Control Award Submission Form

****Please turn in this sheet during your judge interview along with your engineering portfolio****

Team # 8696	**Team Name: Trobotix**

Autonomous objectives:
- Read the team prop's position and place the purple pixel on the correct spike mark.
- Navigate to score a pixel on the corresponding backdrop.
- Park backstage.

Sensors used:

Logitech Webcam	Streams images to our custom pipeline that detects prop placement.
Odometry Pods x3	For accurate robot localization during autonomous.
Slide Encoder (built-in)	Prevents the linear slide from exceeding it's maximum length or unspooling.

Key algorithms:
- Gaussian blur combined with HSV color masks and contour detection to locate objects in images.
- Three dead wheel localization algorithm that accounts for heading / turning drift using a process known as the "pose exponential".
- PID controllers, one per driving, strafing, and turning.

Driver controlled enhancements:
- Toggleable drive between field-centric and robot-centric.
- Improved controller sensitivity by squaring the raw value, attaining a linear rate-of-change.
- Toggleable reduced speed mode, for when finer drive movements are desired.
- Toggleable "turn everything on" mode, where the active intake and internal transfer system are turned on and angled to pick up pixels.

Driver interfaces:
- Driver configurable autonomous. Intuitive telemetry-based UI for configuring autonomous parameters. Drivers can, for example, change the HSV color values used in the autonomous image processing pipeline to account for lighting variations.
- Autonomous scripting. A custom scripting language for programming autonomous routes. More intuitive and has a simpler syntax compared to Java.

Example:

```
GoToShortOrLongRoute
ShortRoute
   GoToTotemSection
   SectionTotemCenterRed
      drive 800     -8.72     178.76
      intake up
      itsPower -1.0
      wait_seconds 0.5
      itsPower 0.0
      drive 543.91 -4.69     178.76
...
```

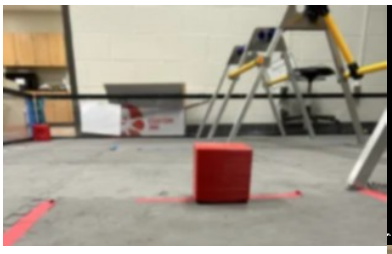
Engineering portfolio references:

Design § 3.7.b	Sensors
Programming § 4.1	TeleOp
Programming § 4.2	Autonomous

Additional information:

Image processing steps:

- Apply a gaussian blur to reduce noise.
- Convert the color space from RGB to HSV.
  - Difficult to filter colors in RGB.
  - HSV resistance to lighting changes.
- Mask image to filter for certain colors.
- Detect contours (e.g. edges) based on the mask.
- Find the largest object.
  - Calculate the “pixel totality” per contour, the number of colored pixels in an object divided by the total pixels in the image.
  - Ignore objects that do not meet the minimum totality.
- Assume the largest object is the prop. Locate spike mark.
  - If no prop is detected, assume it’s on the rightmost spike mark.



Software design:

- This year, we developed our own library, Mollusc, to improve organization.
- By categorizing common functionality into reusable modules, we can more effectively adapt our codebase to meet new functionality.
- An intimate understanding of the library also reduces confusion.

Autonomous program sample diagram: