Lab 3

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Part 1 & 2

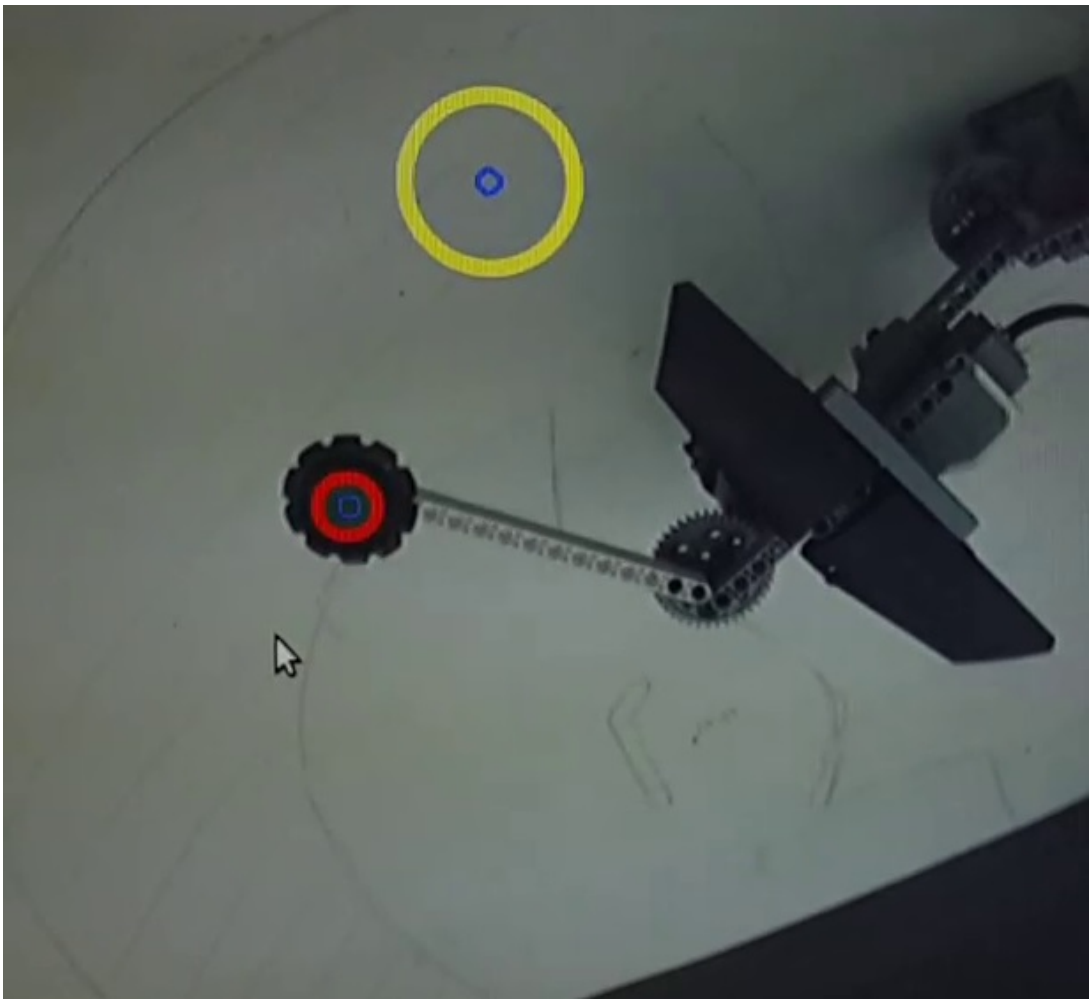

Figure 1. 2DOF Arm with video tracker.

Our integration makes use of LeJOS's Java RMI feature, which allows methods on the EV3 to be called remotely by a PC. This allowed us to perform CPU - intensive calculations on the PC instead of the EV3, significantly speeding up the program.

Part 3

See: VisualServoRobot.java

The solution of this task worked really good, the target can be changed from one position to another at any time and the arm still can reach the target new position. The camera position and orientation can be changed at any time too with no major problems (as long as the target is in a position inside the arm workspace). The only problem we experienced was the

shoulder or the elbow could reach a configuration where it would physically be unable to move, but the other joint's movement would still cause error to decrease. In some cases, the algorithm was able to recover from these scenarios. Because the robot has several singular configurations, we limited its movements to be very small (lines 113 through 119 throttle movements if they are over a certain threshold), however that limited movements allowed us to do the Broyden update in every single movement.

Part 4

See: VSRPart4.java

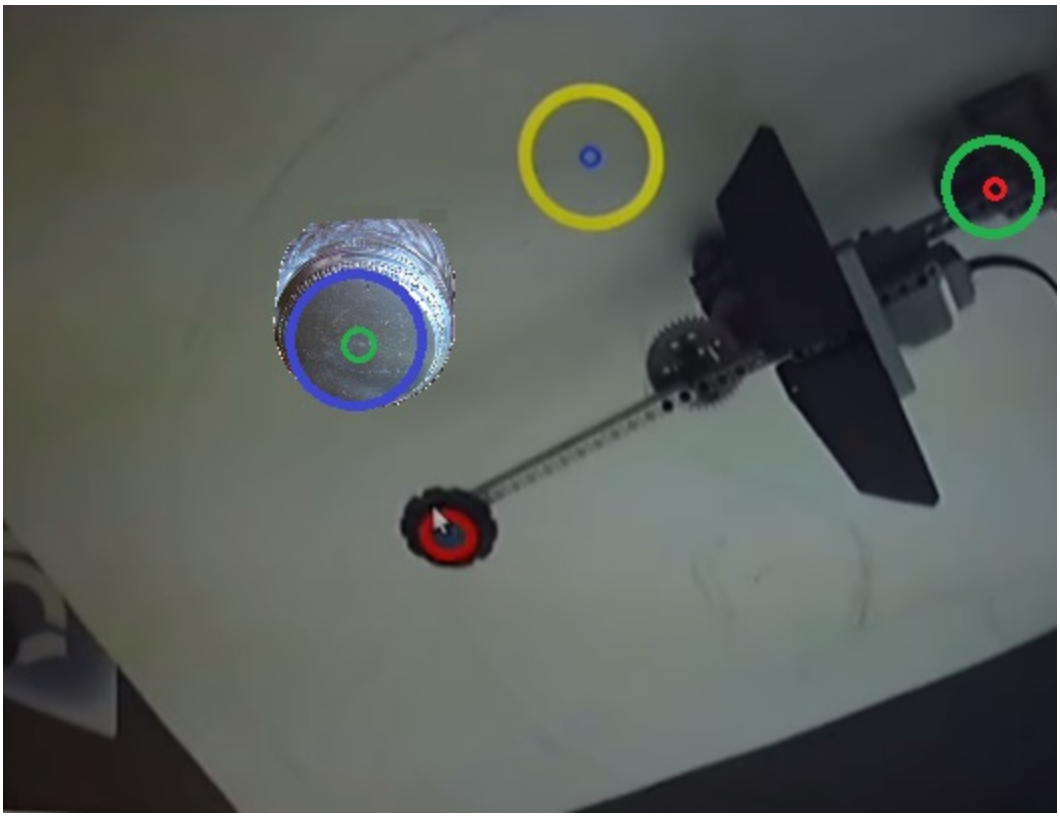

Figure 2. Manipulation task

We chose object avoidance as our manipulation task. The principle is quite simple: the robot must navigate around the obstacle, but not in a way where the arm sweeps the obstacle. We made use of the existing tracker code and modified it to also track some user defined positions for the base of the arm, its end effector, and an obstacle. Then the simplest path to plot will be 2 points - first to the midpoint between the base and the obstacle, and then from there to its destination. Because we had significantly limited the size of the movements the robot could make, our implementation was effective in most cases where the obstacle was not too close to the base.

The tracker selections are controlled using the keyboard. End effector tracking remains the same, but the right mouse button is toggled between selecting the target, base and obstacle with the keys Z, X, and C respectively.