UI-AI3D 2007 Research Proposal

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Abstract. The new 3D soccer simulation server, necessitated fundamental changes in the design of UI-AI team's architecture. Although this variation does not imply a deviation from the team's previous experiences in Portugal, Japan and Germany, a new hierarchy for the agent structure is inevitable. The UI-AI2007 3D soccer team is designed with a multi-layer architecture. This model, which is based on the most probable features of the simulator in Atlanta 2007 competitions, is explained in detail in the following proposal.

1 Introduction

The new 3D environment introduces a more developed aspect of human soccer simulation which results in a better approximation of the reality. This complicated environment has proposed a challenging opportunity for specifying the agent's behavior. In addition to the relatively high level processes that were required in the previous server, new actions such as walking, getting up, running,... must be modeled in terms of body joints movement.As a consequence, the design of a new structure for the agent which takes advantage of all available facilities, especially ones concerning its physical motions, is unavoidable. Since the release of the new server, our main efforts have been concentrated on the design of a structure which satisfies this new, complex environment.

2 Team Architecture

Using multiple layers in team structure, will make us capable of decomposing the very complex task of playing soccer into several simpler subtasks. Therefore UI-AI2007 team structure consists of three hierarchical layers which implement different levels of abstraction. The bottom layer is the very low level layer which interacts with the server. This level tries to hide unnecessary server details from the upper layers. The second layer which tries to implement mid level skills consists of two sub layer itself; the states sub layer and the skills. The highest layer in this architecture is the decision making layer which contains the reasoning components of the agent for selecting the best possible action from the lower layer. Obviously, this layer is based on the skills provided by the middle layer.

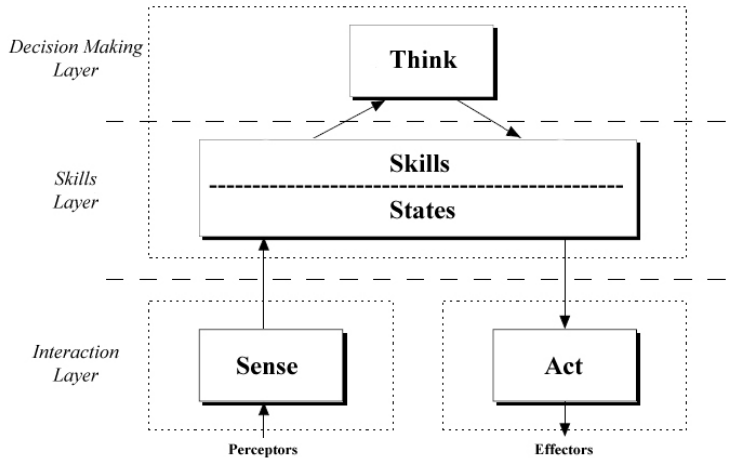

Fig. 1. UI-AI2007 team architecture

2.1 Low Level Layer: Interaction Layer

In order to decrease the complexity of interaction with the server, we were enforced to hide details from the skill layer as much as possible. This level of abstraction leads to the implementation of two types of functions, functions that parse incoming messages to extract information provided by preceptors and some simple functions which send messages in order to work with effectors. In other words, interacting with the server is the main job of this layer. This layer is completely implemented and it's description can be found in the UI-AI2007 agent description.

2.2 Mid Level Layer: States and Skills

Having had more than fourteen effectors, the new 3D simulator is a very complex environment to act in. Each action requires a very accurate composition of actuators' affection. There can be infinite number of available compositions and therefore there will be an infinite number of states which the agent can go into. Consequently, it seems impossible to define crisp states in order to model agent's skills. To overcome this problem we can define fuzzy states to model the agent movements. Each state is expressed as a composition of desired angles and velocities for the joints. These states will be used to define fuzzy membership functions which can be used to determine the current state of the agent. A mid level action can be defined by some states and the transitions within. For example "walking" can be described by three main states; initial state (standing), right leg forward and left leg forward (note that the final state is the same as the initial state i.e. standing). Transitions between two adjacent states can be

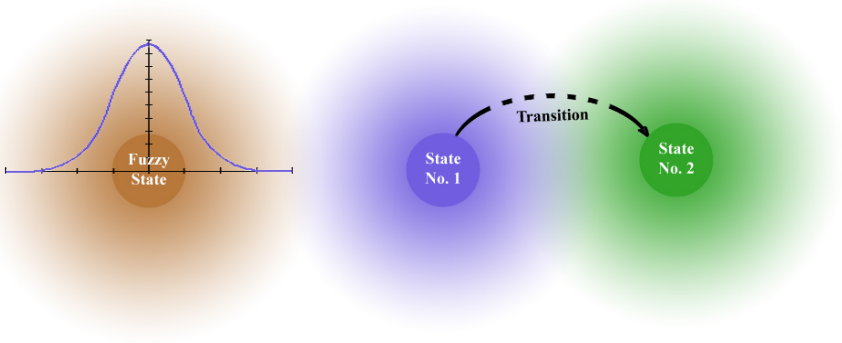

Fig. 2. Fuzzy states and transitions

expressed by a set of low level movements which can be implemented using act files described in the agent description paper. These transitions can be optimized using some artificial intelligence methods like reinforcement learning, genetic algorithms and etc by considering some parameters like time of transition and the robot's balance and ZMP point after transition. This kind of optimization can bring us faster and more subtle skills.
Defining states for the purpose of covering the entire possible situations which an agent can move in is a very critical task. Too many states result in unnecessary complexity while a few ones lead to some kind of ambiguity. Thus, in order to

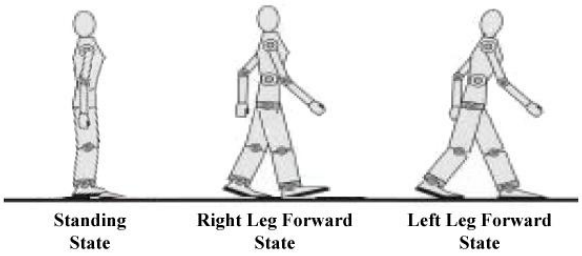

Fig. 3. States of the walking action

define required mid level skills such as walking, running, kicking and etc, most efforts will be focused on an accurate design of states and the transitions between them. This will be done by taking implemented features of the server into account.

2.3 High Level Layer: Decision Making

Finding the best possible action is the main task of this layer. However, this layer is highly dependent on the implemented skills in the lower layers; so the design and implementation of this layer can not start without knowledge about the available skills and their properties. But the mid level layer is a huge task on its own and therefore we may be forced to start working on this layer before having high performance working skills. As a consequence, at some point we may use a set of working but awkward skills like crawling instead of running to build the soccer team; while working on the mid level skills in parallel for the technical challenge competitions. Since the new server is much more complicated than the previous ones, it is not easy to apply well investigated methods in the old simulations here. For example, the offline prediction of opponents' movement is not possible because each team has its own movement model, and the prediction must be done using online methods. Therefore, we will use some kind of abstraction that tries to hide such skills and information from the thinking process and then we will be able to use old techniques to make decisions. Again, fuzzy modeling of the environment and using related fuzzy learning methods seems promising.

3 Conclusion

The main aspect for the UI-AI2007 is to the design and create a working team for the new born generation of 3D soccer simulation server. In addition to the design of the whole team architecture, the low level layer and a simplified version of important actions such as walking and kicking the ball have been implemented, since there was not enough time to implement everything. We tried to design a fuzzy model of the environment by considering all the implemented features of the server and some of the most probable coming ones. Our future works are based on fixing the short comings of the model and implementing the other layers. Because of the complexity of the new 3D server, it seems that the most efforts till Atlanta 2007 will be on the mid level layer in order to make powerful skills.

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