Automatic Target Acquisition and Alignment

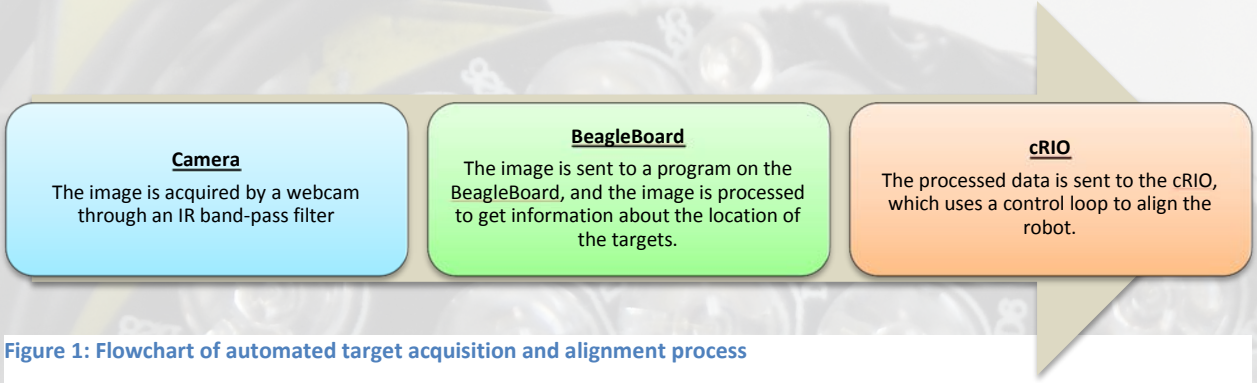

Figure 1: Flowchart of automated target acquisition and alignment process

Camera Setup

The inherent challenge in any computer vision system is ensuring that the results are accurate and consistent between readings, and that those results are processed quickly enough that the system can respond in time. As the Beagleboard has a limited processing power which is shared between two different cameras, we decided to do the large portion of the image filtering process in hardware, rather than software.

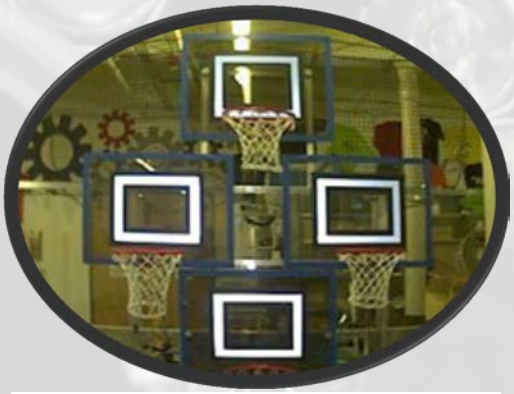

Figure 2: The four camera tracking targets without the filter

Through testing, we determined that the reflective tape was particularly visible under infrared light. As a result, we used a high-power 850 nm LED right to provide lighting for the scene, and placed an 850 nm bandpass filter in front of the camera lens to only allow light of that wavelength through. We also removed the infrared cutoff filter from inside the camera, so that the light would be clearly visible. As can be seen on the right, this was extremely effective in masking out all but the squares of reflective tape.

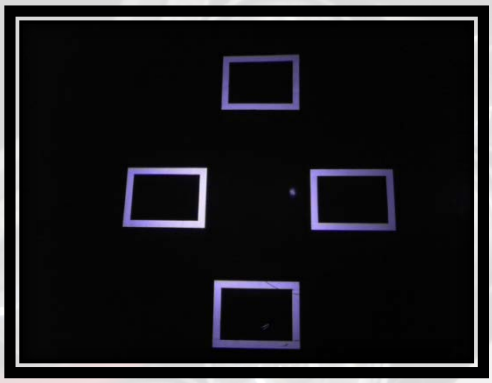

Figure 3: The four camera tracking targets with the filter

Image Processing

The processing of the image itself is done by first thresholding the image on the intensity of each pixel, and then using a Canny edge-detection algorithm to find all of the shapes within the image.

The program then loops through the shapes and eliminates those which are clearly not viable, such as those which are too small or have more than four vertices. The shapes are then sorted by their height on the screen, such that the tracked shape is the highest one visible, so that we align with the higher value targets.

Finally, the program determines the target's offset from the center of the robot, and sends that data (along with which target is being tracked) to the cRIO, or, if no targets are visible, it sends an error value.