

BahiaRT 2022: An Open-Source Customized Gym Environment for RCSSSERVER3D*

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Recent work in the RoboCup Soccer Simulation League uses Open AI Gym [1] to apply Deep Reinforcement Learning(DRL) on the creation of new strategies, such as path-planning [2], setplays [3], and amazing skills, such as kicking [4]. However, in many cases, the created gym environments are fully dependent on their own agents' source code.

The BahiaRT Gym is a toolkit provided by team BahiaRT as an open source software¹ that enables the creation of customized Gym environments using the RoboCup Soccer Server 3D (RCSSSERVER3D) for single-agent and multiple-agent DRL. The BahiaRT Gym architecture is described in Figure 1.

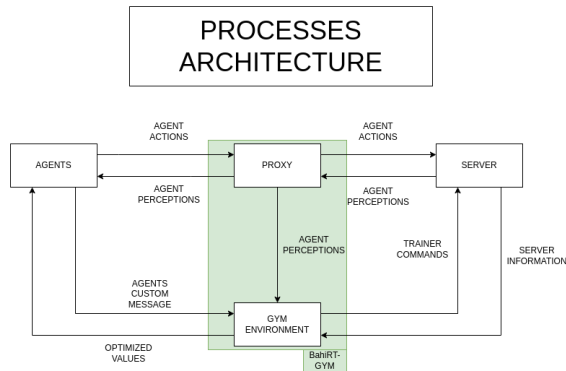


Fig. 1. The BahiaRT Gym software architecture.

The Gym Environment is able to receive all the perceptions sent by the server (simulator) to the agents. It can also receive information about agents' actions sent to the server. The Proxy is the component of this architecture that intercepts and forwards all the communication between agents and server, and relays this information to the Gym Environment.

The Gym Environment is the component that implements the Open AI Gym interface to the RCSSSERVER3D providing all the information that its users may need to create their own environments. To achieve this goal, the Gym Environment connects to the server using the monitor port, which enables it to receive noiseless information from the simulator (the same information sent to the RoboViz monitor). This feature is also useful to enable Gym to use Trainer commands, such as defining players and ball positions, play modes, etc. These

commands are essential for resetting the environment at the end of an episode.

The Gym Environment also establishes a direct connection to agents to send them the actions generated during the training process. The agents can also send messages back to the Gym Environment, such as specific data to feed the observation space or be applied on the reward calculations, or even a simple synchronization flag to let Gym know that the agent has finished the current action and can continue to the next training step. All communications use TCP sockets.

The main features of BahiaRT Gym are: i) it's independent of the BahiaRT source code, meaning it can be used by any team; ii) having flexible architecture and an open source license, it can be extended by the RoboCup community to be used with other simulators, such as Webots or Gazebo; iii) It fully supports multiagent DRL, being tested with RCSSSERVER3D using 11 agents trained in matches against 11 opponents; iv) it's easy to install and use; v) it's fully compatible with stable-baselines3.

The BahiaRT Gym was used to support a recent Ph.D. thesis [5] to learn a setplays selection policy from a large setplays dataset. The BahiaRT Gym simulated several 11-vs-11 matches, training BahiaRT's agents to learn the desired policy.

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¹Available at <https://bitbucket.org/bahiar3d/bahiar-gym> and <https://pypi.org/project/bahiar-gym/>