Agent-Driven Entities Incorporated into "Capture the Flag"

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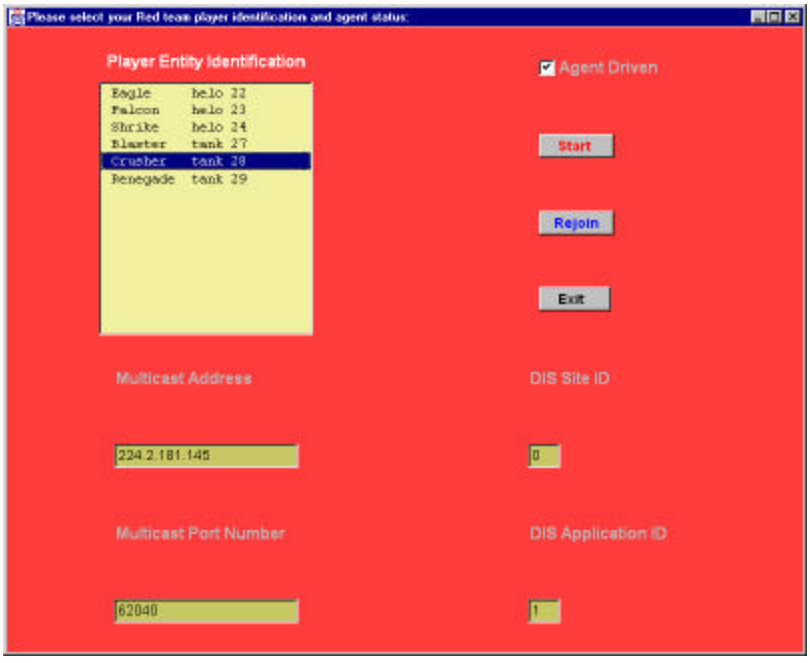
Summary. As part of their thesis work, LT Mike Dickson and LCDR Kim Roddy developed and incorporated six new java classes to provide autonomous, agent-driven elements into the existing networked DIS-JAVA-VRML application "Capture the Flag." These classes provide the ability to select "agent driven" offensive or defensive behaviors, for any entity available on the red or blue start panel. The names of the classes are:

AgentHeloActionInterpreter.java
AgentHeloControlPanel.java
AgentTankActionInterpreter.java
AgentTankControlPanel.java
BlueStartPanel.java
RedStartPanel.java

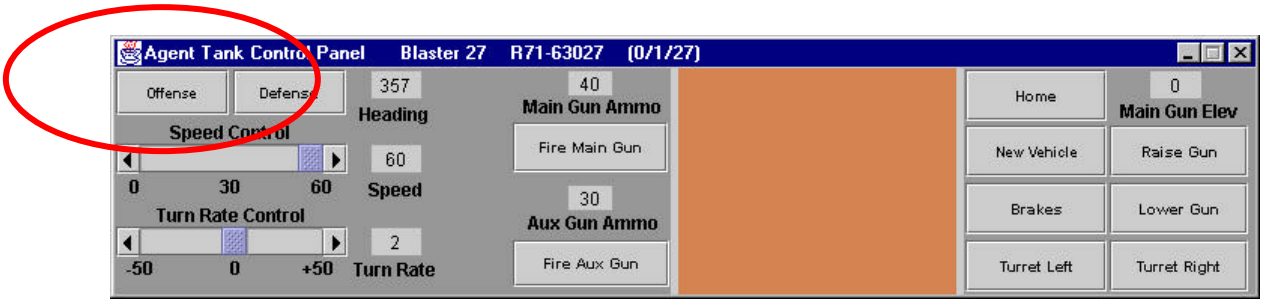
The following paragraphs briefly describe the classes and the tactics employed by the agents if selected.

Red and Blue Start Panels



The only changes to these two files was to modify the panel to include an "Agent Driven" selection block, and to launch the appropriate agent control panel if it is selected. Any entity normally available to a user can be agent driven simply by selecting this feature and starting as usual.

Tank Agent



The AgentTankControlPanel.java uses the same basic control panel as a manually controlled tank, but the "Forward" and "Reverse" buttons have been replaced with "Offense" and "Defense" buttons. The default tank agent is offensive. The heading, speed, and turn rate indicating blocks, as well as the sliders are updated by the agent as it maneuvers through the battle field. Main and Aux Gun Ammo values do not change and never run out. All other controls are able to be manipulated, but the user will be fighting the agent. For instance, if the agent is at a certain speed and the user manually inserts a speed change, it will reflect the change in both the control panel and the behavior of the agent *while the control is being held by the user*. The tank agent will try to insert correction speed changes, causing a slight cycling effect. As soon as the user releases the speed control, the agent's commands will take full effect.

Engaging Enemy Units

All tank agents develop a target list based on a fixed sensor range of 1750 m (approximately the same range that a user would be able to visually detect another entity). Once an entity is detected, a determination is made as to friend or foe. If the newly detected entity is an enemy unit, it is added to the target list. The tank will always attempt to engage the closest-proximity enemy unit in its target list. The engagement behavior only controls the aiming and shooting of the main gun. Direction of motion is controlled by the role of offense or defense, as selected by the user.

Offensive Tank Agent

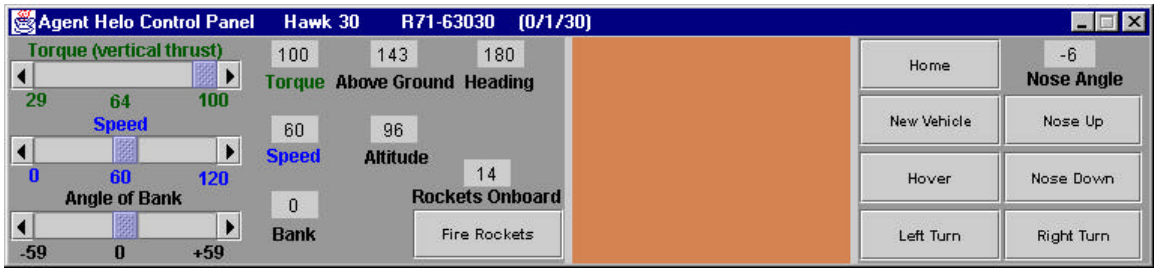
By default, all tanks are offense unless defense is selected. An offensive tank will always attempt to capture the enemy flag, wherever it is located, engaging the closest enemy unit within sensor range. It does this by driving maximum speed (60 kts) to close the distance to the flag until it has captured it. Its turning radius is set based on 40% of the desired heading change.

Defensive Tank Agent

A defensive tank will always drive at maximum speed around its own flag, engaging the closest enemy unit within sensor range. If an enemy unit successfully captures the flag, the defensive tank will follow the flag, and the enemy unit carrying it, all while continuing to engage the closest enemy unit with gunfire. Even if the defensive tank follows the enemy unit all the way back to the enemy base, then destroys the opponent just prior to the flag being won and point given, the defensive tank will not shift to capture the enemy flag. Instead, it will continue to drive in a circle around its own flag, attempting to protect it from any approaching opponents. Note that this behavior is consistent

with the rules of the game: the original Capture the Flag code does not allow a unit to carry its own flag back to its own base, so the agent cannot do this either.

Helicopter Agent



The helicopter agent is, by default, an offensive agent but is not capable of shooting. Its only goal is to capture the enemy flag and return to base. When the helicopter gets within 1000m of the enemy flag, it begins a decent algorithm and flies to within 100m of the flag to capture it. See "Observed Bugs" below for an explanation on why the helicopter can capture the flag without actually landing.

Future Work

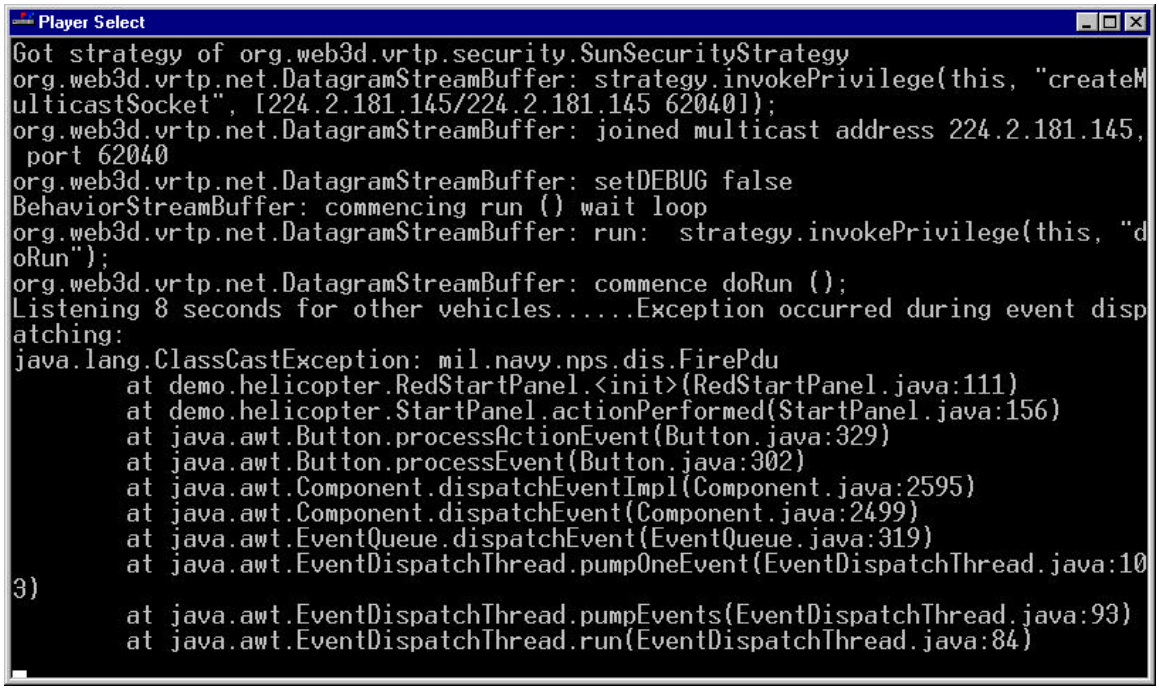
1. Incorporate "isVisible" method that checks to make sure entities are visible prior to adding them to the targetList. This will probably be simply utilizing the existing line-of-sight algorithm. Terrain collision detection needs to be integrated.
2. Add small red and blue dots or squares to represent the entities when in a "big picture" view such as a monitor overhead. These small icons would sit on the terrain (for tanks) or be at the appropriate altitude (for helicopters) and be directly under the center of the data tags when activated.
3. Give the agent helicopter the ability to shoot.
4. Give the agent helicopter offensive and defensive capabilities, similar to the tank.
5. Give the agents the ability to alter their motion to avoid or close enemy units, vice always just driving to the enemy or friendly flag.
6. Give the agents the ability to dynamically shift their goal priorities to take advantage of the perceived environment.
7. Give the agents the ability to communicate with each other and work as a team.
8. Etc., etc., etc. …

Observed Bugs

1. In the original code, the z-value, or height, is not checked when determining if the flag has been captured. Because of this, and the accurate flying of the agent helicopter, the agent helicopter can fly directly over the enemy flag, *at any altitude*, and still capture the flag. We set a landing algorithm to force the agent helicopter to attempt to reach the ground as its vectoring in from 1000m, but often it only makes it down to about 80m.

2. For the same reasons as 1. above, if the helicopter is shot while bringing the flag back to base, the flag remains up in the air. Any other opposing unit to that flag, including tanks, can recapture the flag by simply driving or flying within 100m of the X-Y location. This means a tank can capture the flag by driving immediately underneath the floating flag, regardless of its altitude (the altitude the helicopter was at that was carrying it before it got shot).

3. An exception is thrown when starting up a new game or requesting a new vehicle if a "FirePdu" is received while listening for other players. For demo purposes, this can be avoided by starting all entities roughly at the same time.



4. The agents have definitively proven that you can shoot through the mountains if you know where to aim. Since the agents currently only have sensor range incorporated, and not line-of-sight, they can successfully target and destroy an enemy that is behind the mountain. From the "high above airfield" view, you can actually see the shots penetrate through the terrain.