Building Test Beds for AI with the Q3 Mode Base

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Abstract

We extend the open source Quake 3 Arena code base released by Id Software to include modification friendly code segments, art asset blueprints, external agent control and perception interfaces, game interaction logging, and a tool set that allows the creation of test beds for artificial agents. Our current modification work in the Urban Combat Testbed using the *Q3 Mod Base* is currently being used to study transfer learning in human and agent players and as an AI teaching tool.

Introduction

Interactive computer games have been considered human-level AI's "killer app" (Laird & van Lent 2001) in that current games have a sufficient level of realism to require human-level intelligence to play well. However, the path to using commercial game engines for agent work is often fraught with limitations or steep learning curves. Many commercial game engines only allow limited control over in-game entities and game state perception, often hidden behind proprietary scripting languages. With the release of the full Quake 3 Arena (Q3A) source code by Id Software some of those limitations have been removed. Game modifiers can now use native C code in the game to alter every aspect, but proprietary art assets, limited documentation, and a large code base still provide an obstacle to many. Our Q3 Mod Base is designed to provide a set of extensions to Q3A to overcome some of those limitations. We have developed a realism-based modification called the Urban Combat Testbed that is being used to study transfer learning concepts and agents and human players using the Q3 Mod Base.

The Q3 Mode Base

The Q3 Mod Base consists of a collection of modification friendly code segments with documentation, art asset blueprints, external agent controls and perception interfaces, game interaction logging, and support tools as shown in Figure 1. The modification friendly code segments are installed into the Q3A-1.32b code base and contain conditional compilation flags that aid developers in identifying the code segments associated with specific modifications throughout the code base and allowing them to select which features are included in the modification. Well-commented code promotes ease in modifying the features in code, and the conditional compilation flags and documentation make it easy to make changes in all of the correct places. Types of features incorporated include rotating doors, ladders, player classes, various weapon mods, locational damage, and other frequently incorporated facets.

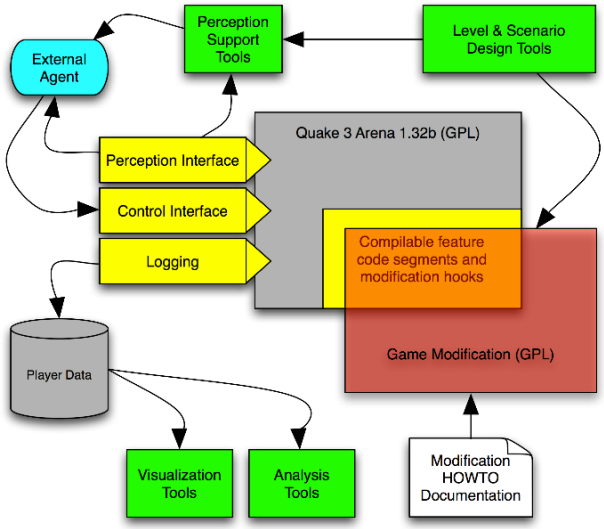

Figure 1: Q3 Mode Base components and tools.

Despite the source code being offered under the GNU Public License (GPL), the art assets of Q3A are still under copyright and may not be freely distributed. However, if all of the art assets (graphics, models, sounds, etc.) are replaced Q3A game mods can be distributed freely with the source code. The major obstacle to replacing the art assets in a complex game such as Q3A is the knowledge of what needs to be replaced, how the assets are used, what formats are required, and how to replace them. We have generated a series of art asset blueprints to aid in the process by guiding the modifier through those obstacles. We also seek to develop online communities offering creative commons and public domain based art assets for incorporation into Q3 Mod Base

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games through our *gamesairesearch.uta.edu* website.

For artificial intelligence work centered on creating in-game agents it is important to have a set of percepts and effectors that can be used to perceive the state of the game agent and act upon the environment to change the state. This interface must be robust and fast to allow agents to interact in real-time with the game. We have developed a shared-memory based interface that allows for receiving egocentric dynamic game information through over 30 percepts and control through over 40 effectors for the Urban Combat Testbed. We have also designed a reflexive shared memory system that uses UDP-based communications to mirror shared memory on remote machines allowing an interacting agent to run on a different platform.

In order to facilitate experimentation and analysis of players and agents playing games built using the Q3 Mod Base, a logging system can be initiated to record all aspects of the game. XML-based log files can be stored locally, or by using our web-based experiment control system they can be uploaded to a server. We have developed a PHP-based system for Internet distribution of game scenarios through a registration process that assigns, based upon a defined policy, scenarios for play by an experiment participant using a code key. Complete scenarios are uploaded to a server and progress is tracked for the participant. This system allows for soliciting experimental participants from a larger pool of candidates via the Internet without being location or time dependent.

Many support tools provide additional value to the system. These tools include perception support such as SSPS (Static Spatial Perception Service), which provides perceptual information about the static geometry of an environment both from a high-level topological view and a detailed immediate area low-level view to support agent reasoning. The Mission Profiler provides human and machine-readable mission information and advice to players helping them to meet in-game goals and desired outcomes. Interface test tools are provided as references for testing and developing agents around the percept and effector shared-memory interfaces. Data visualization tools for player traces, path rendering, playback, and visual analysis as well as player performance and evaluation tools are included. We incorporate tools that focus on interactive feature points of immersive first-person shooter (FPS) environments to create player graphs that can be clustered and evaluated objectively for player relationships (Youngblood & Holder 2003; Youngblood 2002). The standard level design tool Radiant (www.qeradiant.org) has been extended to incorporate modification elements through definition files, and is also being modified to assist in the breakdown of levels into quantitative, convex regions annotated with symbolic information for AI work.

Urban Combat Testbed

Using the Q3 Mod Base, we have begun development on a visually and tactically realistic urban warfare simulator called the Urban Combat Testbed (UCT). UCT focuses on a military-type player who is placed in urban scenarios. We have defined simplified games within these worlds that portray realistic urban warfare scenarios and simple tasks. Figure 2 shows one such environment (UCT_Apartments) and the heads up display (HUD).

Figure 2: Urban area map (left) and in-game player view HUD (right).

UCT is currently in use in over six major US universities to develop research agents in the exploration of transfer learning which can bootstrap agent knowledge from a source domain to a target domain reducing the amount of learning necessary by an agent and improving solution convergence time. Human player and agent work is being performed using UCT. UCT is also a part of TIELT (nrlsat.ittid.com).

At AIIDE 2006, we will demonstrate the Urban Combat Testbed built upon the Q3 Mod Base. We will collect and analyze human player data on site, demonstrate agents interacting and learning, demonstrate our tools, and release a public downloadable version of our systems. Online link: http://gameairesearch.uta.edu/AIIDE2006Demo

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