Tool Demonstration: iv4XR Agent-based Testing Framework

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***Abstract*—The iv4XR Framework is an open source agent-based Java framework for automated testing. Currently the main use case is for testing computer games. The main novelty of iv4XR is in its choice for an agent-based approach. Agents are inherently reactive programs, and hence a good match to test highly interactive systems such as computer games. Iv4XR uses BDI based agency, which allows an agent to have belief and desire. Desires are formulated as goals, e.g. to test a certain state in the SUT. Goal solvers can be composed from reasoning rules and rule combinators, and complex goals can be formulated through goal combinators. This approach combines a proactive dimension, that together with the reactive nature of agents provides more versatility and strength for automated testing.**

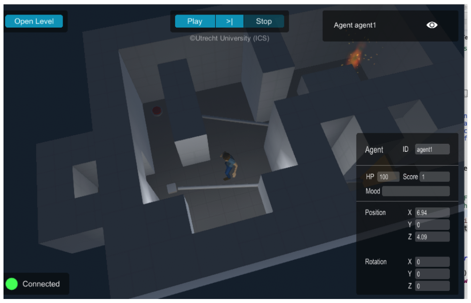
***Index Terms*—AI for automated testing, automated testing XR systems, agent based testing, AI for testing games**

The iv4XR Framework [1] is an open source agent-based framework for automated testing. The intended main use case is for testing of 'Extended Reality' based systems. This subfamily of interactive systems includes 3D games, 3D simulations, VR systems, and AR (Augmented Reality) systems. The domain urgently needs test automation support as manual testing is becoming very expensive and tool support is scarce (even record and reply is often not available), so with iv4XR we hope to be able to help improving this state of practice.

The Framework has reached a working prototype level, with 3D computer games as current pilots. It is available in the Github[1]. A demonstration is available, where the Framework is used to automate the testing of a 3D game called Lab Recruits[2] (Figure 1). Larger pilots are work in progress.

The main novelty of iv4XR is in its choice for an agent-based approach. An *agent* is essentially a program that interacts with an environment by repetitively performing actions, either on its own initiative or as reaction to events generated by the environment. An agent is thus inherently a *reactive program*, and in this sense it is fundamentally different than e.g. a procedure or a service. Arguably, this makes agents a more natural framework for testing interactive systems.

To deal with the huge and fine grained interaction space of XR systems, iv4XR necessarily relies on AI. While the current interest in AI mainly focuses in machine learning, iv4XR's main AI is agent-based AI; Figure 2 shows a top level architecture of iv4XR test agents. Iv4XR is inspired by a popular concept of intelligent agents called *Belief-Desire-Intent* (BDI) [2], [3]. An agent is thought to have a mental state: its 'believes' and 'desires'. 'Desires' are formulated as goals (e.g. to test a certain state in the SUT) that the agent seeks to achieve. 'Intent' represents the agent's plan towards achieving a goal. The intelligent part comes from the agent's ability to reason, e.g. through reasoning rules, about its believes and goals, to decide which goal to pursue, and which plan to use. This approach combines a *proactive dimension*, that together with the *reactive nature* of agents provides more versatility and strength for automated testing than just invoking e.g. a random tester or a genetic algorithm.



Agent ID agent1
HP 100 Score 1
Mood
Position X 6.94 Y 0 Z 4.09
Rotation X 0 Y 0 Z 0

Fig. 1. *A screenshot of the game Lab Recruits we used as a pilot for iv4XR.*

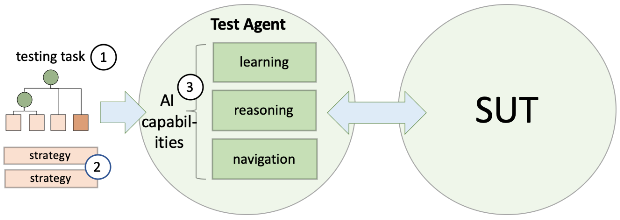


Fig. 2. *An iv4XR test agent accepts testing tasks (1), expressed as BDI goals. Strategies (2) are used to solve them, which in turn make use of general AI capabilities (3) such as reasoning and navigation.*

Website and download: see the footnote. Build instructions, documentations, and demo: in the website. Video:

Short: https://youtu.be/Hc8NP4NuHAk

Longer: https://zenodo.org/record/4661945#.YHVBLxMzZsM

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[1] https://github.com/iv4xr-project/aplib

[2] https://github.com/iv4xr-project/iv4xrDemo

References

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