In our Final Project, We make a robot that tracks a target using blob detection. It uses a stereo camera setup to find the distance from the robot to the target. We then calculate the angle at which the projectile needs to be fired to hit the target. Once the proper configuration has been achieved, the robot fires a pneumatic powered BB through an electric solenoid valve.

The robot we use is the same modified OWI robot arm used in previous demos. Two joints are used: the waist joint and the wrist joint. Closed loop control of the waist joint is achieved through the cameras. Closed loop control of the wrist joint is achieved through the potentiometer acting as a rotary encoder attached to the robot. The robot is coated in white paper to improve image processing.

We design and 3D print a stereo camera holder which mounts easily and without fasteners to the robot. The Cameras are 4 inches from center to center.

For the projectile launcher, 120 psi lab air supply is regulated down to 15 psi with a standard regulator. It then passes through an electric solenoid valve, which is controlled by the Arduino with a standard relay. A bypass button was added to allow the projectile launched manually.

The Barrel of the launcher is a simple tube just large enough to accommodate the projectiles

The projectiles are manually loaded one at a time through the muzzle.

The target is a black square mounted on a white poster board. For the image processing, the centroid of the blob is found on both cameras. The robot waist joint moves to aim at the target.

The Stereo Camera setup was calibrated with a checkerboard pattern of known dimensions.

Distances are then calculated with a triangulation function to be used for the trajectory.

A Trajectory calculation is developed using standard kinematic equations, and then implemented in Matlab. The wrist joint is moved to the angle necessary for the projectile to hit its target

The velocity of the projectiles was calculated by taking a time of flight measurement over a known distance. The average velocity of the BBs was just over 9 m/s. This is necessary in the trajectory calculation

Here, you can see the system working.

The setup was tried at different distances. At close ranges, the setup was consistent in hitting the target.

At long distances, the image processing struggled to detect the correct target. This could be improved to result in a more robust target tracker.

Another problem we encountered was Oscillations around the target. This can be improved by implementing a controller as opposed to an on/off voltage signal

Thank you for watching! No BBs were harmed in the making of this video.