Auto-Targetting in a Remote Sentry Turret

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The initial idea for our project was to create an auto-targetting system for a Nerf Vulcan, an automatic, belt-fed gun that shoots small foam darts. The weight of the Vulcan, however, makes it somewhat unfeasible to do this without spending a large amount of effort engineering a system to handle the gun's bulk, so the plan is to do a proof of concept using a laser pointer and small servo motors. The project is divided up into four parts: the GUI, video processing to produce a pixel that is the 'center of the target', a calculation module to determine the necessary gun position to fire at that target, and the actual movement module.

A camera mounted below the gun will remain stationary to provide all of the footage necessary for targetting. The plan is to have a GUI that would allow users to either set the turret into an automatic shooting mode, where it would shoot at targets when it sensed movement, or to override this and use the gun manually, directing its movement and picking targets using the video feed. The GUI will take the input from the video camera in, display it, and then output an enable switch, which tells the calculation module whether to take input from video processing or from the GUI, a pixel target, which will only be used if the enable switch is appropriately set, and a fire command. One of the ZBTs will be devoted exclusively to this module in order to properly display the video input. The module will need to keep track of the mouse's movement relative to a predetermined origin and will transmit its current location when a click is sensed.

The second module will deal with the actual video processing when the turret is in autofire mode. It will store four frames of video and compare them, finding changes between frames and determining whether or not those changes are large enough to constitute a threat that should be shot. It will have to decide which shifting sets of pixels constitute a single object, pick a single object to target if there are multiple moving objects, and determine the center of motion on that target. This module will also take the video data from the camera, using the other ZBT and downsampled images to store multiple frames, and will output a pixel to aim the gun at and as well as a fire command.

The third module will take the pixel target and determine the necessary rotation of the gun to point it at that target. It will take in two pixel-locations, two firing commands, a single switch that tells it which to listen to, the distance to the target from the movement module, and a 'ready' signal from the movement module. When a pixel target is given, the module will send an output to the movement module, specifying the azimuth of the target. Once the movement module has indicated the distance to the target, this module will calculate the elevation necessary to hit the target and provide that calculation to the movement module. It will then pass through the firing command when the movement module reports it has reached the provided position. The initial plan is to manually input a distance to be used in the elevation calculation. If we have time, we will mount a rangefinder under the laserpointer that feeds data to the calculation module after the movement module has reached the correct azimuth.

The last module will turn the actual gun using the azimuth and elevation provided by the calculation module and fire the weapon once it is in position. It first takes an azimuth from the calculation module and moves the gun to the proper position. It will then take the distance data, pass it back to the calculation module and wait to receive the elevation data in response. When positioned correctly, it will send back a 'ready' signal, at which point it will receive a fire command and trigger the gun. There will be some margin of error allowed so that the gun will not constantly be trying to finish tracking a slightly-moving pixel without ever evaluating 'ready' and being able to fire.