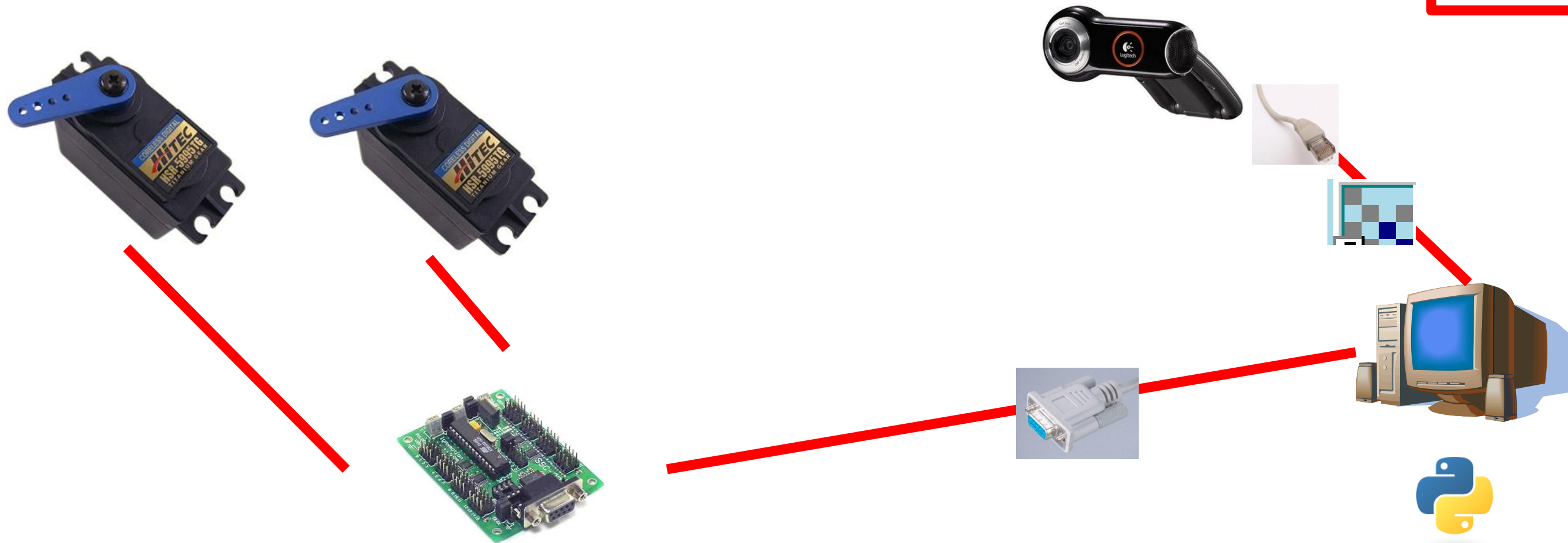


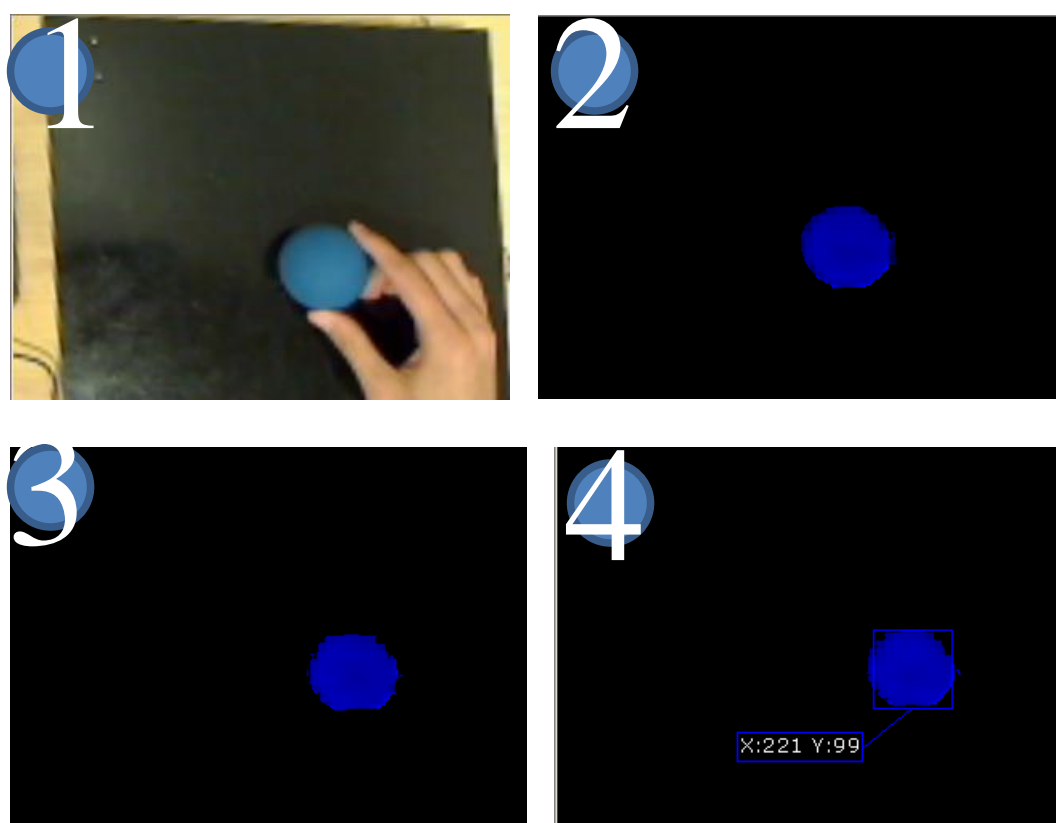
Ball and Plate System: Implementation

Name: Jay Gorasia
EXPO ID: 312
Class of 2011



Sensors

1. Affine
2. Filter for colors
3. Threshold
4. Find centroid



Resolution: 160x120
33 frames per second

Motors

- Hitec HSR-5995TG
- Moves at maximum speed of 0.12 sec/ 60degrees
- Which translates to a maximum frequency of 14rad/ s of the plate
- Torque 417 oz-in



Motor Controller

- Lynxmotion SSC-32
- Controlled over serial
- Outputs PWM to control servomotors



Discretization

- Use design by emulation
 - Do everything in s domain, then digitize
- Substitute s to z using:

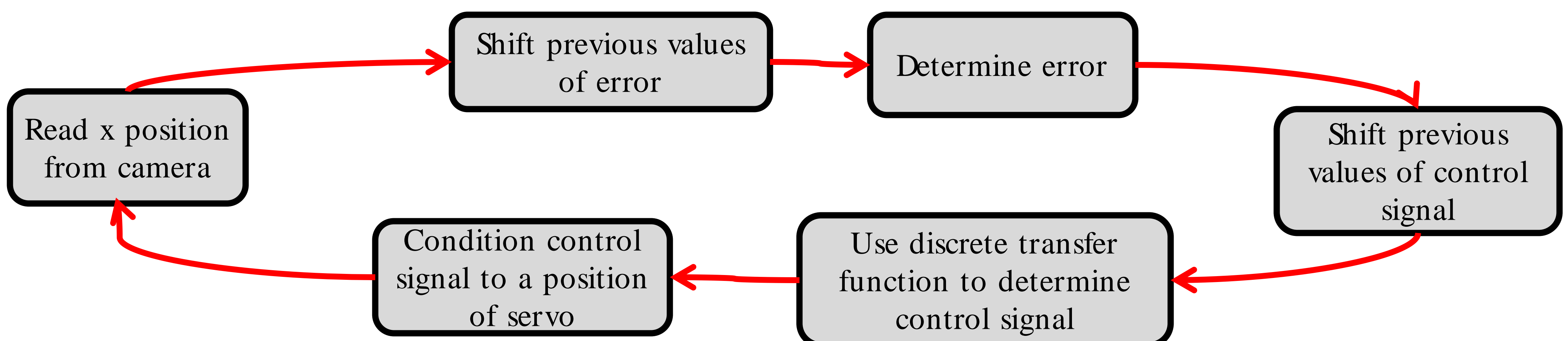
$$s = \frac{2}{T} \left(\frac{z-1}{z+1} \right)$$
- Solve for largest power of the output
- Then perform the inverse z transform

Discrete Compensator

$$C(s) = \frac{K_L(\alpha\tau s + 1)}{\tau s + 1} R(s)$$

$$c(t) = r(t)K_L \frac{(2\alpha\tau + T)}{2\tau + T} + r(t-T)K_L \frac{(-2\alpha\tau + T)}{2\tau + T} - c(t-T) \frac{(-2\tau + T)}{2\tau + T}$$

Algorithm



Going forward

- Use vvvv or FPGA for vision tracking
- More angular displacement of plant
- Use RTOS or embedded chip for control system
- Better plant design