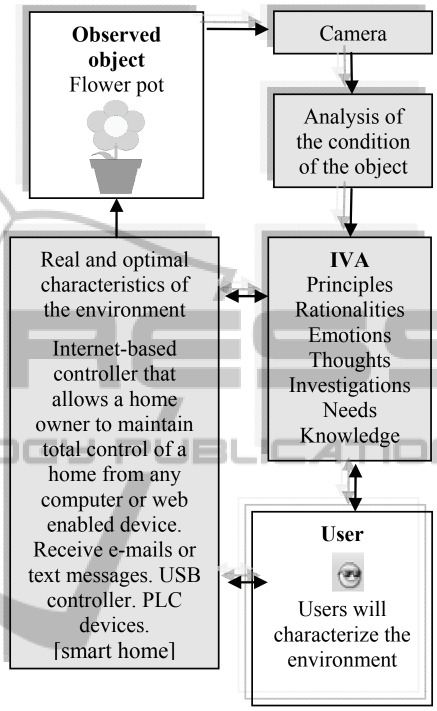

Figure 4: Structural scheme of the experimental setting.

Let a thought addressed to the situation s be denoted by Th_s. If the importance of the thought Th_s is denoted by I_{Th_s}, the weight of the need, related to this thought is expressed by W_{needTh_s}, the emotion implied by this thought is marked by $E_{emot.Th\_s}$, then, following the formulae for calculating the assessment value of the thought O_{Th_s} corresponding to the situation s will be:

$$O_{Th\_s} = E_{emot.Th\_s} * W_{needTh\_s} * I_{Th\_s}$$

If a thought is partially related to more than one need then the sum of the weight percentages of the needs to which it is related is taken into account in the formulae.

Each thought is related to an action.

The assessment values of the thoughts related to one and the same action in one and the same situation are put on the one basin of the "thoughts balance". The assessment values of the thoughts for the same situation, but related to another action, are put on another basin etc. Our "thoughts balance" will have as many basins as the alternative actions considered by the agent in the particular situation are. The module of the assessment values is summed and the action from the basin having the highest assessment value is undertaken.

The emotion experienced by the IVA in a particular situation is determined by the prevalent emotion. After an action has been undertaken, the agent keeps track of the effect from it. The IVA's state and priorities are changed anew and they depend on whether the problem has been solved or there is a new conflict situation to be solved.

5 EXPERIMENTAL SETTING

For the purposes of the experiment an IVA intended to maintain the desired by the user characteristics of the environment as well as to take care of an observed object – a flower pot - is considered.

The user can predetermine the temperature in the house, the amount of light, the mode of flower watering, and the critical level of air pollution.

The agent is capable of accumulating knowledge concerning the condition of the observed object for particular characteristics of the environment. It can change the real characteristics of the environment in the house in its own judgement. The structural scheme of the experimental setting is shown in fig.4.

5.1 Defining the Condition of the Grown Plant

A model of a virtual plant has been realized. The model includes: a scale of the conditions of the plant, the optimal temperature, humidity and light for it to grow. For what number of consequent days with inappropriate / appropriate temperature, humidity or light the plant will get worse/better and to what extent; for what number of consequent days with temperature, humidity or light going beyond the critical survival thresholds the plant will die.

The agent can observe the plant, at the same time receiving the result from a subprogram, doing an analysis and reporting the information about its condition. The virtual plant changes its size and condition when appropriate .bmp files containing pictures of the plant corresponding to each of its possible conditions are changed.

The following algorithm has been developed for the purpose of the observance and the definition of the condition of a real plant: Pictures of the plant are taken every hour. The image from the camera is recorded in a .bmp and stored in a database. The number of pixels for the whole image is found. The whole image is checked and all background and pot pixels are filtered, thus keeping only the plant pixels. The number of plant pixels in the image is found. The percentage of the plant pixels is calculated dividing them by the number of pixels of the whole image and the result is multiplied by 100. The percentage of the plant pixels is kept on a database. This percentage grows together with the plant growth. When the leaves fall down or when the flower is dry, the percentage of its pixels decreases. Thus the condition of the plant is defined and the result is transmitted to the IVA.

5.2 Initialization on IVA for the Experiment

At the beginning of the experiment there is no conflict situation and the needs of the PRE-ThINK agent are arranged from the basic ones to the high-order ones according to the principle actions and things related to the high-order needs to be preferred.

For simplicity of the experiment only gladness (a positive emotion) and anxiety (a negative emotion) are modelled as alternatives with corresponding values of ±1.

The agent has at its disposal a multitude of thoughts concerning the plant, the user and the agent itself. Each thought is related both to an emotion, and to a need, and also has its rational component – importance – with a value from 1-6 according to the assessment accepted by the programmer.

An IVA can define the following stages in the condition of the plant: it comes into leaves or its leaves fall down.

An IVA can also keep track of the environmental characteristics light, temperature, humidity, pollution. An IVA can execute the following actions: increasing or decreasing the temperature; increasing humidity (watering the plant); increasing or decreasing the light and airing.

Watering is done when the soil humidity reduces up to 5% of its limiting moisture capacity and when the humidity is not easily accessible by the plant. If the soil humidifies up to 75% of its limiting moisture capacity by watering, it is accepted to be its optimal humidification.

The limiting moisture capacity is the maximum amount of water the soil could take while filling all the pores and before drainage occurs.

For simplicity of the experiment watering mode does not change and the plant is not shifted from one place to another in order to keep the light unchanged during the experiment.

The agent's behavioural rules are as it follows:

1. **Related to the characteristics of the environment:** If a householder pre-sets environmental characteristics and if at a particular moment the real characteristics differ from them, then the necessary action is –> Check whether the pre-set characteristics are not marked as doubtful or harmful for somebody in the house and:

- If the pre-set characteristics prove to be harmful or doubtful then inform the user and do not change the current characteristics.
- If there is no information about the usefulness of the pre-set characteristics or if they are marked as doubtful then start maintaining the desired characteristics and register the existence of a problem (1) related to the characteristics of the environment.

2. **Related to growing the plant in the house:** If the plant is not in perfect condition then the necessary action is –> compare the currently set characteristics of the environment with those characteristics from the database, at which the plant has already been in perfect or good condition and correct the characteristics of the environment accordingly. Register the existence of a problem (2) related to growing the plant and

Mark the current characteristics as doubtful and observe the condition of the plant at the new characteristics for as long as it is known to be needed by the plant to recover.

If the plant recovers then mark the doubtful characteristics as harmful for the plant.

If you do not manage to conduct the observation because of a new change in the environmental characteristics then save the marking for doubtful characteristics.

3. **Is there a conflict of interests?**
If there is more than one problem, then start the process of decision making of their solution by generating thoughts about the conflict. Evaluate the thoughts according to your principles, emotions, needs and their importance.

6 THE EXPERIMENT

6.1 Experiment 1

The agent maintains the user's desire characteristics of the environment but the flower starts deteriorating. Yet the threshold at which rearrangement of the needs is going to happen has not been overcome. The IVA generates thoughts about the observed deterioration of the flower. The thoughts are addressed mainly to the probable reaction on the side of the householder towards the possible decision of the agent to change the temperature characteristics in order to improve the condition of the flower:

Thought 1: The householder will be glad if I change the temperature so that the flower survives.
A thought addressed to the householder. Positive emotion – gladness, rational component – importance with a value of 3, motivator - the need, esteem and self-assessment with a weight of 40, action – saving the flower.

$$Th\_1_{user} = 1 * 40 * 3 = 120$$

Thought 2: I am not sure what to do – to save the flower or to follow the householder's instructions.
A thought addressed to the householder. Negative emotion – anxiety, rational component – importance with a value of 1, motivator - safety with a weight of 20, action – maintenance of the characteristics pre-set by the householder.

$$Th\_2_{user} = -1 * 20 * 1 = -20$$

Thought 3: I am not sure what to do – to save the flower or to follow the householder's instructions. The assessment of Thought 3 is analogous to the one of Thought 2.

$$Th\_3_{user} = -1 * 20 * 1 = -20$$

Thoughts about saving the plant:

$Th\_1_{user} = 120$

Thoughts about keeping the pre-set by the user characteristics unchanged:

$Th\_2_{user} = -20$

$Th\_3_{user} = -20$

The thoughts about the two alternative actions are weighed as if on a balance and the IVA takes the decision for action. The thoughts about saving the flower obviously overweigh here. Therefore the IVA undertakes action towards temperature change corresponding to the optimal temperature for the plant.

The agent's state is calculated: the emotion of gladness prevails based on the thought that saving the plant would be approved by the householder and thus both the esteem and selfassessment of the agent will go higher.

6.2 Experiment 2

The plant deteriorates and the threshold at which rearrangement of the unfulfilled needs happens is overstepped. Thoughts *for* and *against* changes in the pre-set by the householder characteristics are generated. This time the thoughts are addressed not to the householder's reaction but to the flower itself as well as to its survival. The motivators are rearranged and the biggest weight now is the weight of the physiological needs. e.g., the needs are arranged as it follows: physiological 120, aesthetical 60, self-actualization 50, esteem and self-assessment 40, love and belonging 30, safety 20.

Thought 1: The householder will be pleased.
A thought addressed to the householder. Positive emotion – gladness, rational component – importance with a value of 3, motivator – the need, assessment and self-assessment – with a weight of 40, action – saving the flower.

$$Th\_1_{user} = 1*40*3 = 120$$

Thought 2: I love the flower.
A thought addressed to the plant.
Positive emotion – gladness, rational component – importance with a value of 3, motivator – love with a weight of 30, action – saving the flower.

$$Th\_1_{flower} = 1*30*3 = 90$$

Thought 3: I am worried about the flower.
A thought addressed to the plant.
Negative emotion, rational component – importance with a value of 2, motivator – love with a weight of 30, action – saving the flower.

$$Th\_2_{flower} = -1*30*2 = -60$$

Thought 4: If I do not take an action, the flower will be damaged irreversibly.
A thought addressed to the plant: negative emotion – anxiety, rational component – importance with a value of 3, motivator – physiological with a weight of 120, action – saving the flower.

$$Th\_3_{flower} = -1*120*3 = -360$$

Thought 5: The householder might get angry.
A thought addressed to the householder: negative emotion – anxiety, rational component – importance with a value of 2, motivator – assessment with a weight of 40, action – keeping the pre-set by the user characteristics unchanged.

$$Th\_2_{user} = -1*40*2 = 80$$

Thoughts about saving the plant:

$Th\_1_{user}=120$

$Th\_1_{flower}=90$

$Th\_2_{flower}=-60$

$Th\_3_{flower}=-360$

Thoughts about keeping the characteristics set by the user unchanged.

$Th\_2_{user}=80$

The thoughts are weighed on a balance in accordance with the alternative actions of either saving the plant or keeping the characteristics set by the householder unchanged.

The agent decides to save the plant and sets the optimal temperature appropriate for it. The characteristics at which the plant has started deteriorating are marked as harmful and never used.

Graphical representation of the condition of the plant and the temperatures under consideration for the duration of the experiment – 23 days from the 7th to the 30th day is given in fig. 5a). It can be seen that the actions undertaken by the agent save the plant. The IVA's state is defined. Anxiety about the plant survival prevails and the saving actions are the most important for the IVA. After the salvation of the plant the conflict is solved and the priorities of the agent are rearranged anew as they have been initially set at the beginning of the experiment.

7 GRAPHICAL VISUALIZATION OF THE EXPERIMENTAL RESULTS AND DISCUSSION

Graphical representations of three experiments conducted with the programming system are given in fig. 5 a), 5b) and 5c).

The temperature in the user's home for the days of the experiment and the change in the condition of the plant for the same days are given in the same figure for a better clearness. The numbers of the days of the experiment are given on the absciss (***x***-axis), while the values on the ordinate (***y***-axis) express two things simultaneously: temperature values in the user's home and values, corresponding to the condition of the plant grown. The temperature values on the ***y***-axis range from 0°C to + 30°C in figure 5a), from 0°C to + 18°C in fig. 5b), and from 0°C to + 45°C in fig. 5c). The values from 0 to 18 shown on the ordinate axis correspond to the levels in the condition of the plant as well: 0 corresponds to a lethal condition; 3 corresponds to a critical condition; 6 corresponds to a strongly damaged condition; 9 corresponds to a damaged condition; 12 corresponds to a good condition; 18 corresponds to a perfect condition of the plant.

Fig. 5a) shows the results from the first experiment, during which the IVA observes both the condition of the plant and the characteristics of the environment set by the householder. After detecting the problem of the plant worsening, the agent decides to save the plant in the way described in the previous section. The condition of the plant here depends on the IVA principles, on the generated thoughts and the assessments they receive in correspondence with the priority in the agent's needs, and the values of the assessments for emotionality and importance.

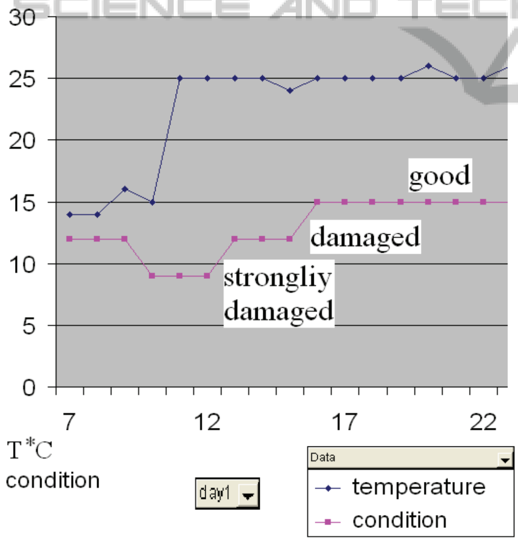

Figure 5a: The condition of the plant depends on the decision made by an IVA with PRE-ThINK architecture.

Fig. 5b) shows the results from the second experiment during which the user has set a desired temperature of 15°C for his/her home, which is not appropriate for growing the plant so the plant deteriorates gradually reaching the level of being "strongly damaged". The IVA here just meets the will of the householder and the capabilities of the PRE-ThINK are not used. The condition of the plant depends on the choice of appropriate environmental characteristics on the side of the user.

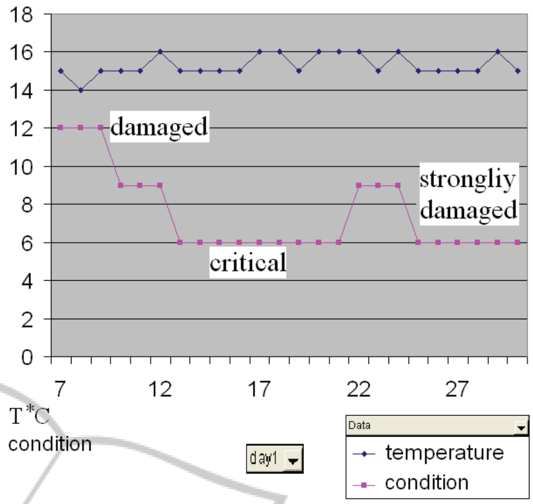

Figure 5b: The condition of the plant depends on the characteristics of the environment set by the householder.

Fig. 5c) illustrates the third experiment in which the plant has been left to the mercy of the natural climate changes and nobody takes care of maintaining any characteristics of the environment. It can be seen that with the stable increase in the temperatures over the critical level of 40°C the plant is crucially damaged.

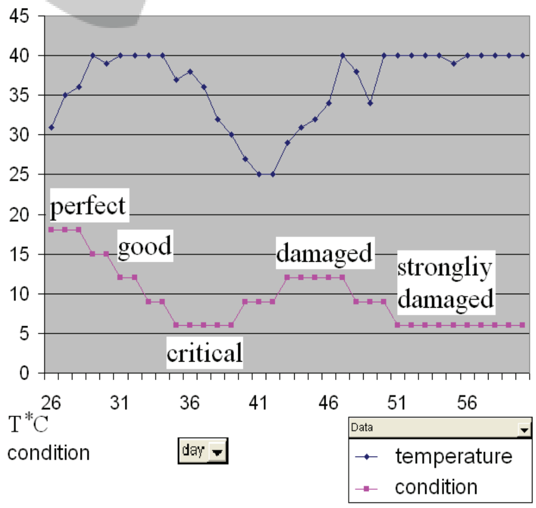

Figure 5c: The condition of the plant depends on the climate changes in the environment. T°C.

8 CONCLUSIONS

This paper considers the architecture and the behaviour of an IVA, taking care of the cosiness and the health-related features of a family house. The process of achieving these two goals can elicit mixed, conflicting, and social emotions and thoughts in the agent. The suggested PRE-ThINK architecture is appropriate for work in such problem situations. The components of the architecture are considered in the paper. The dynamics of the decision making process in problem situations arising with the implementation of the architecture is shown. An IVA with this type of architecture does not only follow the behaviour and the desires of the user. Based on its own principles, knowledge and priorities in a critical situation, it evaluates the possibilities for action from emotional, rational and need-related point of view and chooses the best possible action. The purpose of the software agent is to possibly take the best care of the user and everybody in his/her house even if the undertaken action does not precisely correspond to the user's will. It is assumed that such behaviour would facilitate the establishment of trust between the IVA and the user on the one hand; on the other hand, it could avert certain accidents of everyday life, ill-intentioned hackers' attacks or even terrorists' attacks. The truthfulness of this assumption is a matter of further investigations.

In order to take the best care of the house the agent should know as much as possible about the arguments because of which the householder determines particular characteristics; it should also have as many alternatives for action in a conflict situation as possible (e.g. in the case of flower growing a good option would be to place the plant in an automatically assembled greenhouse and thus isolate it etc.).

It is planned to develop algorithms for defining the condition of each family member as well as of their pets.

It is also envisaged to use the prototype of this programme system with real objects.

An option for the IVA with PRE-ThINK architecture implementation in programs facilitating the educational process as well as in adapted for learning purposes games is under preparation.

A further development of the PRE-ThINK architecture is related to making a classification of the IVA principles and building a hierarchy of their priorities.

Among the important future tasks to solve stands out also the possibility to compare the experimental results from this work with already existing ones from other developments.

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