

PECS and RoboCup

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1 Introduction

My master thesis is about implementing an audience for the RoboCup domain using autonomous agents (see [1] for further information). In this paper I will introduce a first approach towards modeling audience agents using the reference model PECS. Before presenting the details I will give a short introduction of the reference model.

2 PECS - a short introduction

The PECS architecture was developed to provide a better means to represent humans in a computer model. Different from models like BDI PECS takes into account that human beings are not solely based on rational decisions. In four main modules it maps human traits to its virtual counterparts.

Physical Condition this module represents the physical traits of an agent like its energy level, stamina, or appearance

Emotional State emotions like anger, joy, or fear are stored in this module

Cognitive Capacity the knowledge and world model of an agent are stored here

Social Status how an agent interacts with other agents is represented in this module. Also the agent's own status in this community is stored here

These four modules form the foundation on which each agent is build. Apart from those PECS provides additional modules that make up an agent.

Sensor and Perception the Sensor receives all data from outside the agent and transfers it to the Perception unit. Here the data is filtered based on the influence of the 4 main modules and passed on to the Cognitive module. Furthermore, there is a direct link from the Sensor to the Physical Condition module making it possible to model physical reflexes

Behaviour and Actor the Behaviour compiles a list of actions that shall be executed, then the Actor takes this list and formulates respective actions as the agent's output. This output can be directed towards the Environment in which an agent exists, towards the internal Sensor or towards the Cognition module

Connector outside the agent exists a Connector that receives and distributes messages from different PECS agents therefore enabling agents to communicate with each other

Environment likewise outside an agent lies the Environment. Since PECS is open to a variety of implementations this Environment is not specified any further than that it exists and that it contains all PECS agents and the Connector

As already pointed out above a number of connections between certain modules exist (e.g. from the Sensor to the Physical Condition module). They are divided into two groups: Information Flow and Casual Dependencies connections. Please refer to the following schematic for a detailed illustration of the various connections.

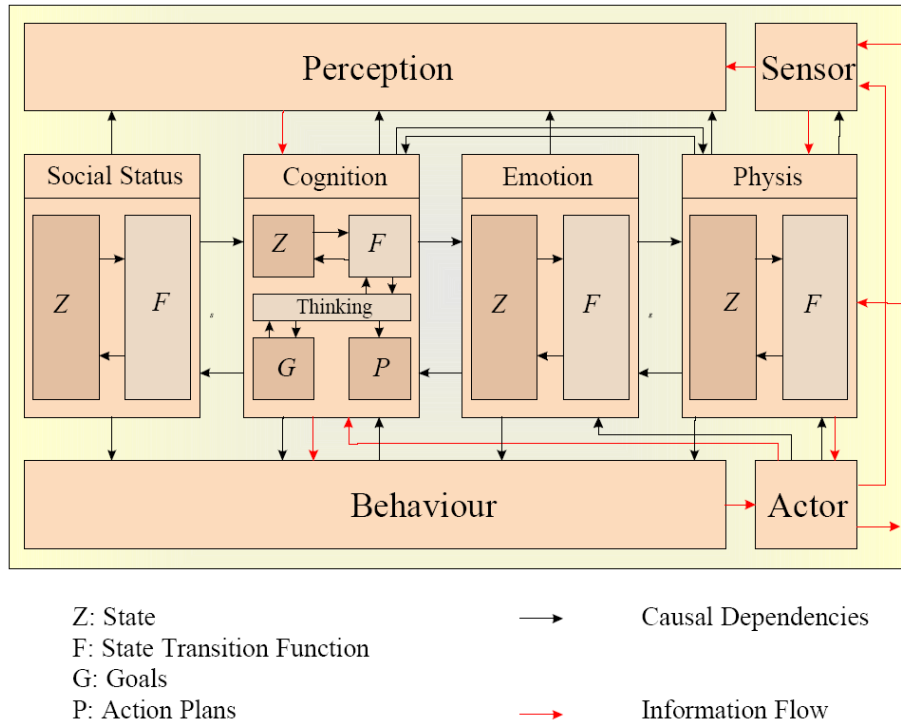


Figure 1: PECS diagram taken from [3]

This illustration and the examples described in [2] led to a first approach towards a RoboCup audience agent which will be laid out in the following section.

3 Traits and Characteristics

Before addressing the specific modules and their functions, I will formulate what the audience agent shall be capable of. The overall goal is to make the agent react to a soccer game in a way human soccer fans might react as well. But

since the behavior of humans is so diverse, a selection of just a few reactions will be taken into the consideration.

First of all, an agent shall react to scored goals and the current score of the game. Also it shall recognize how dangerous the current game situation is and behave accordingly. Usually, an appropriate reaction involves expressing an emotion like joy or anger but could also mean leaving the game.

An agent will have a certain level of energy that decreases over time which can be restored by buying food or beverages either in the game's halftime or during the game. Apart from increasing the energy level the consumption of food and beverages also increases the need to use the restroom. While buying food or going to the restroom an agent cannot watch the game.

The stadium's concession stand can handle only so many orders in a given time. If all agents decide to buy food in the halftime some are bound to miss the beginning of the second half. Orders may be combined by the agents thus allowing an agent to get food and beverages for itself and its 'friends'. To ask for or place orders an agent may communicate with its eight neighboring agents.

This grid of 8 surrounding agents is also used for the evaluation of an agent's community. Each agent will collect information about and exchange messages with its neighbors. During a game an agent can construct an impression of the surrounding agents based on the information and the exchanged messages. For example, when an agent asks its neighbors if it could get them something from the concession stand they will get a positive impression of the asking agent. Likewise if an agent constantly passes negative messages to another agent the receiver of the messages will get a negative impression of the sender. Further, if an agent constantly doesn't react to the current game situation in a way the others do (e.g. if it decides to cheer for the opposing team) it will make a bad impression on his neighbors.

These core traits will now be mapped to the different modules.

3.1 Physical Condition

The main function of the Physical Condition module is to monitor the energy level. If food or beverages are consumed they will not only refresh the energy level but also increase the need to use a restroom.

3.2 Emotional State

Each agent is capable of experiencing joy and anger. Also there is a degree of suspense that an agent experiences. All emotions are triggered by the Cognitive Capacity (for a detailed reason please refer to [2]) but may be influenced by the Physical Condition, for example the lower the energy level is the drastically are the increases of anger.

3.3 Cognitive Capacity

An agent's world model includes the current game situation (e.g. team names, score), knowledge of all eight neighbors (e.g. names and positions) and of itself. This knowledge about itself is expressed through an agent's own competence based on how accurately it recognizes a game situation. This can be judged by

the time difference that is needed for an agent to react in a way that most of the surrounding agents are.

Additionally, there is a long term world model available to an agent that stores basic information about teams and fellow audience agents. This world model is not as detailed as the current world model and will only keep track of tendencies rather than extensive states. A team may be represented as playing just above averagely well or another agent may be remembered as being unfriendly.

3.4 Social State

Since agents can interact with each other a variable is stored representing how much an agent values interacting. This variable can influence for example if an agent asks his neighbors if it can get them something from the concession stand. Another variable records the current group climate, an index generated by how friendly and good willed the surrounding agents are. This index can be modified based on the actions and messages perceived from the other agents.

3.5 Perception

The different modules may influence the Perception while it filters the incoming information from the Sensor. For example, if an agent is angry about another agent, it will pay less attention to the game itself, lack of knowledge may prevent an agent to recognize a favorable situation or peer pressure may force an agent to adapt to the surrounding agent's reaction rather than generating its own.

4 Conclusion

The PECS reference model allows to construct a detailed audience agent capable of many actions that mimic a real soccer fan. Because of its emotional states appropriate reactions to the current game situation can be generated. Furthermore, the long term memory also enables an agent to behave according to previous experience. It may choose its seat based on how friendly it thinks the surrounding agents are or it may leave a game early because it has no hope that the home team will win a match against a team they've always lost against.

References

- [1] NIE, Andreas G.: *Cheering the Crowds*. 2004. – URL <http://science.gnny.de/pub/docs/ma-paper-en.pdf>
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- [3] URBAN, Christoph: PECS: A Reference Model for Simulation of Multi-Agent Systems. In: SULEIMAN, R. (Hrsg.) ; TROITZSCH, K. G. (Hrsg.) ; GILBERT, N. (Hrsg.): *Tools and Techniques for Social Science Simulation*. Physica-Verlag, 2000