

Nautical Autonomous System with Task Integration

(code name NASTI)

Students: Terry Max Christy, Jeremy Borgman

Advisors: Dr. Gary Dempsey, Nick Schmidt

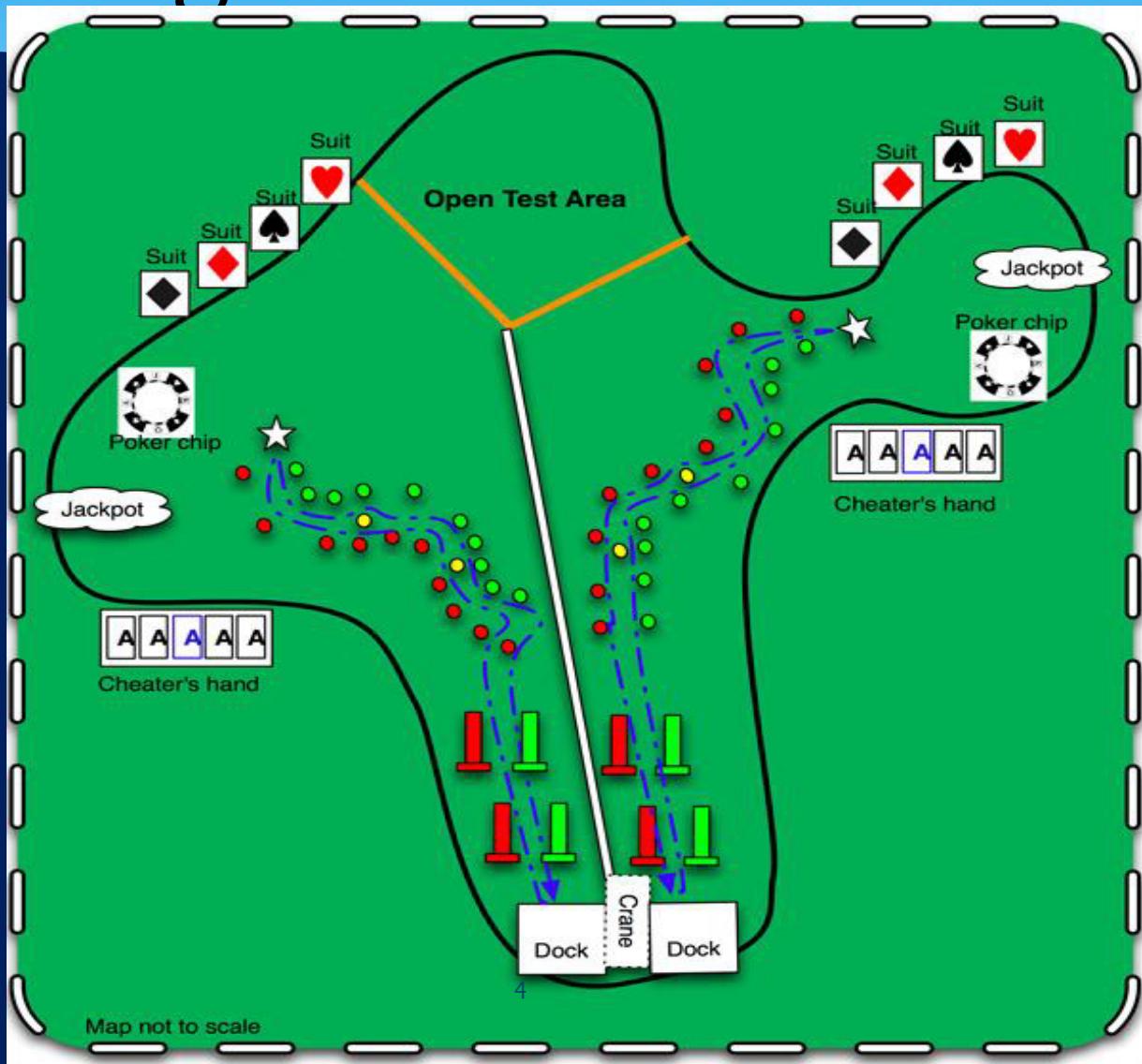
Outline

- * Original Goals
- * System Overview
- * Review of Completed Work
 - * Motor Interfacing Module
 - * Communication
 - * RC Control
 - * Embedded System
 - * Image Processing
 - * Path Planning
- * Results

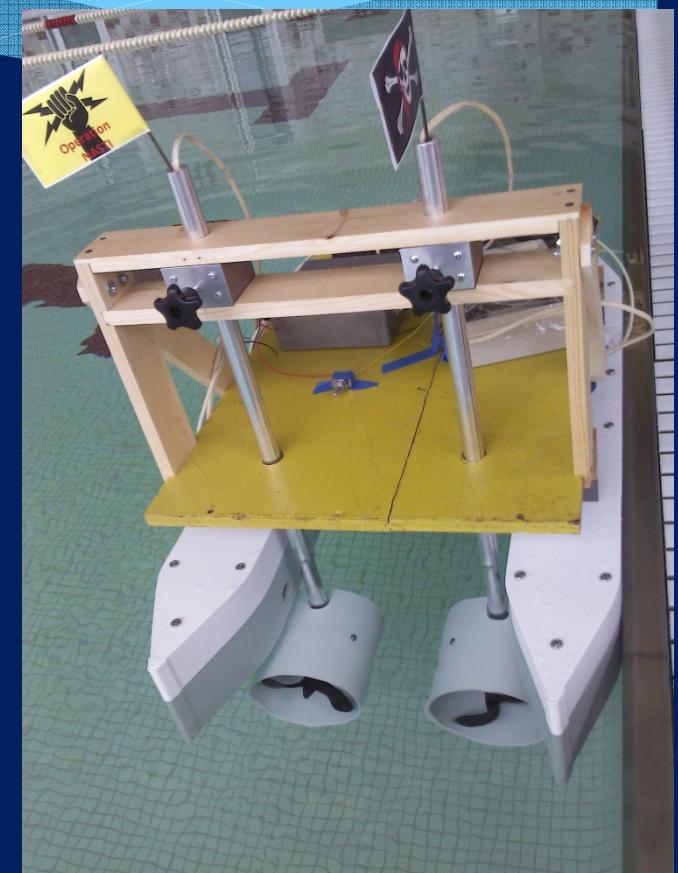
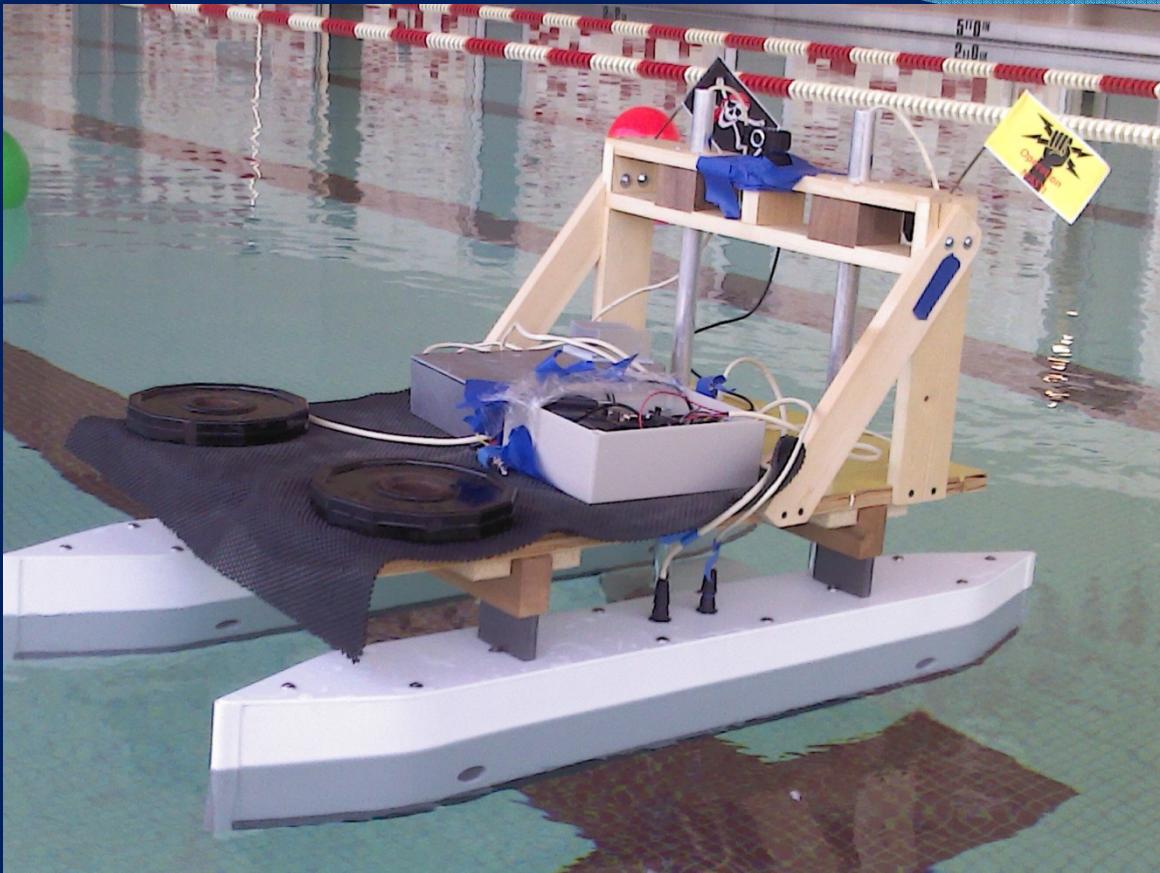
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Background Information



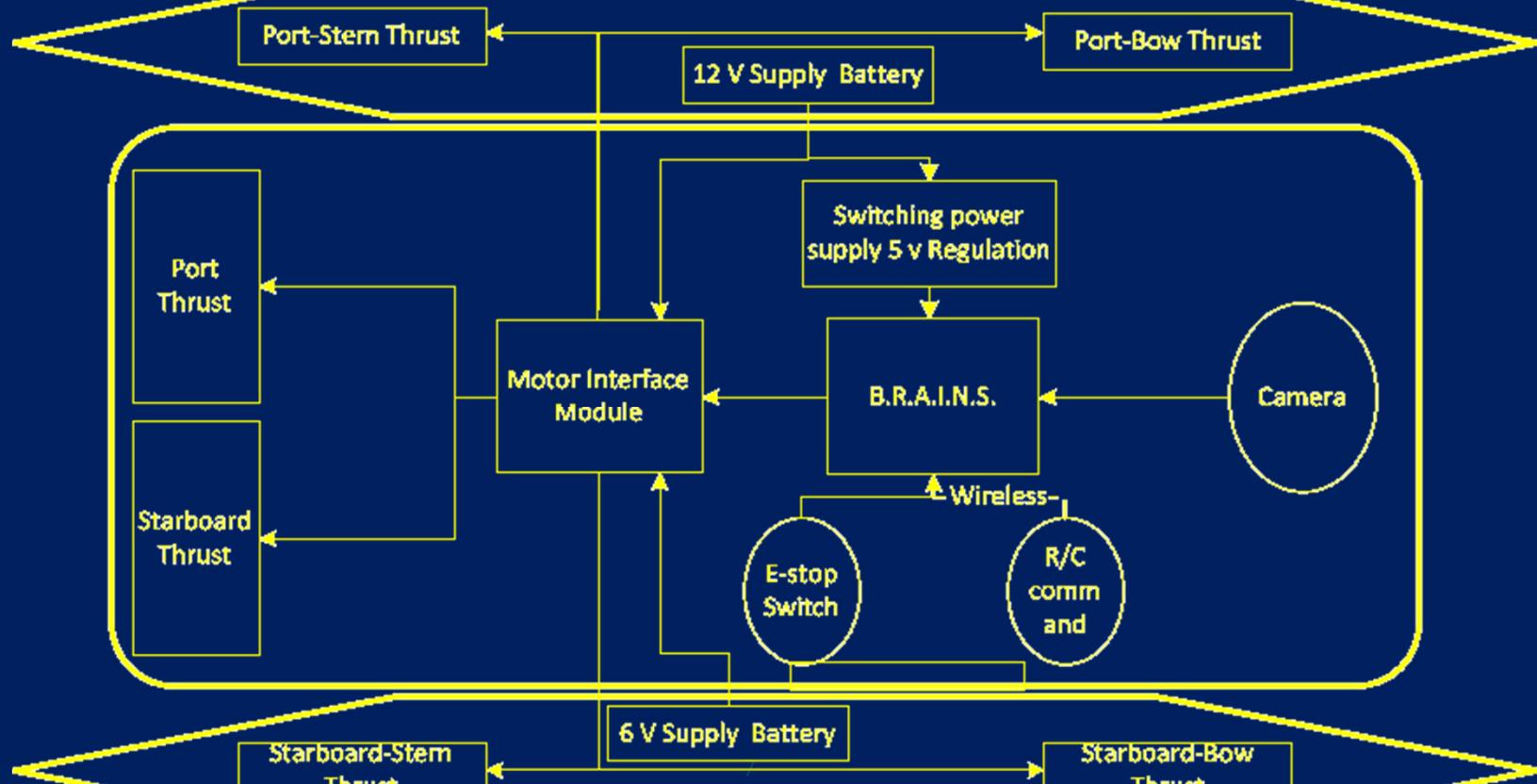
NASTI



Outline

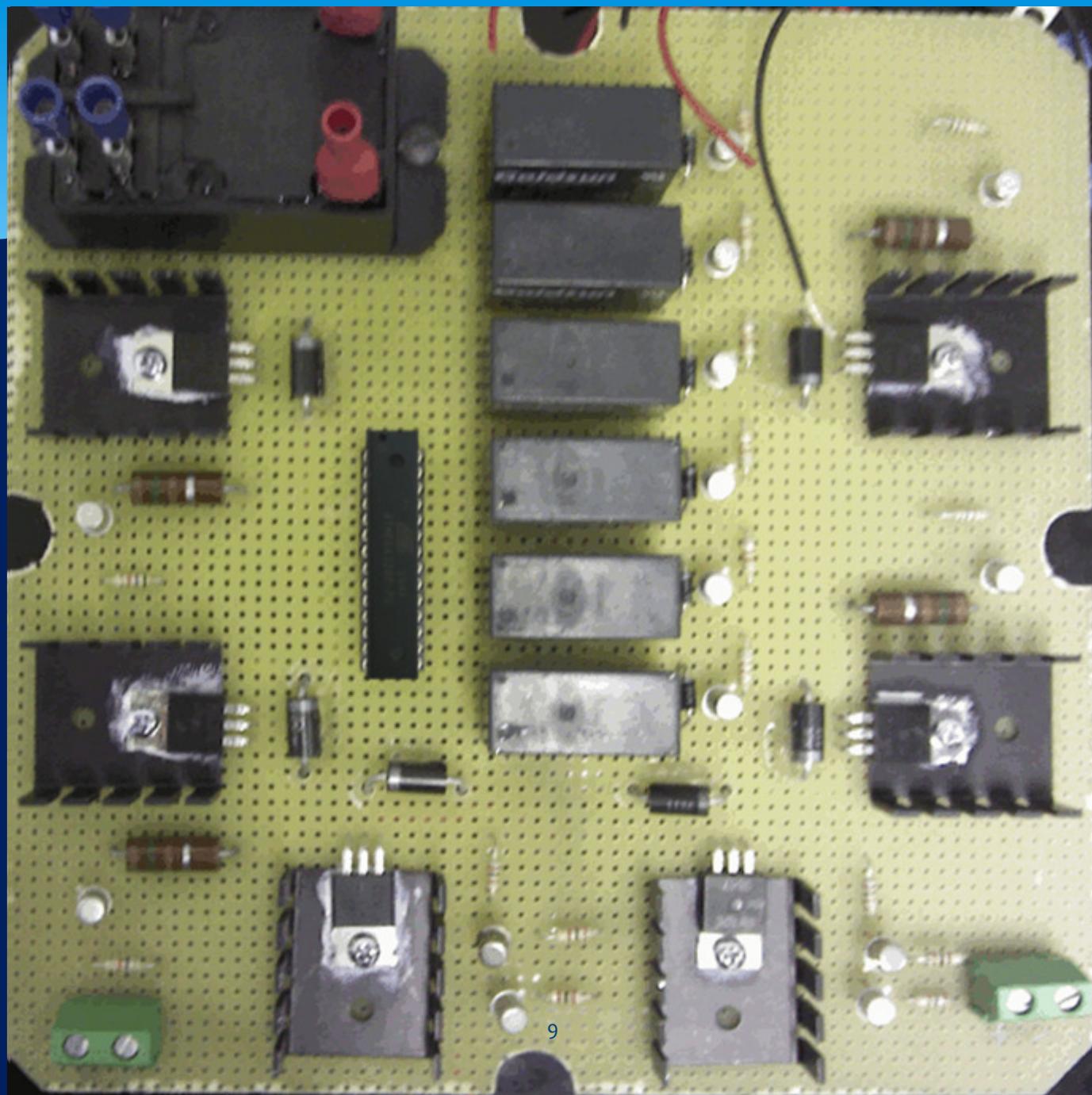
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System Overview



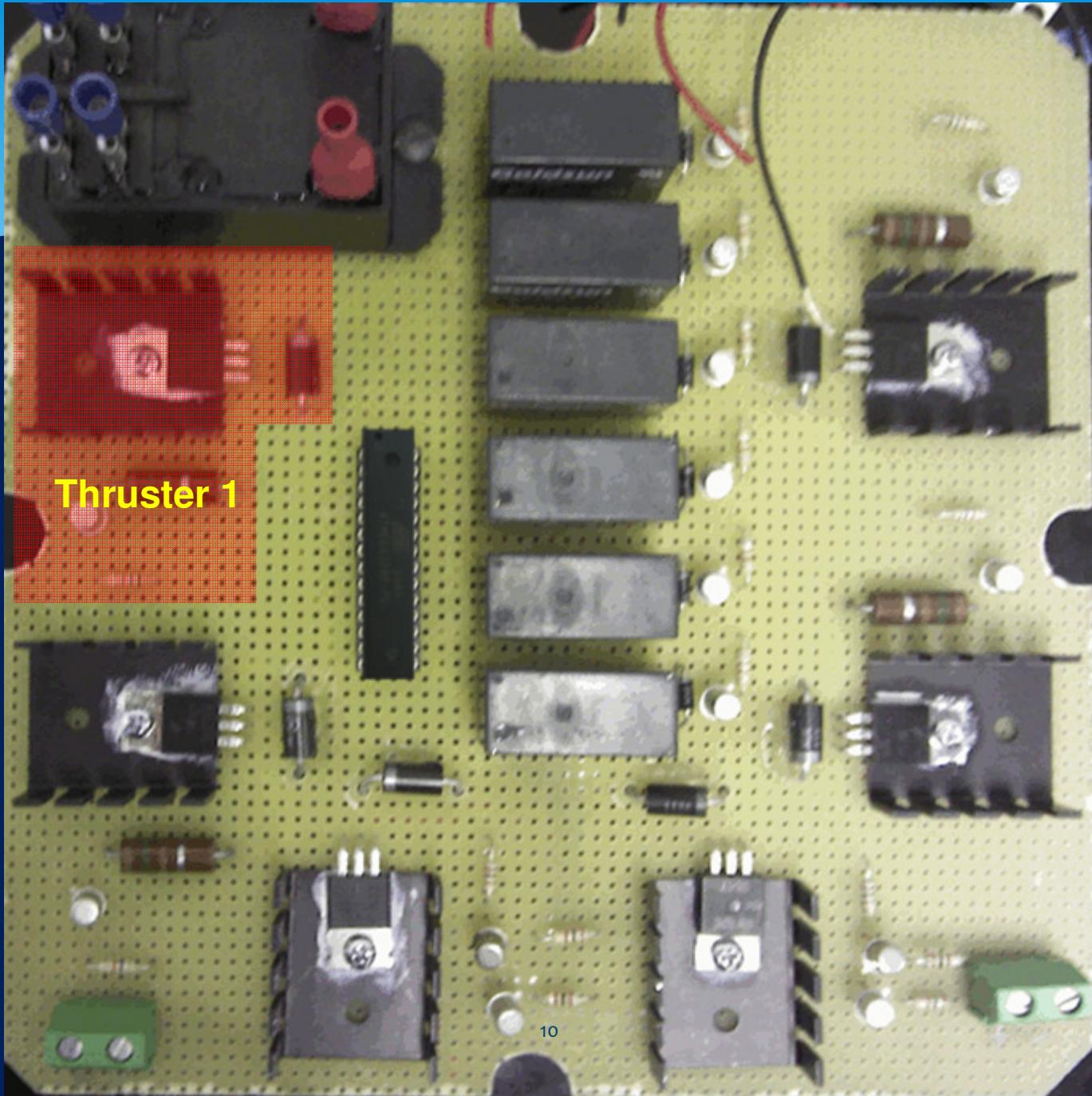
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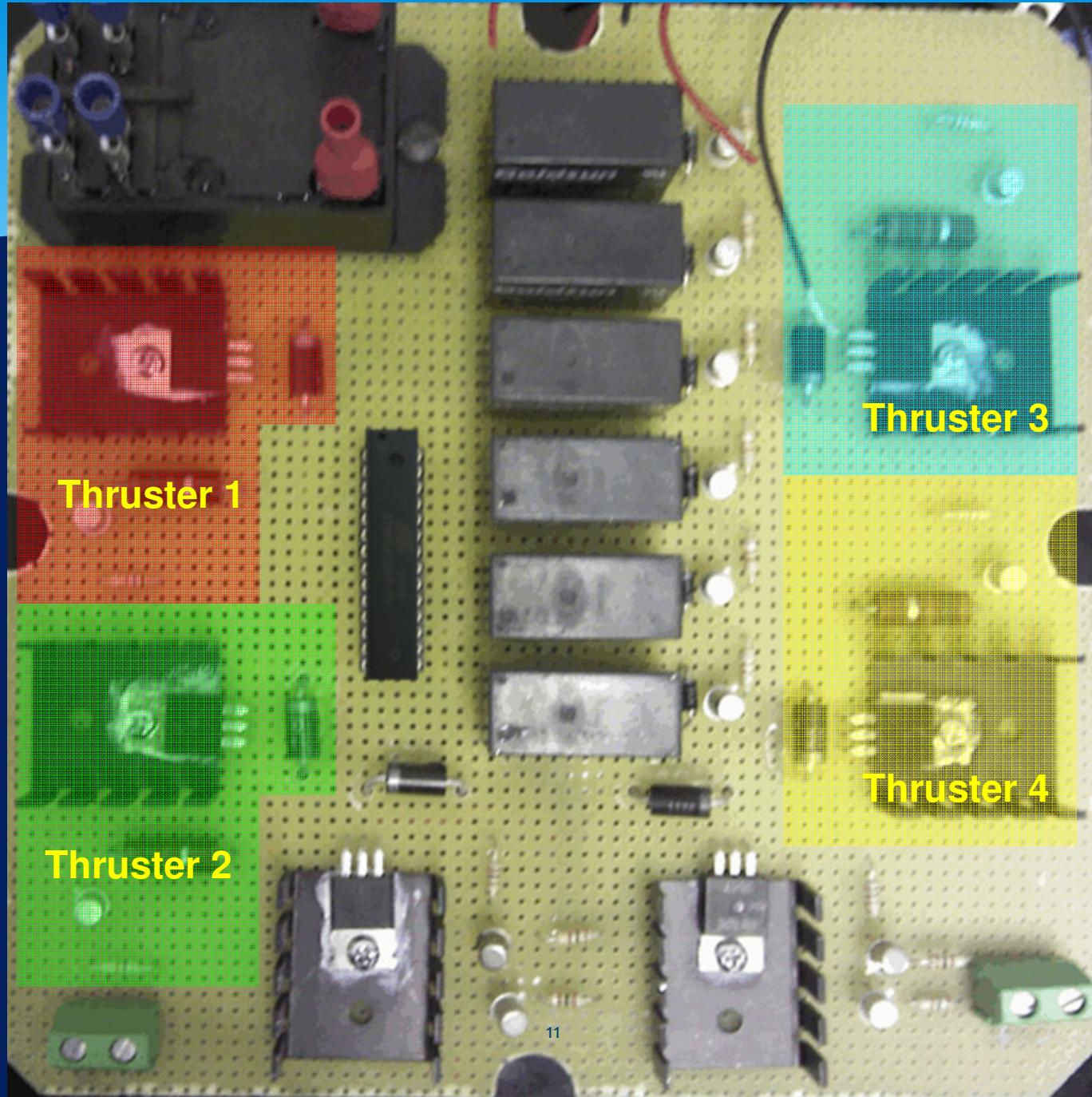


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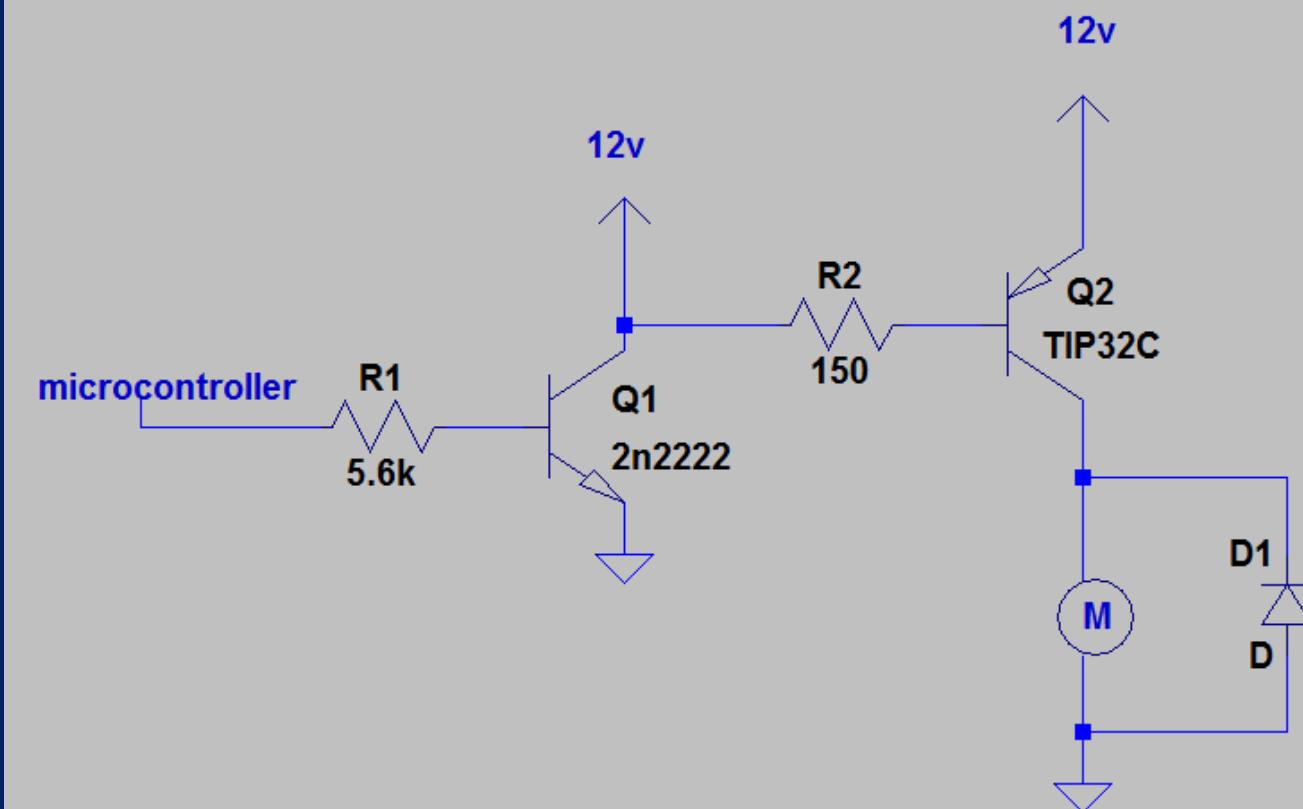
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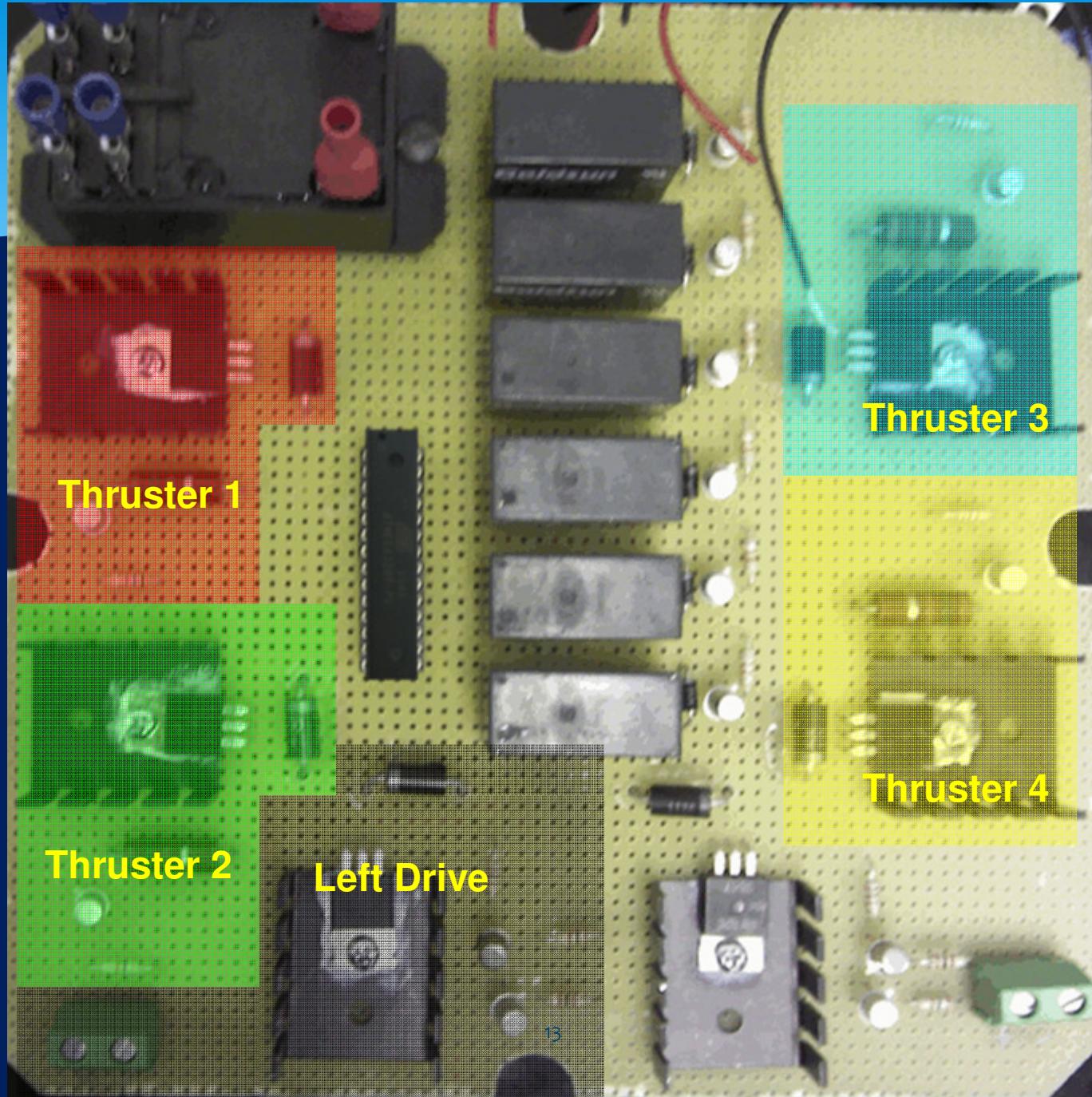


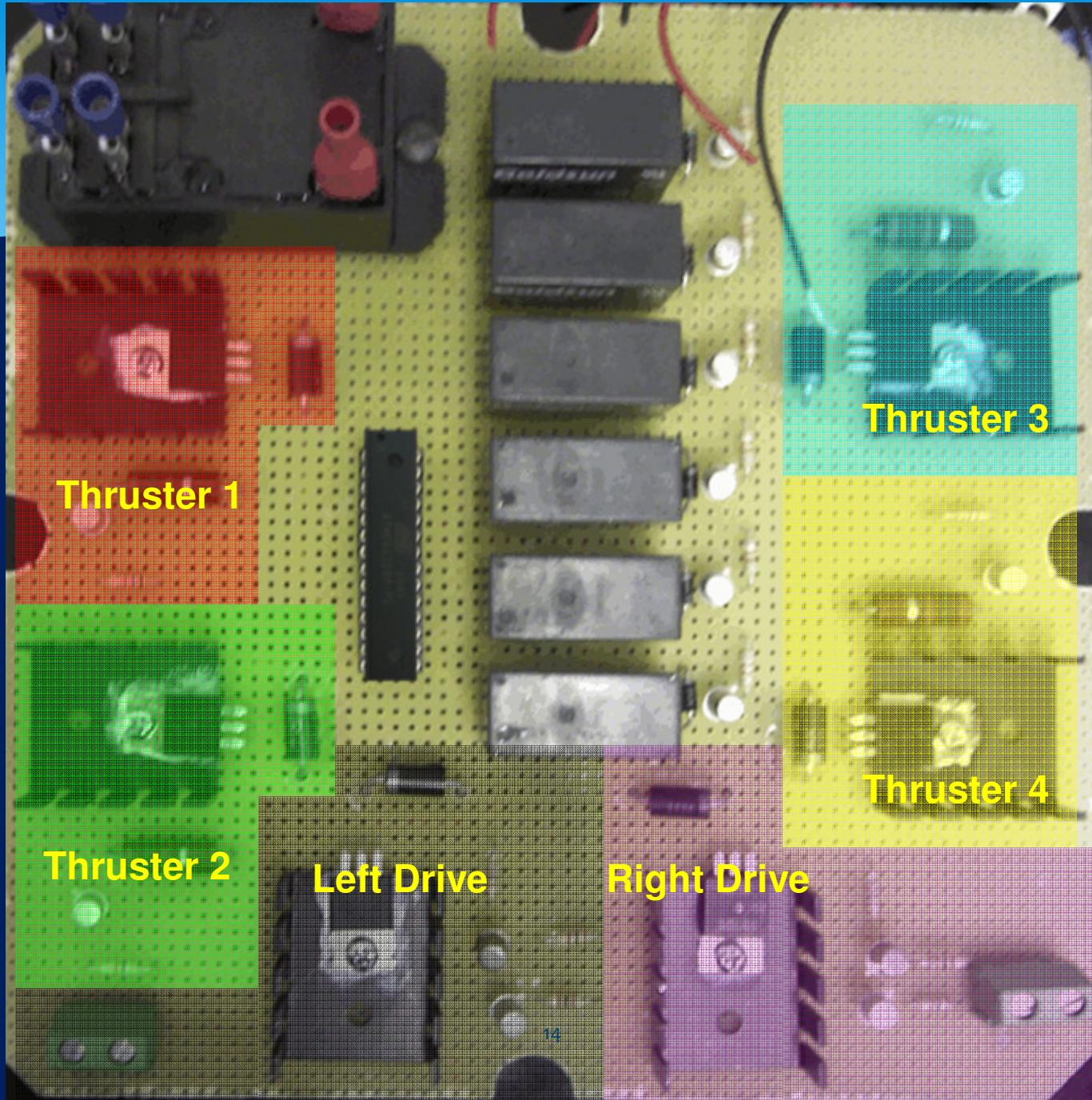
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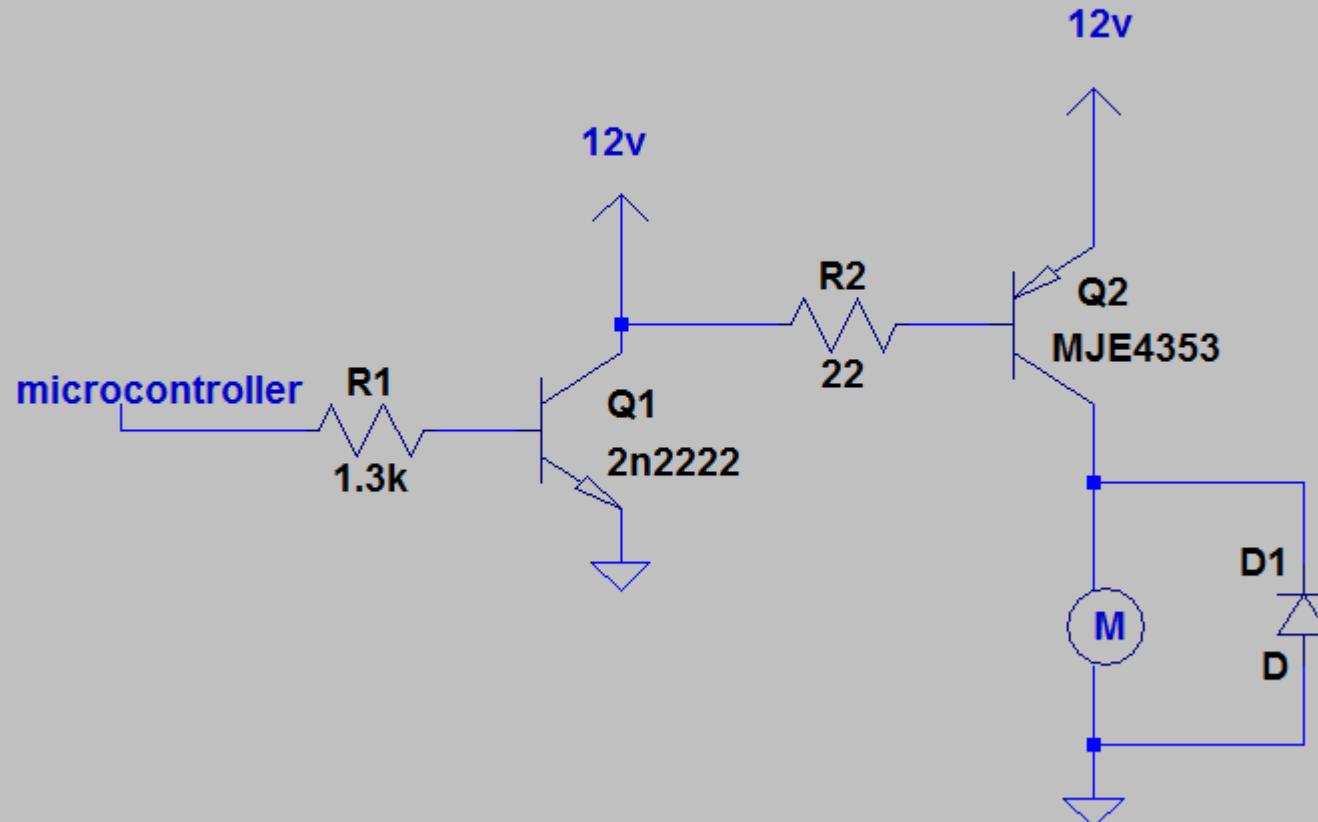
Thruster Circuitry

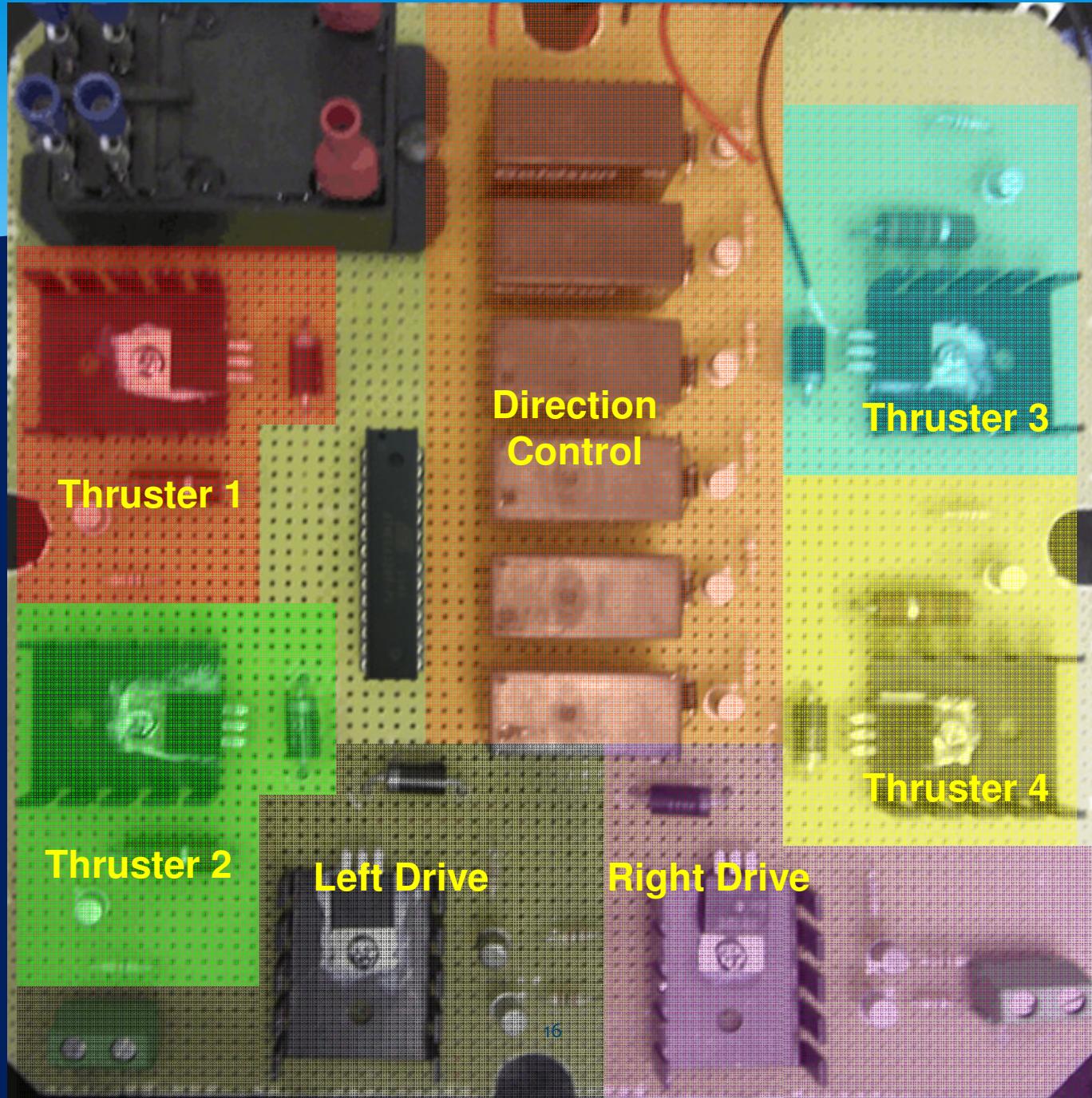




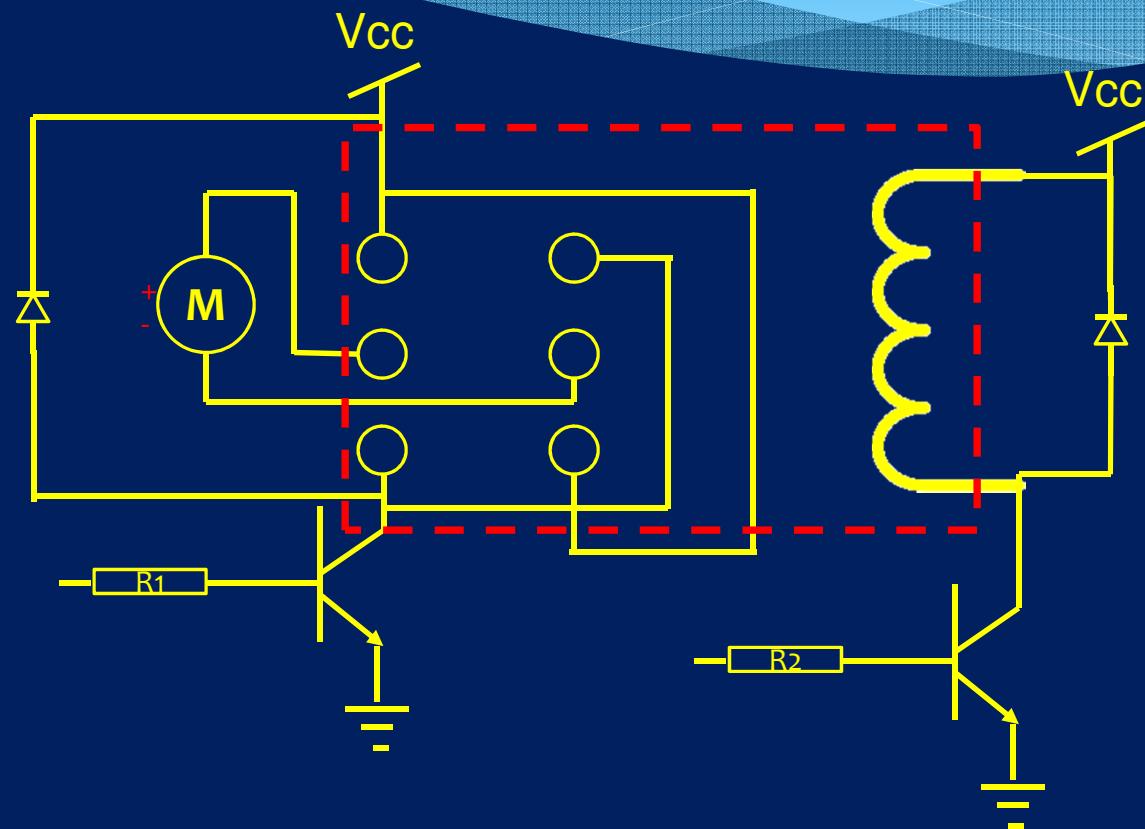


Main Drive Circuitry

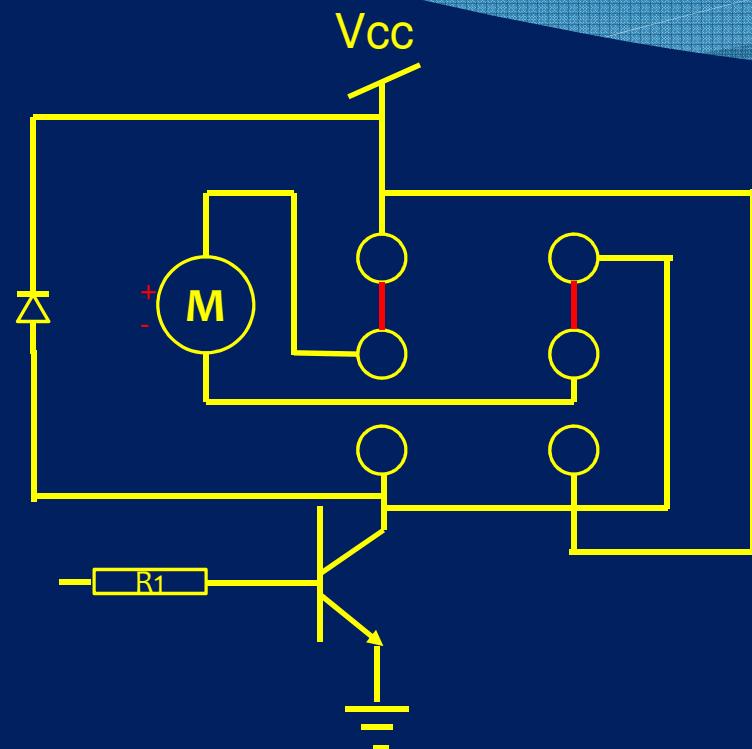




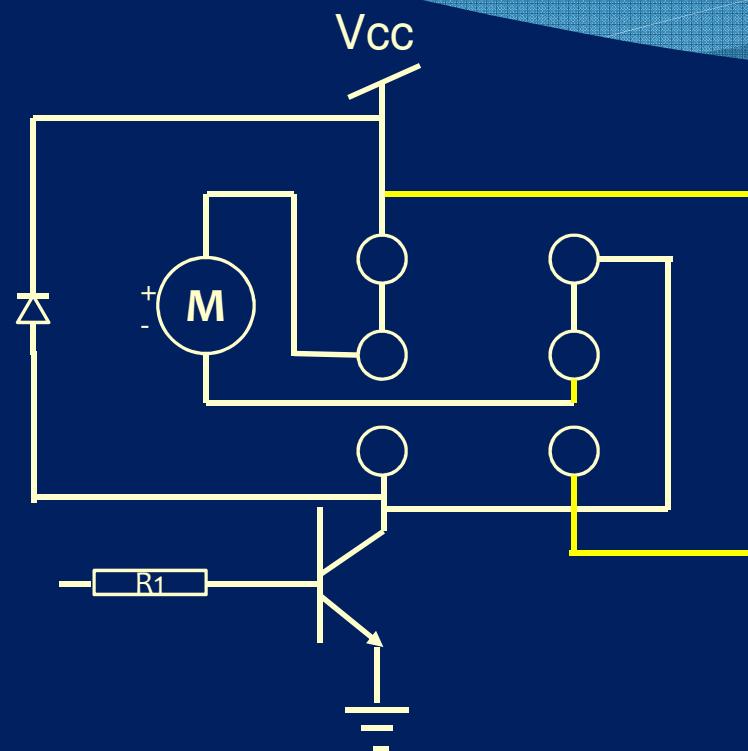
Bi-Directional Motor Control



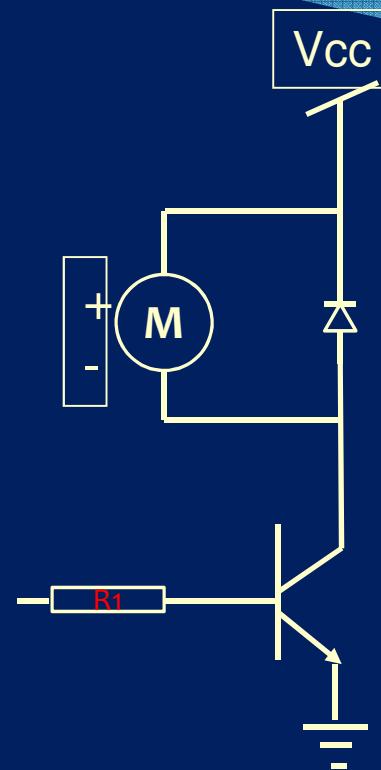
Bi-Directional Motor Control



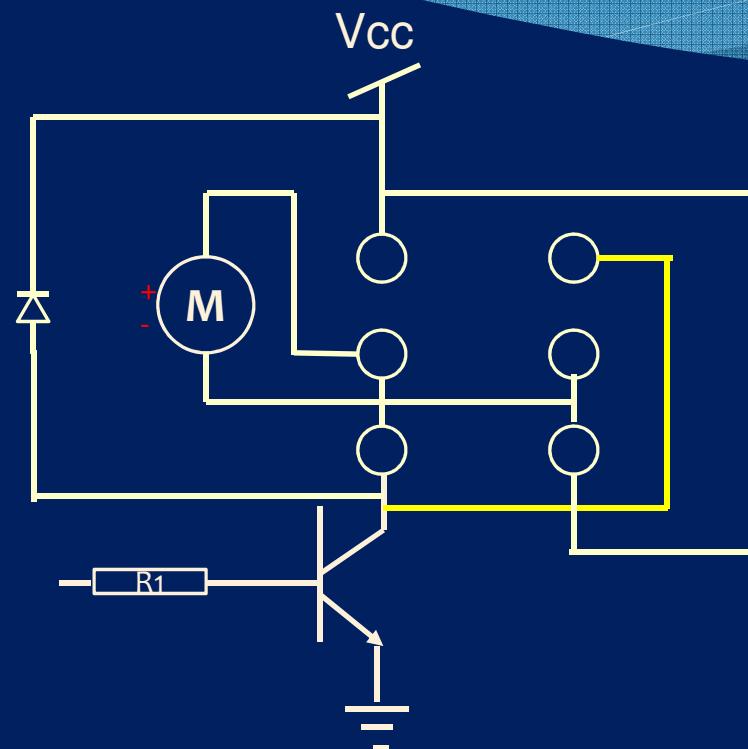
Bi-Directional Motor Control



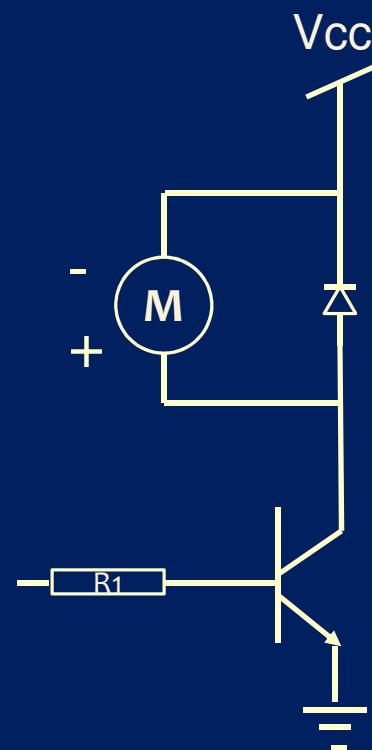
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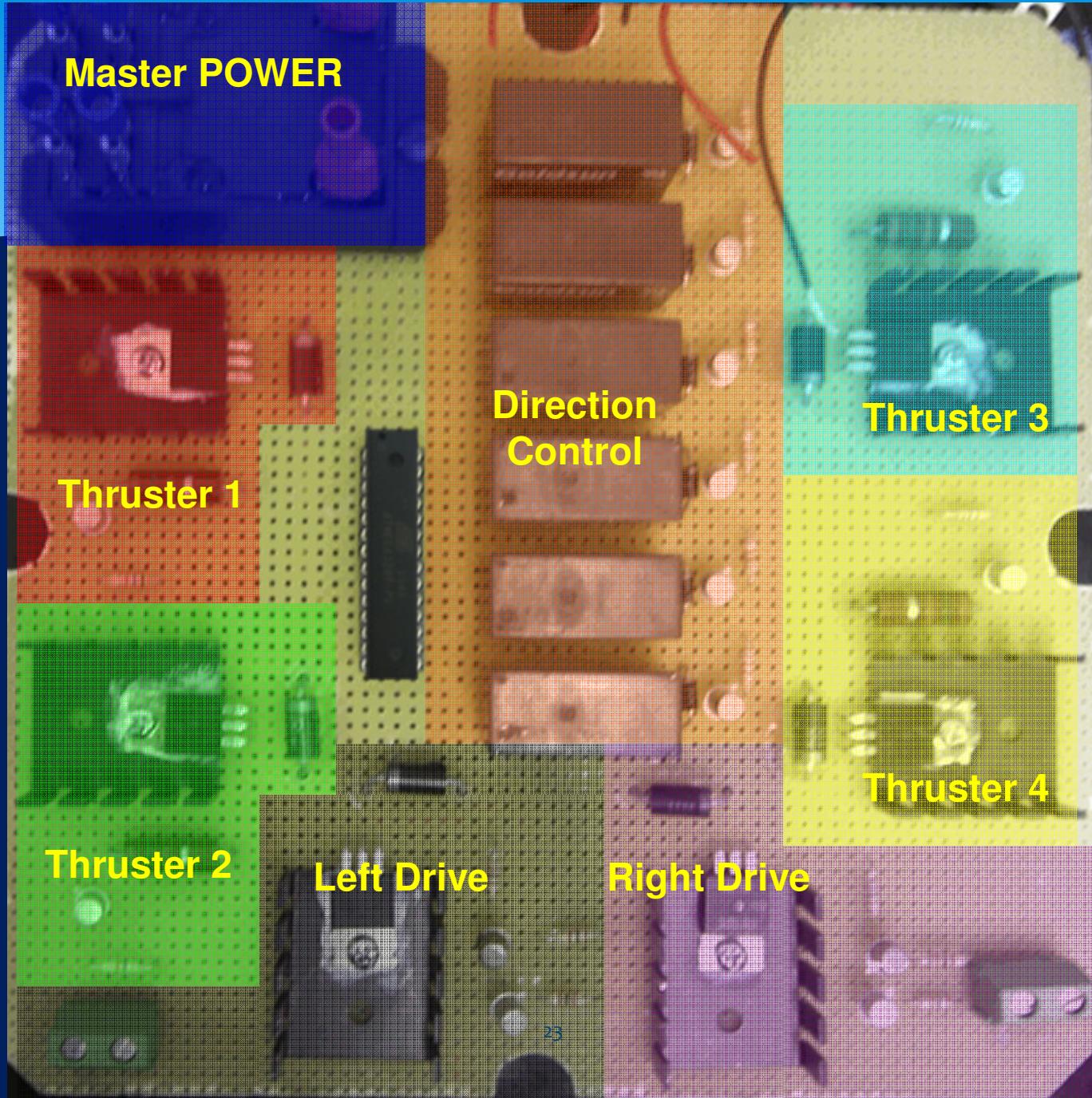


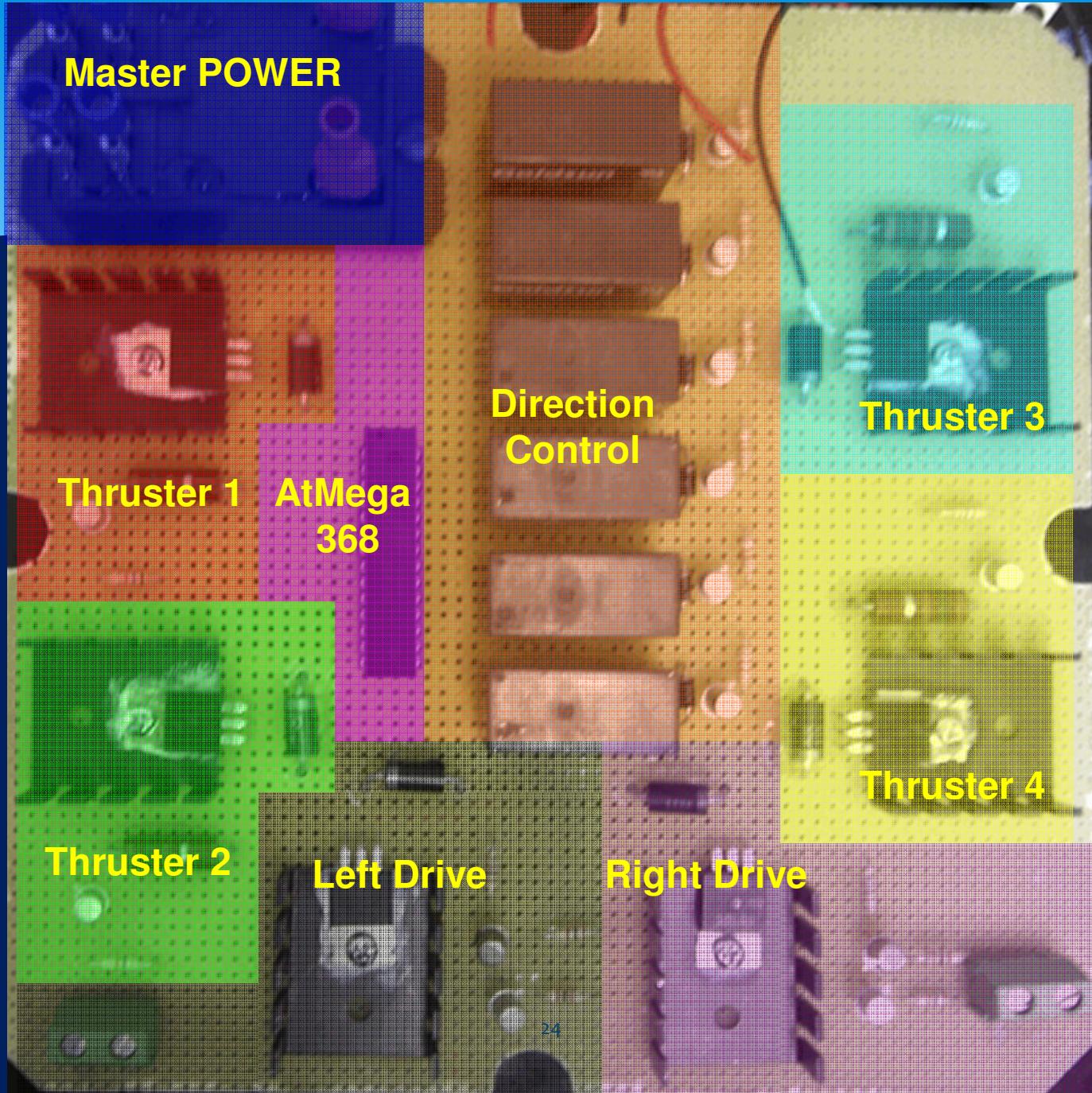
Bi-Directional Motor Control



Bi-Directional Motor Control





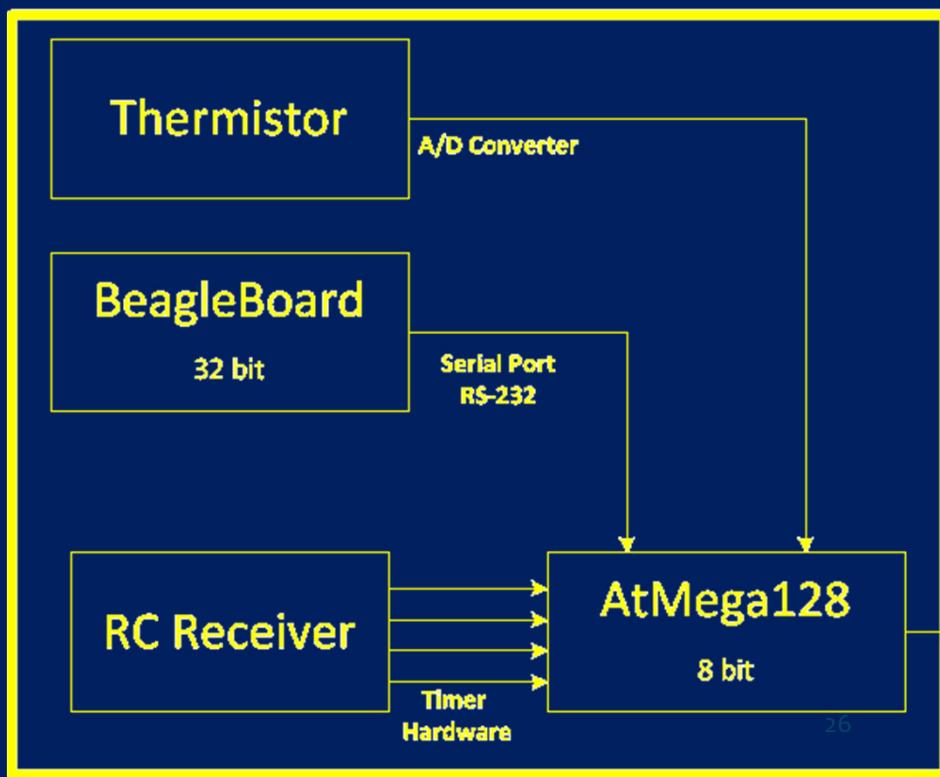


Outline

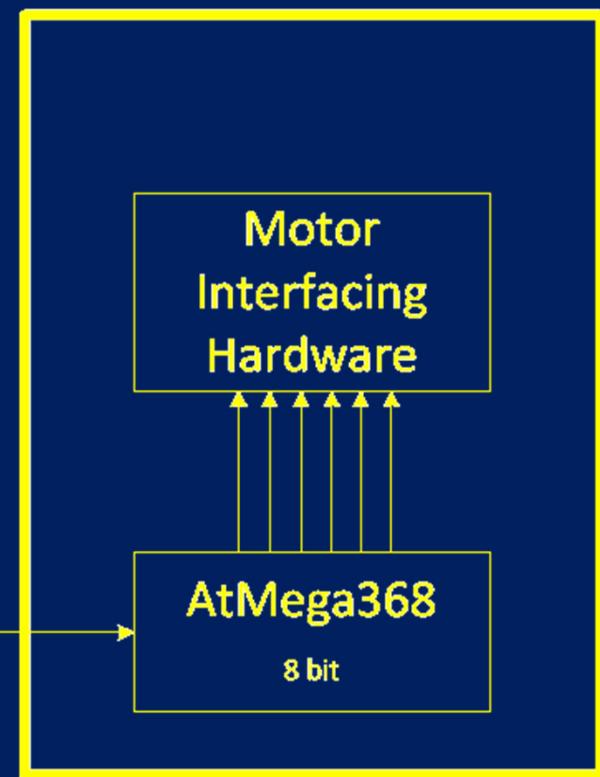
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Communication Overview

B.R.A.I.N.S Module



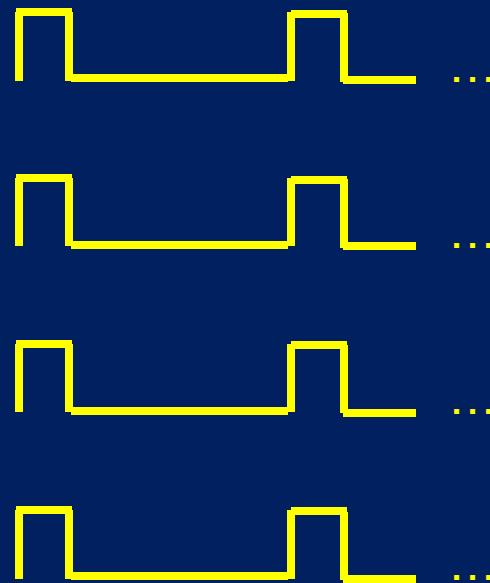
Motor Interfacing Module



Master AtMega 128

Remote Control Output

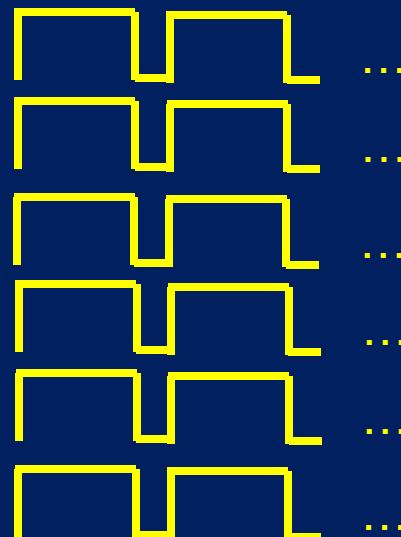
50Hz Servo Signal



Atmega128

PWM Output

... 0 – 99% 1KHz PWM



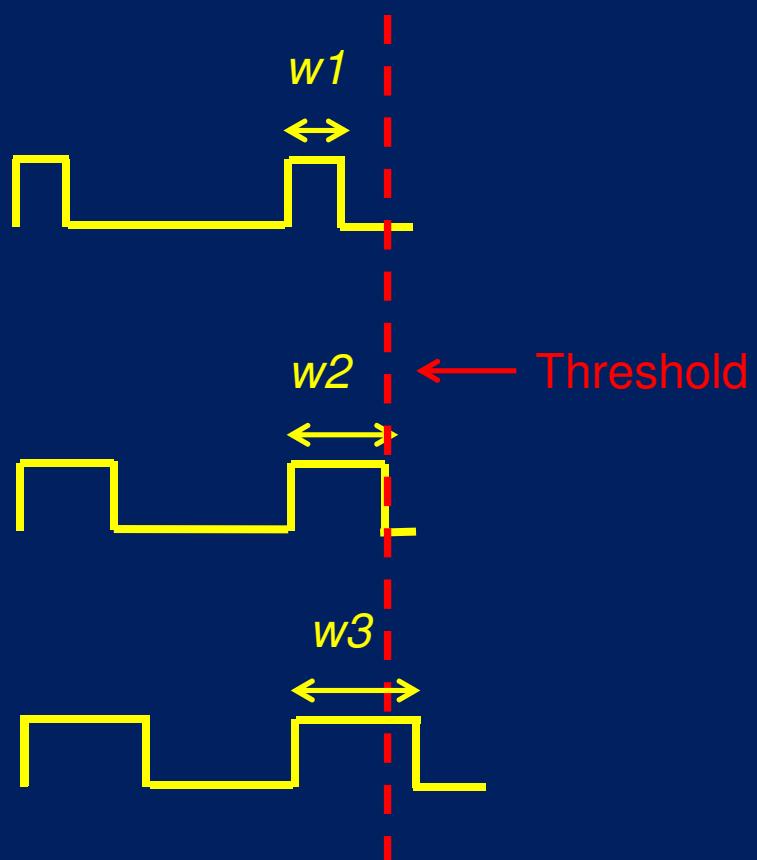
Direction Output

0 – 5v GPIO

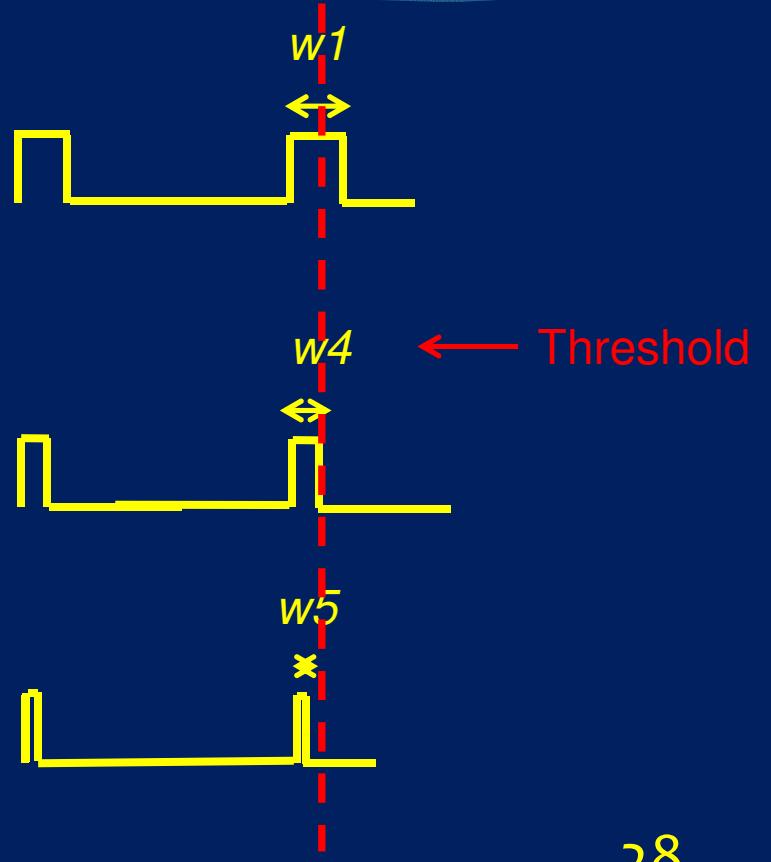


Servo Signals

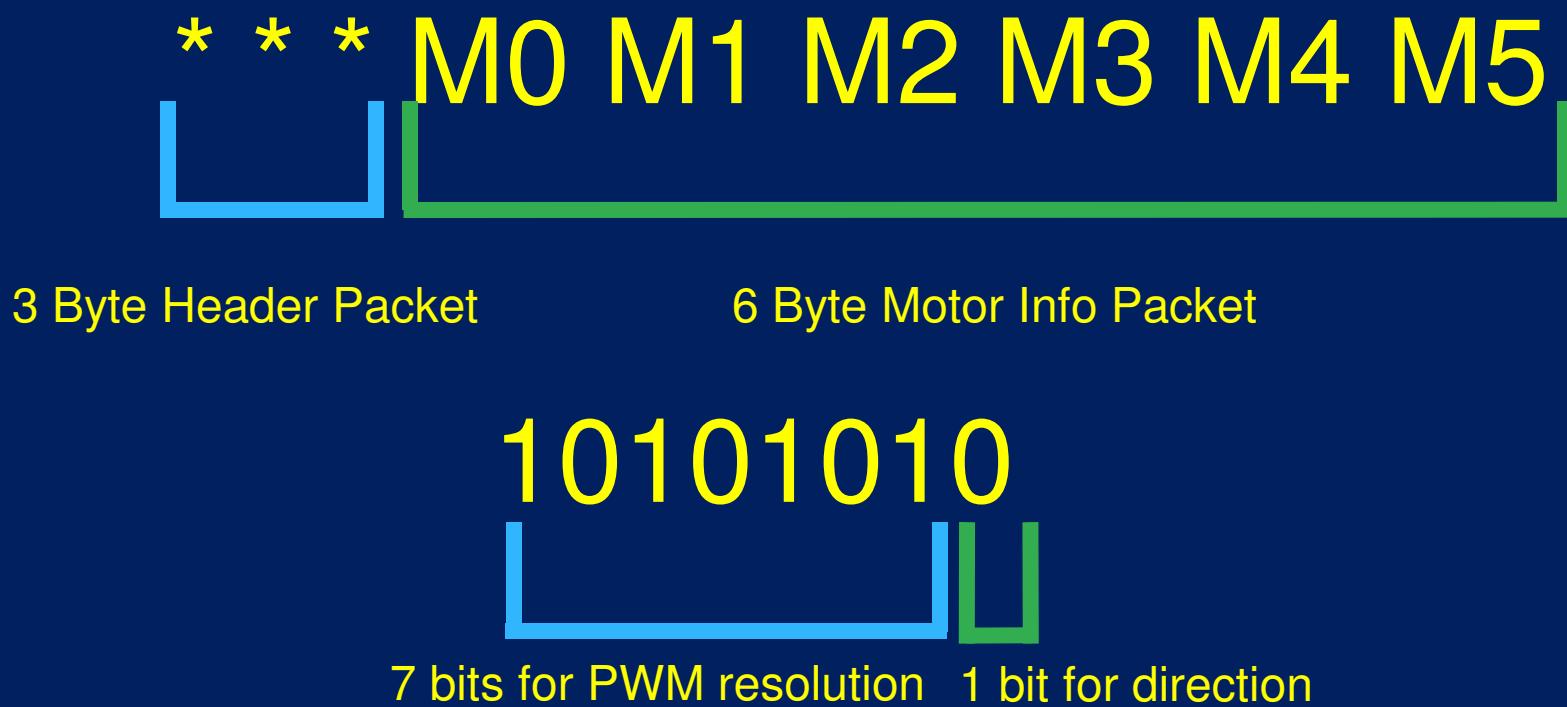
Forward



Backward



Communication Protocol



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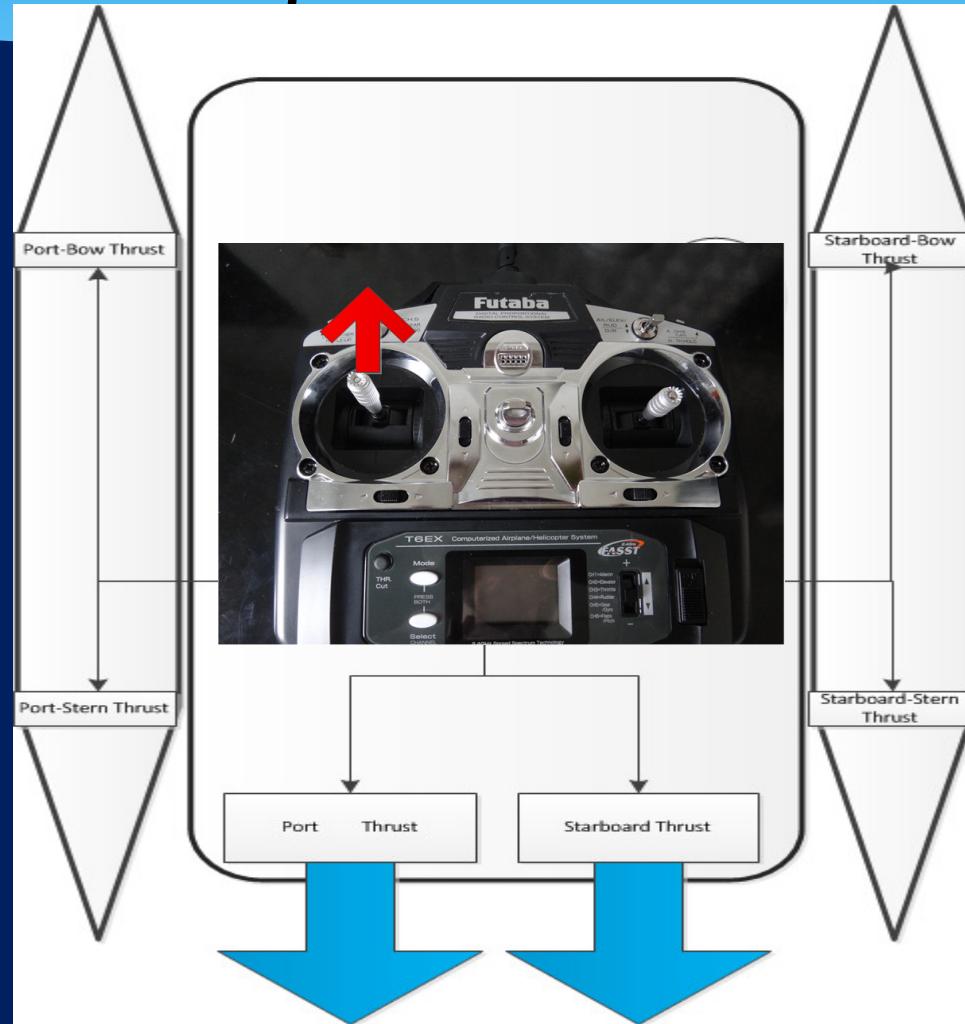
R/C Control



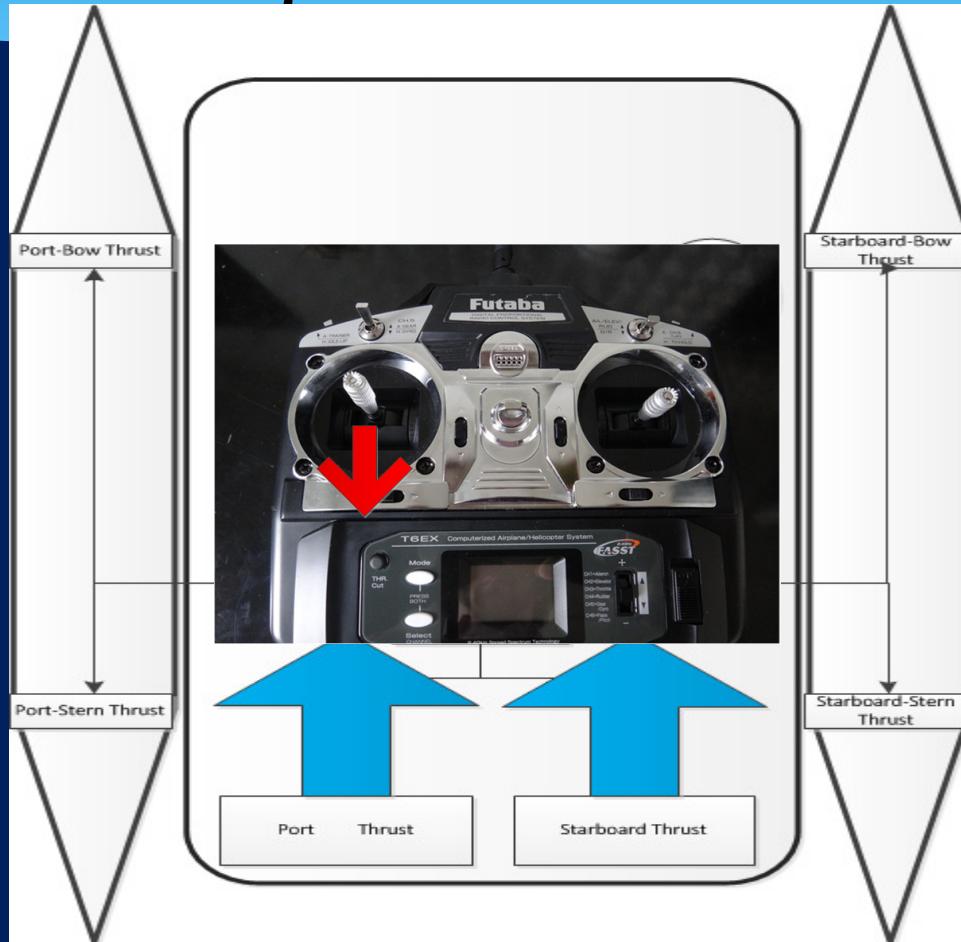
R/C Control



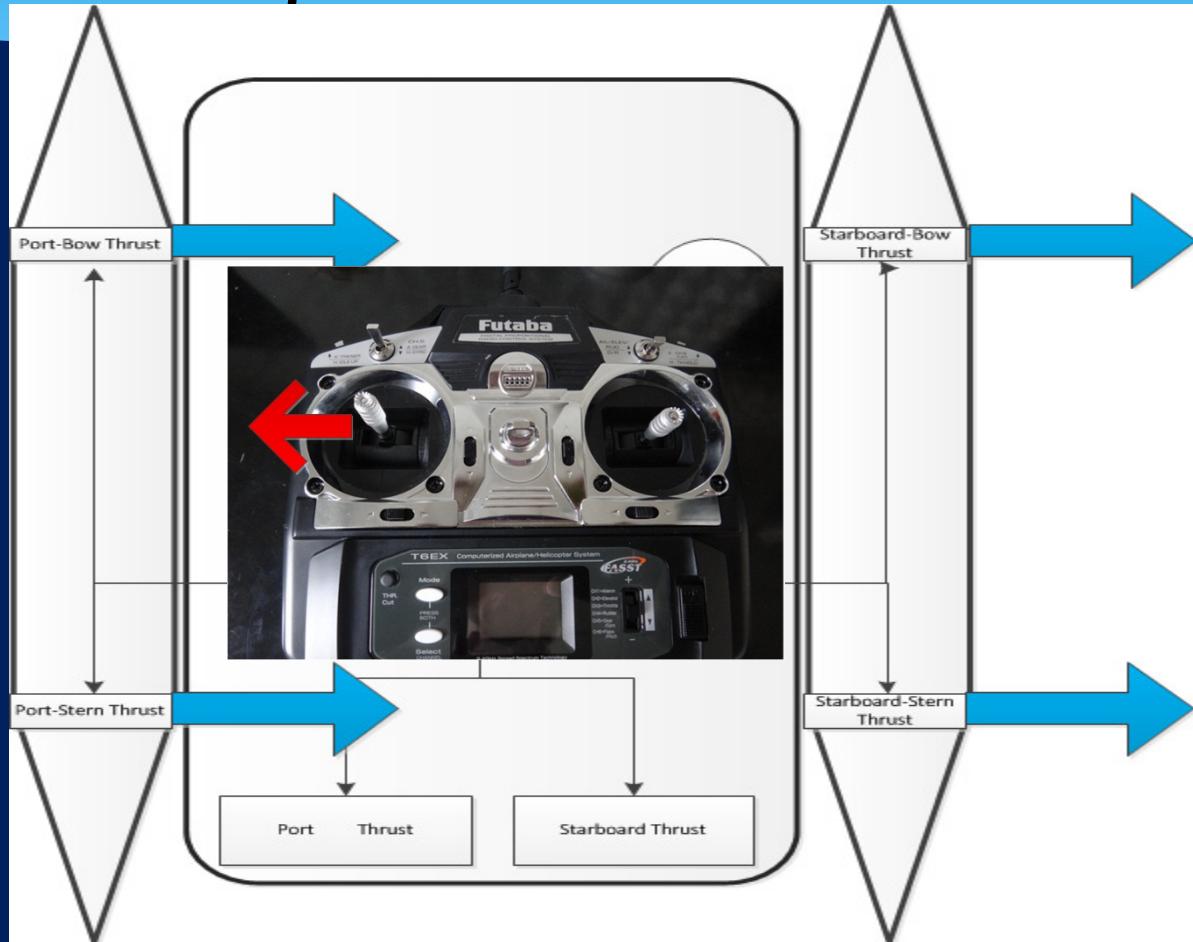
R/C Control



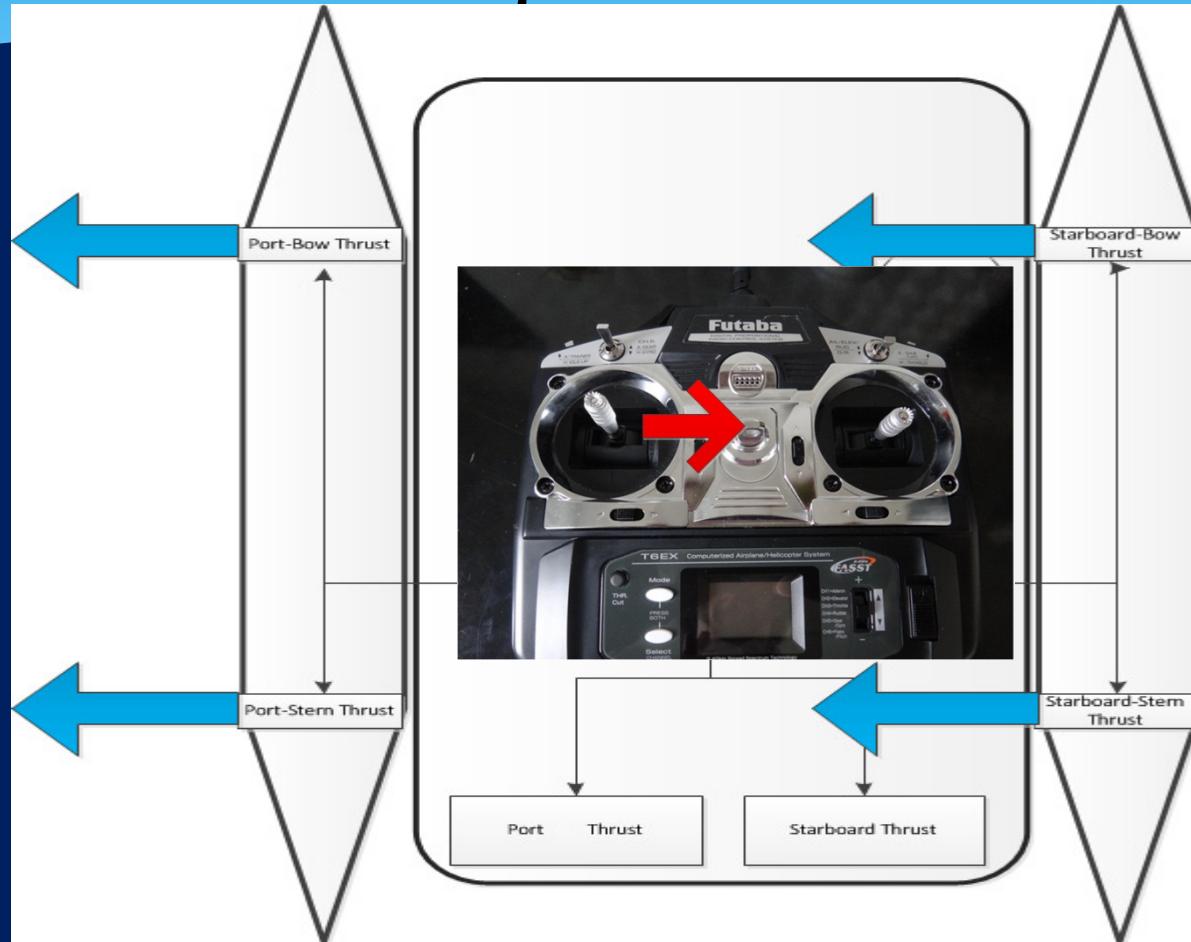
R/C Control



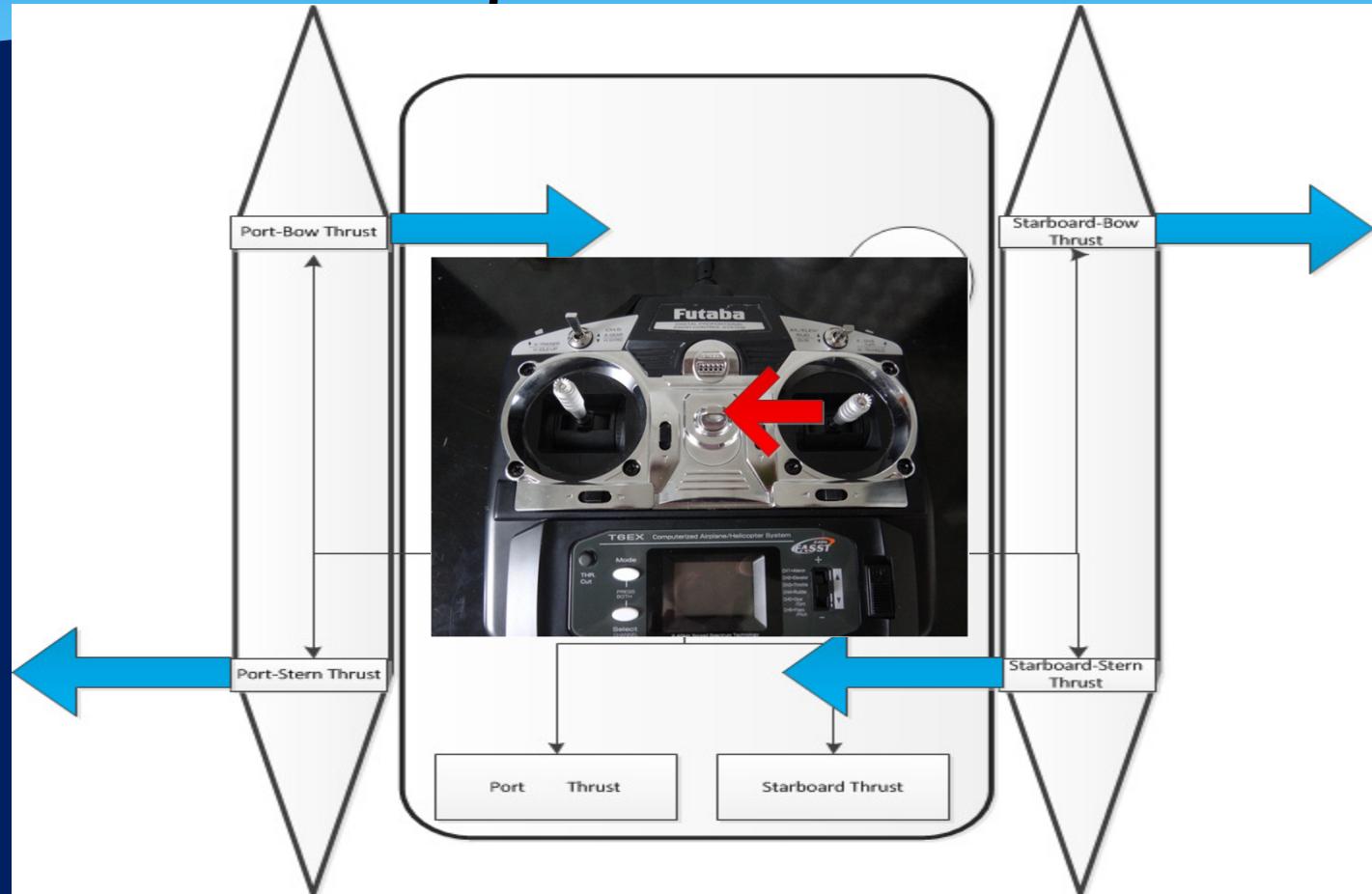
R/C Control



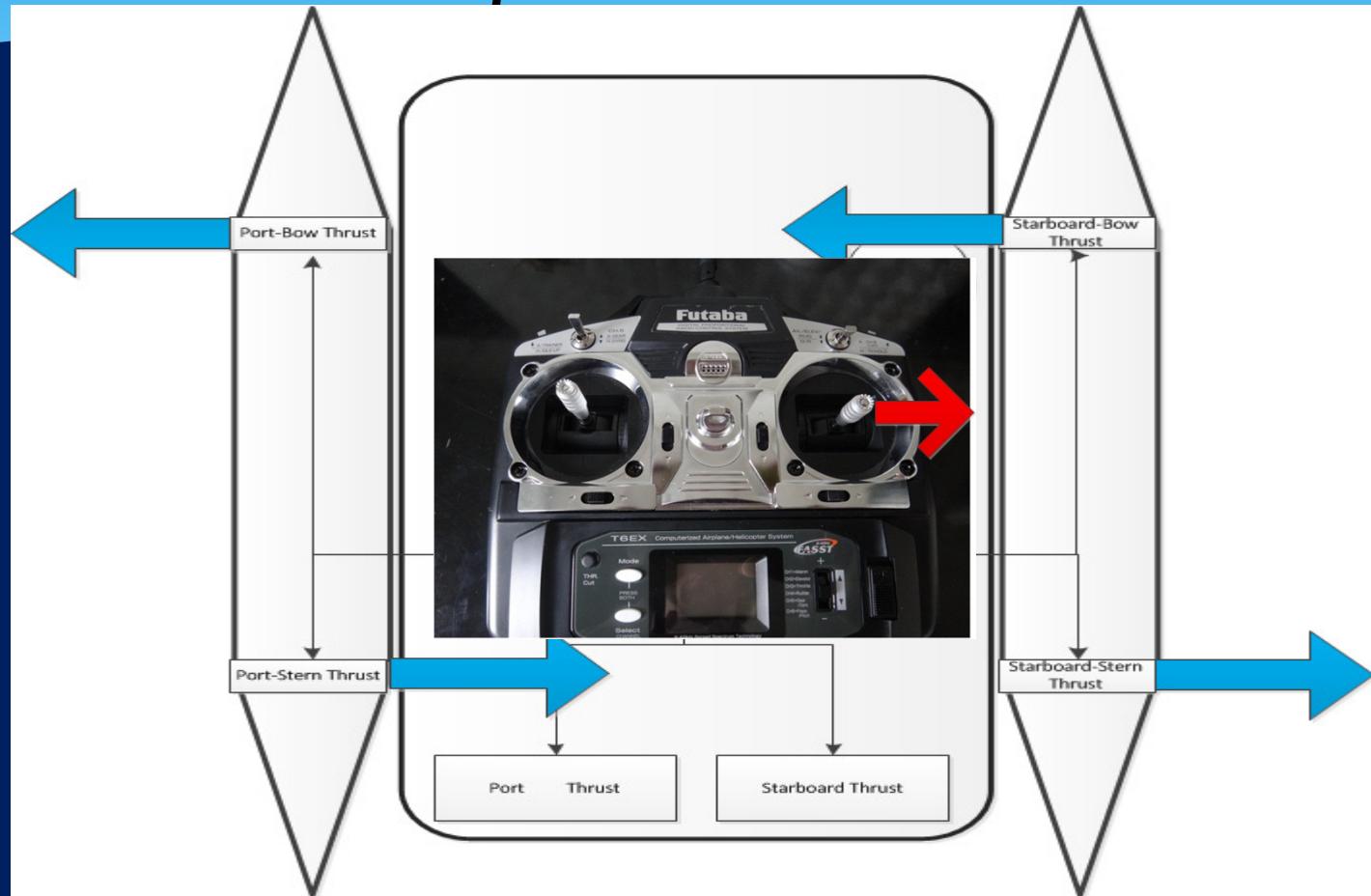
R/C Control



R/C Control



R/C Control



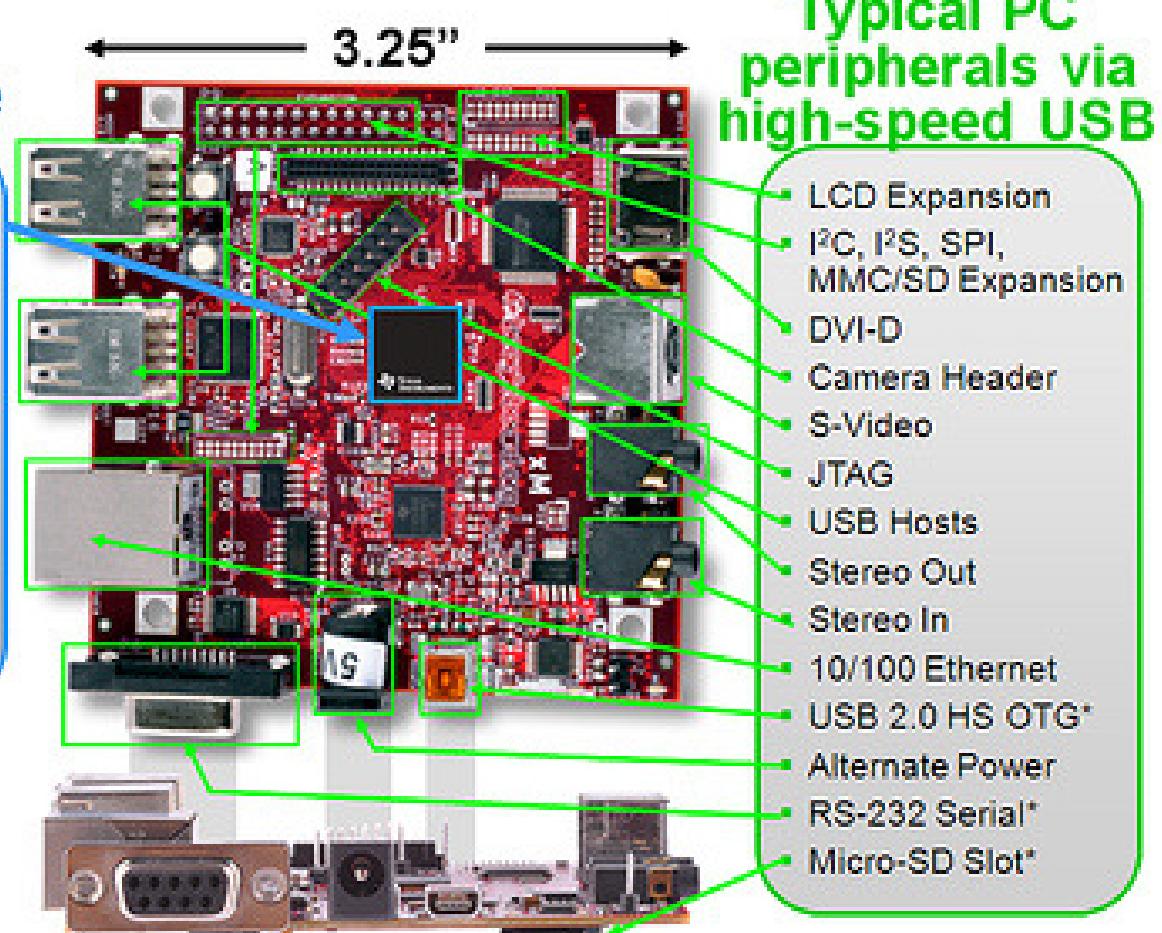
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Beagleboard Overview

Laptop-like performance

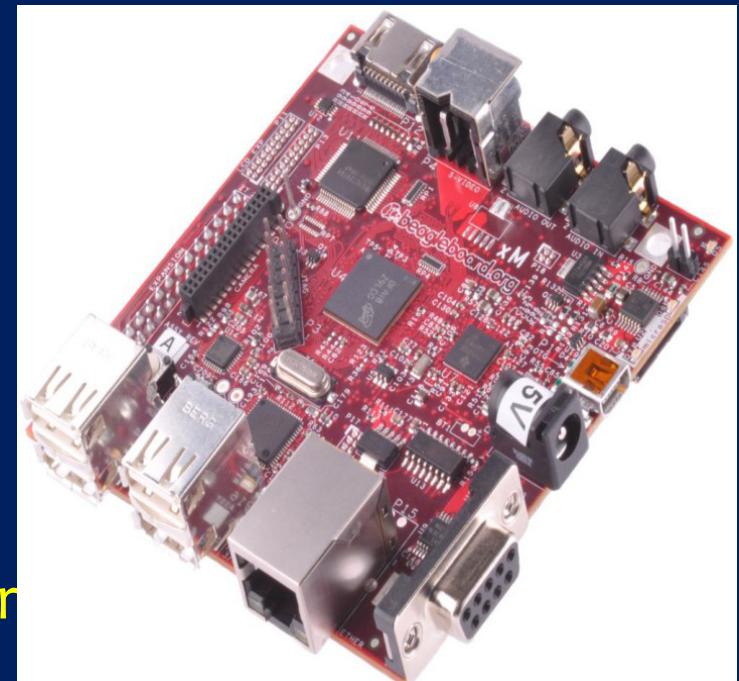
- Super-scaler ARM® Cortex™-A8
- More than 2,000 Dhystone MIPS
- Up to 20 Million polygons per sec graphics
- HD video capable C64x+™ DSP core
- 512 MB LPDDR RAM



* Supports booting from this peripheral

Beagleboard

- * Used Narcissus image builder to create low profile custom image
- * Configured serial port for remote programming
- * Set up Samba server for remote login via PuTTy
- * Installed kernel modules for webcam/wireless adapter
- * Installed and configured openCV
- * Learned how to write makefiles for multifile compiling



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Image Processing

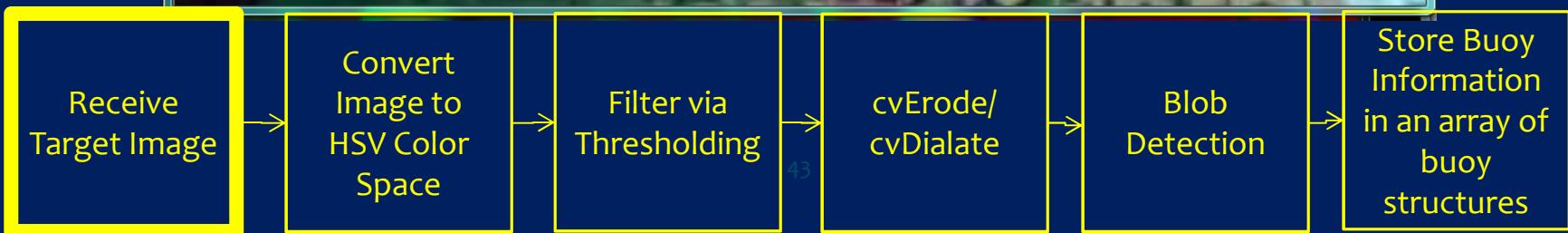


Image Processing

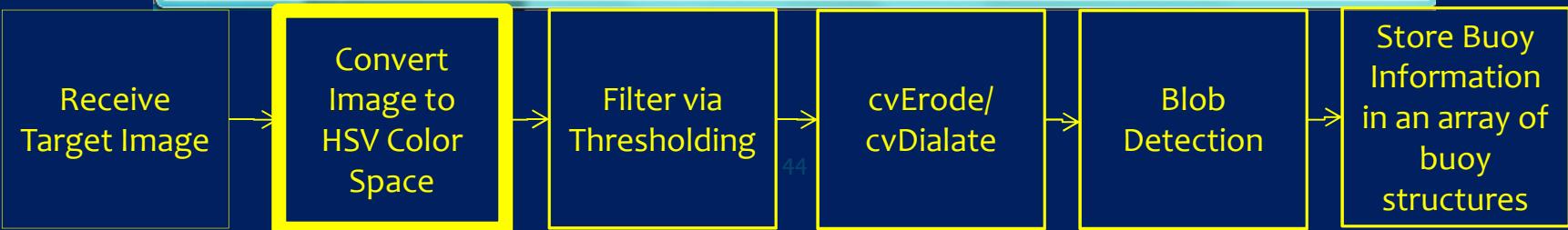
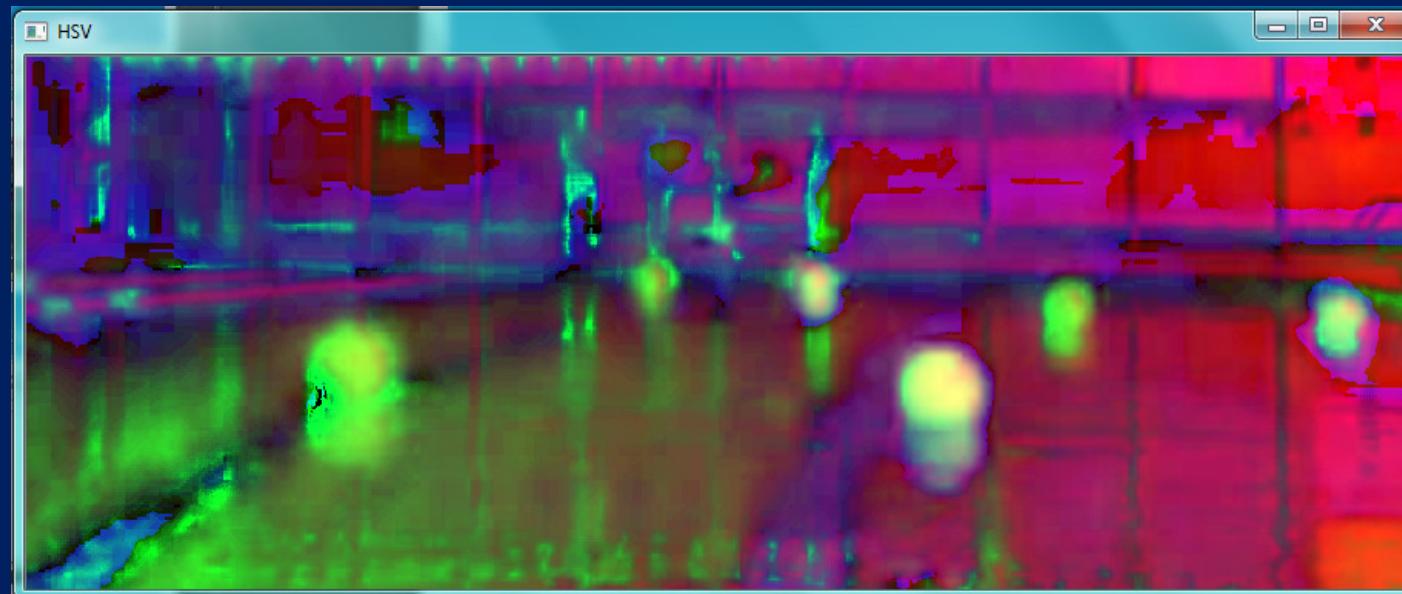


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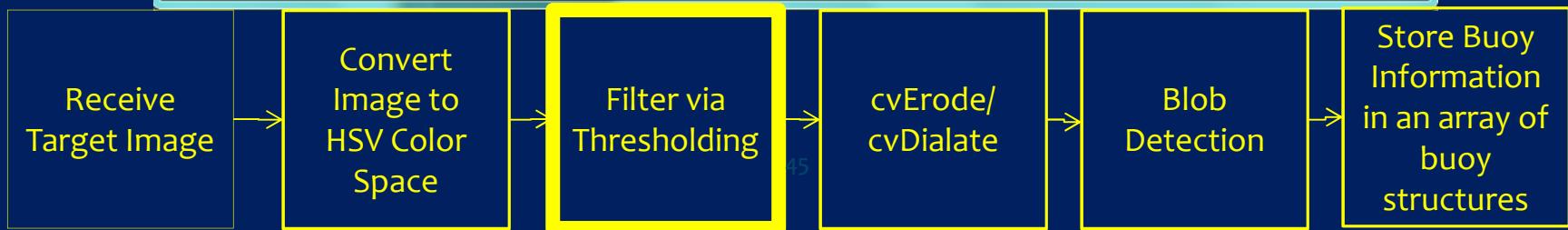


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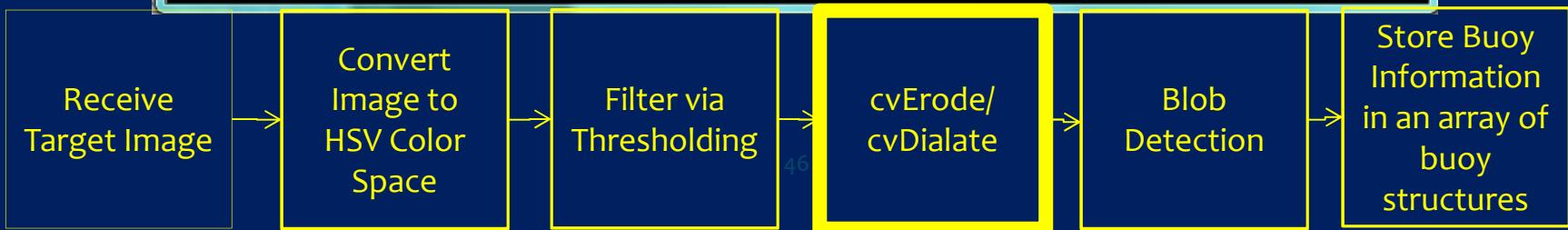
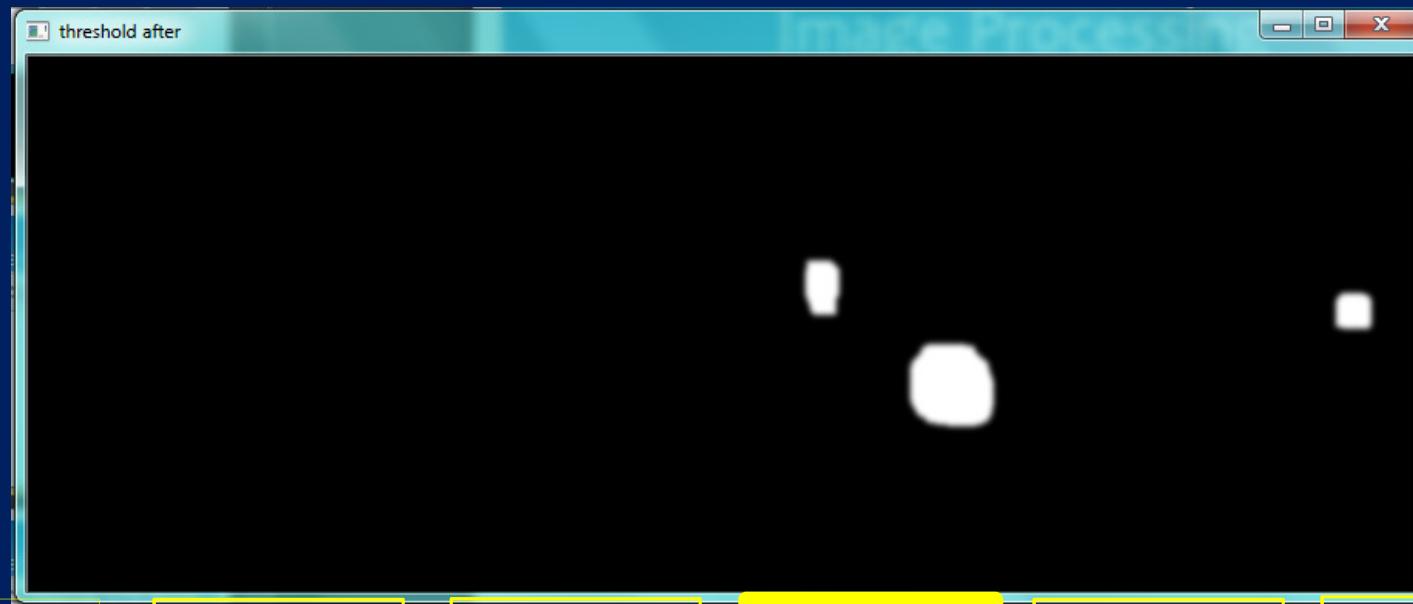


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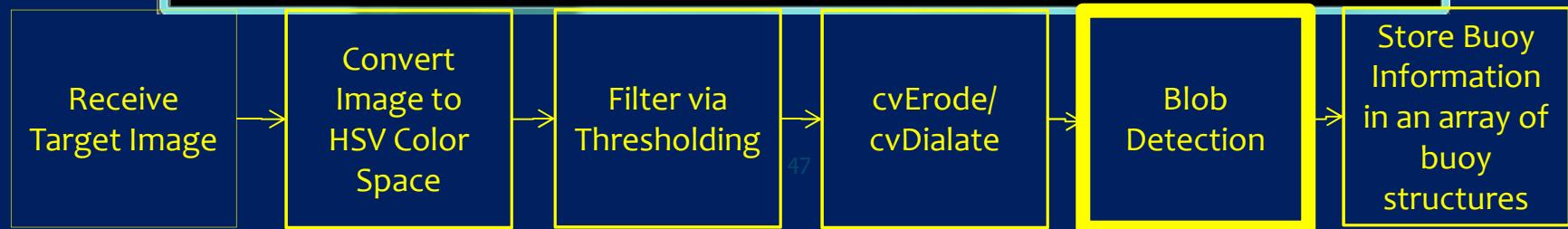
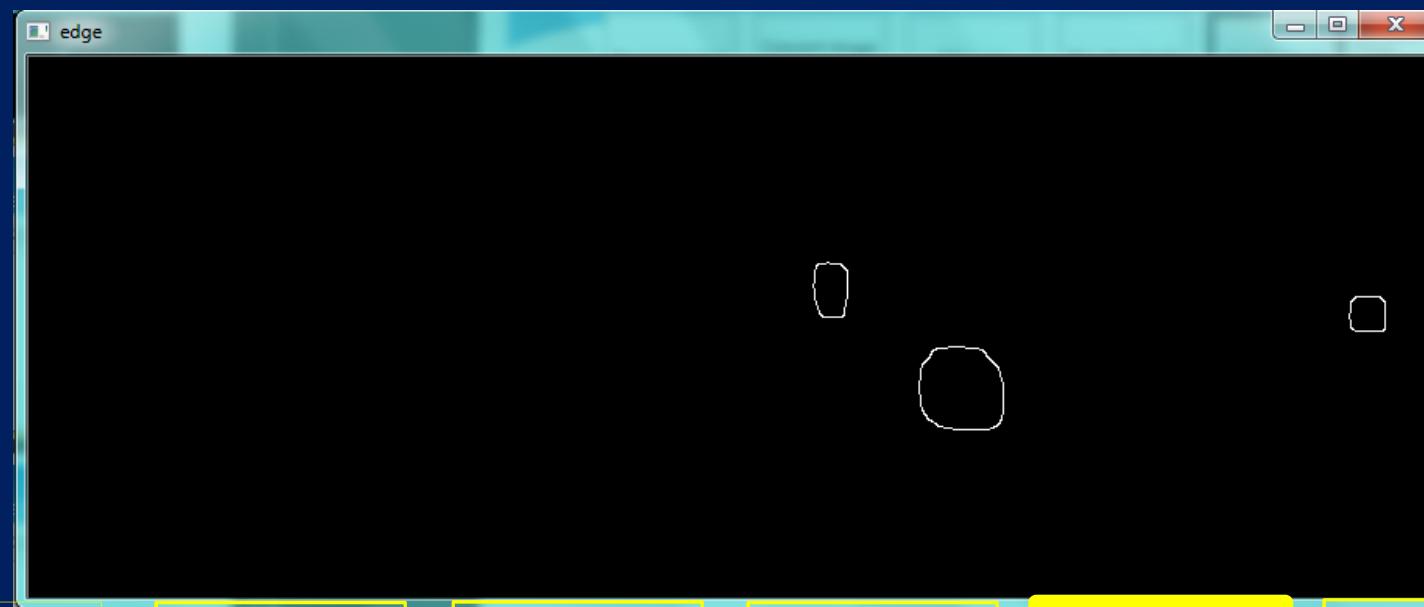


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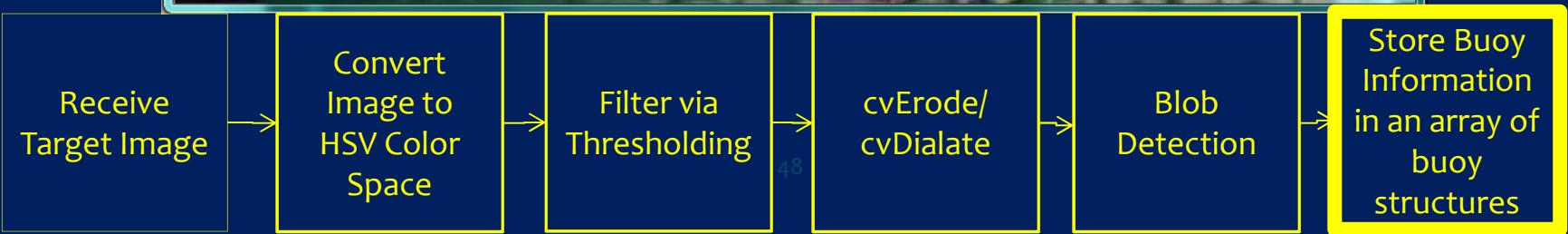
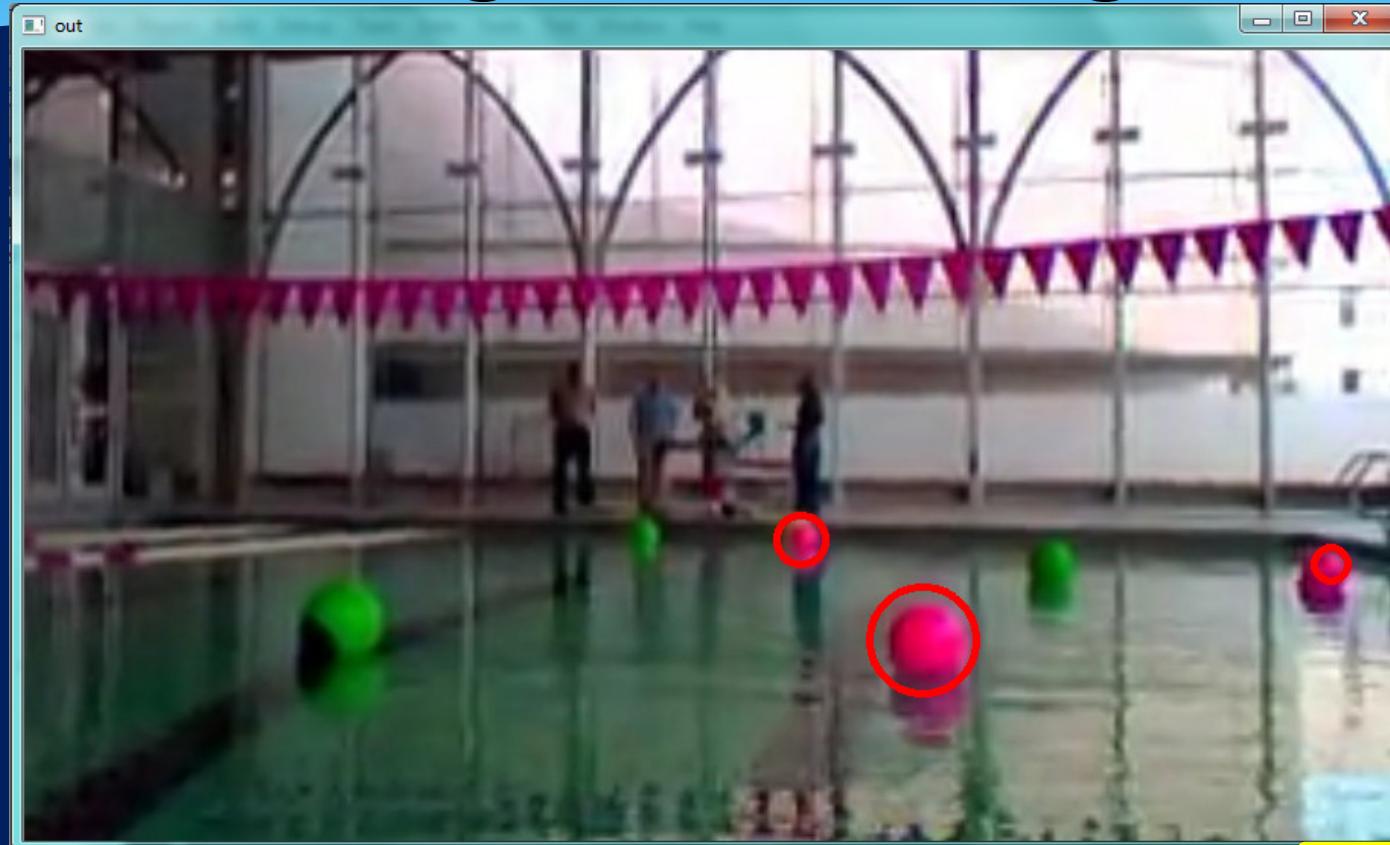
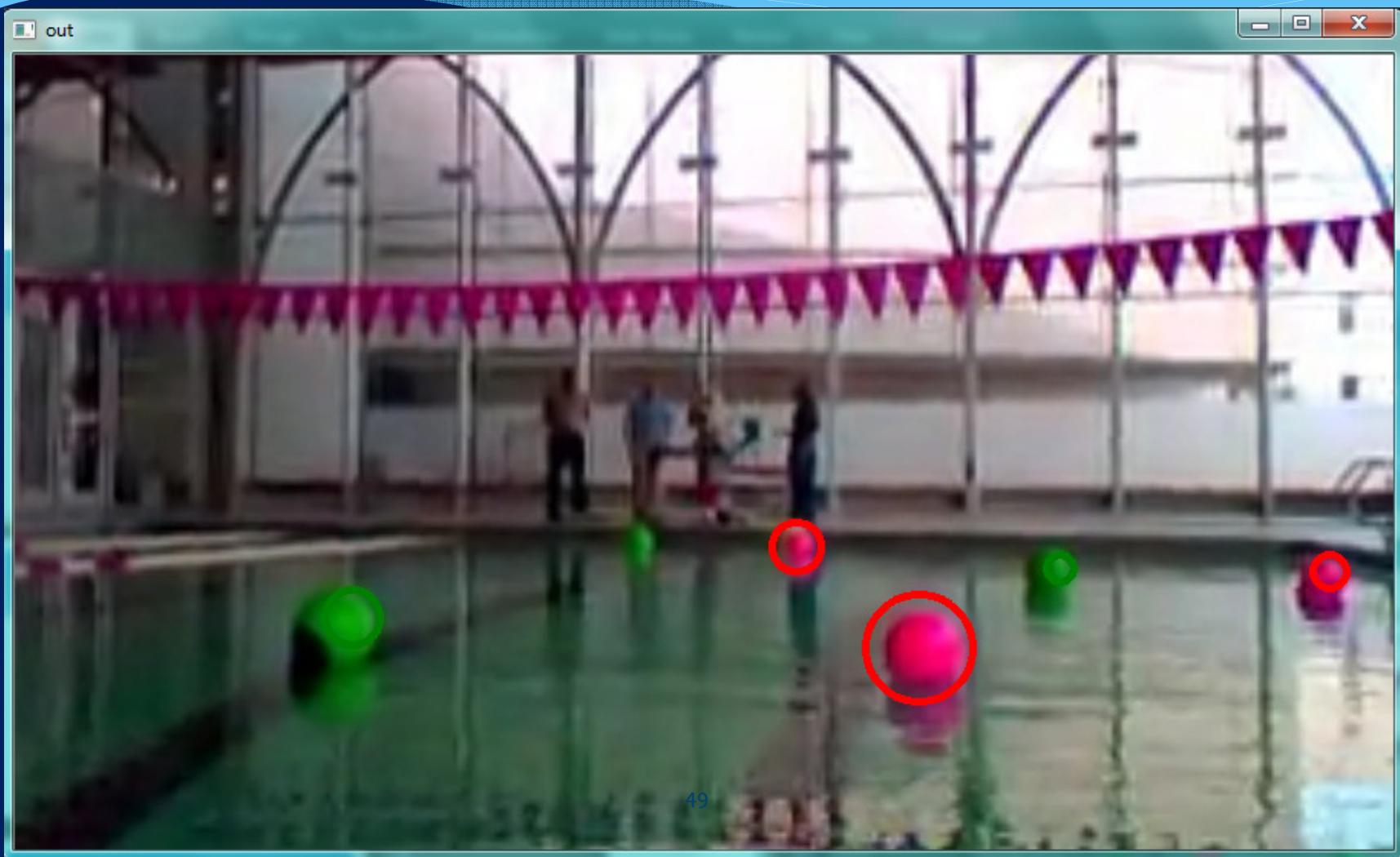


Image Processing



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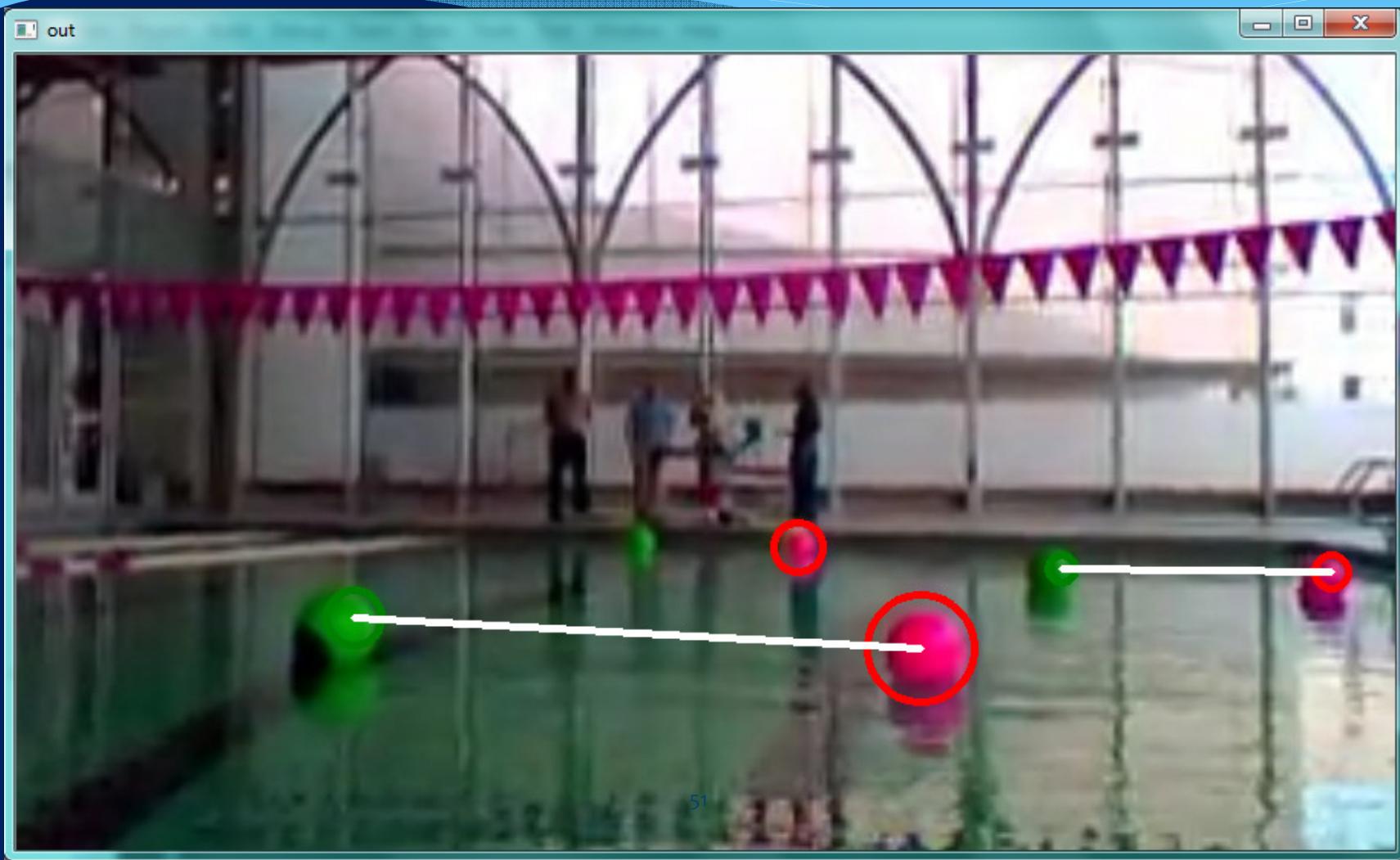
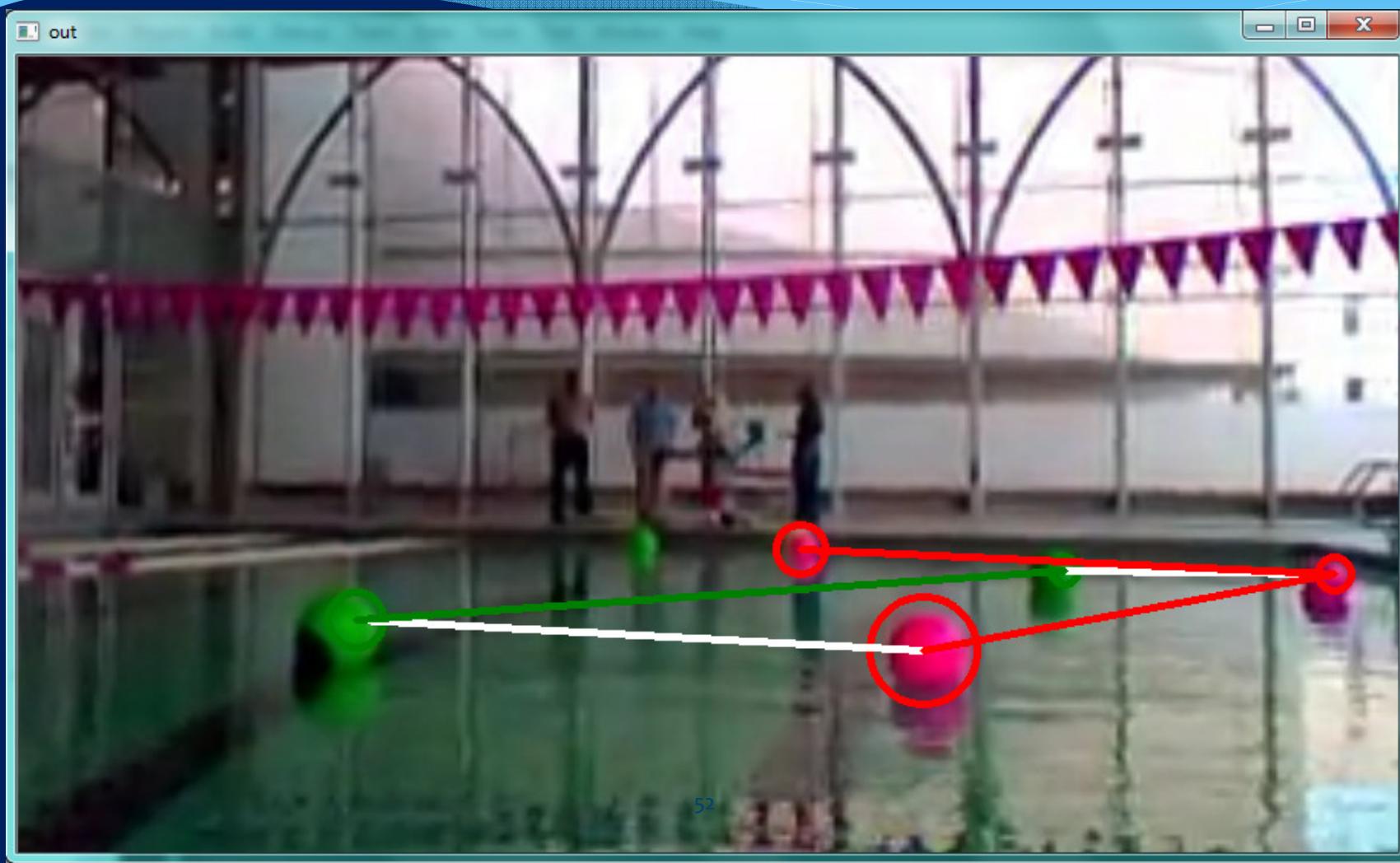
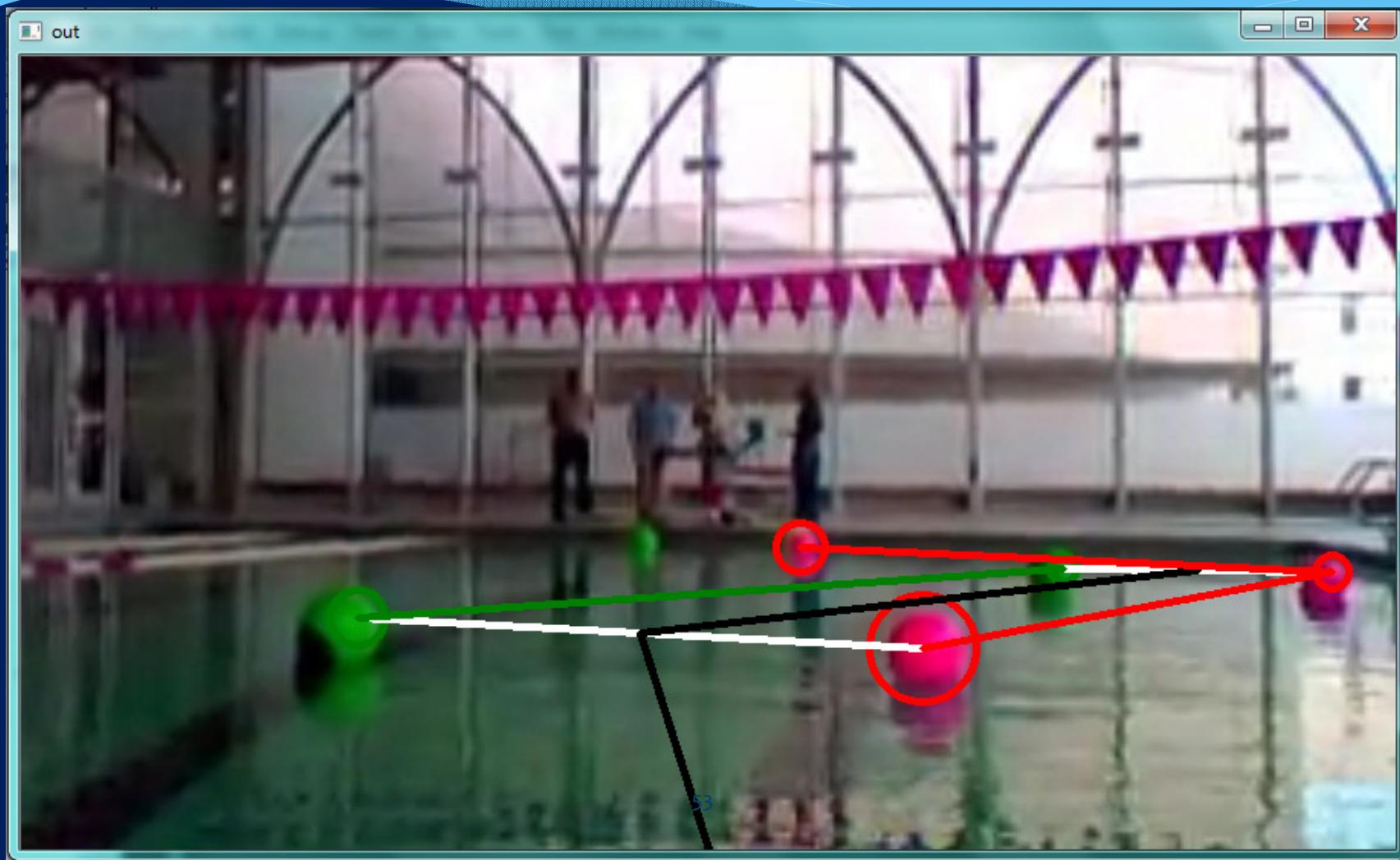


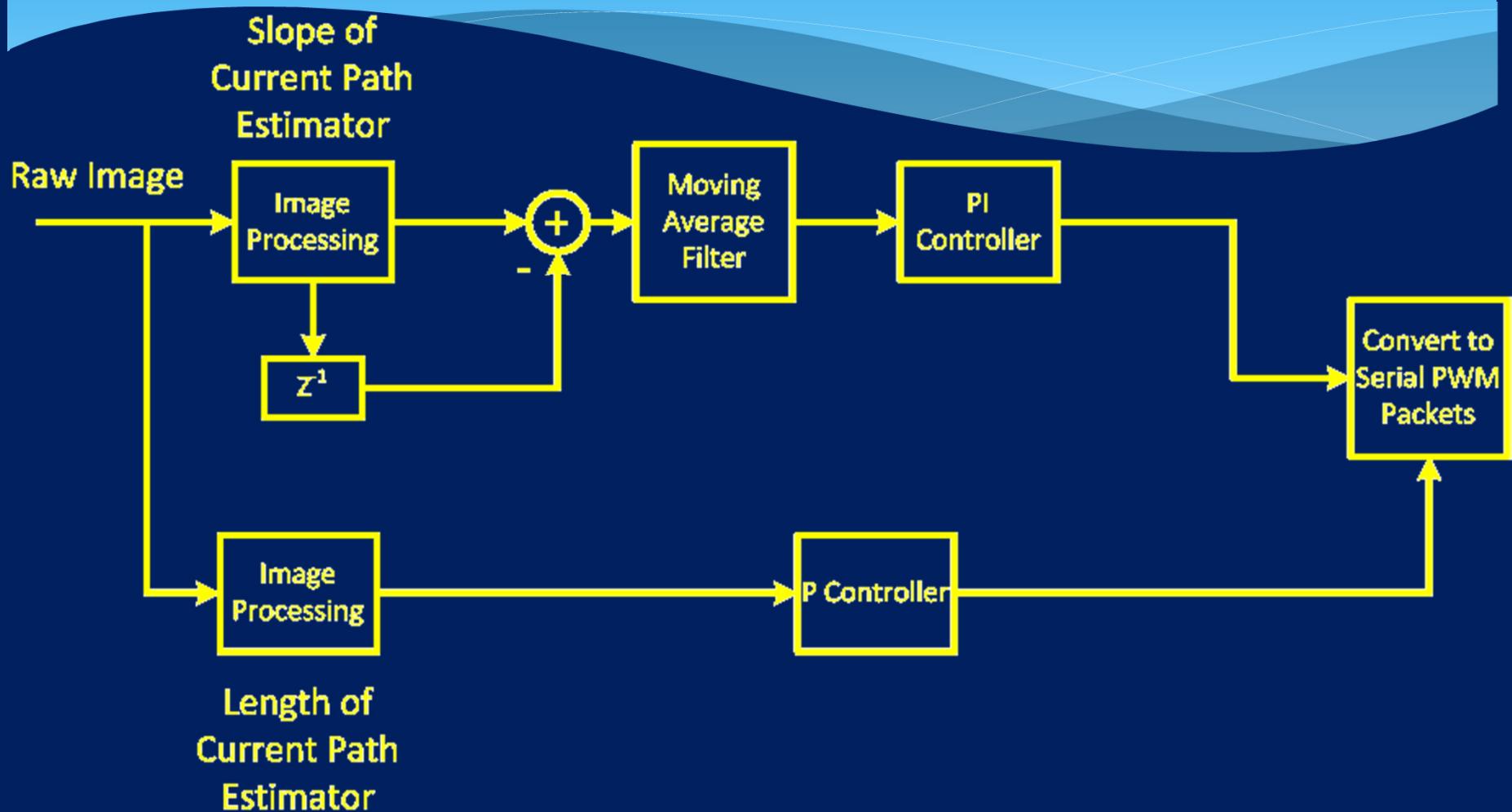
Image Processing



Path Planning

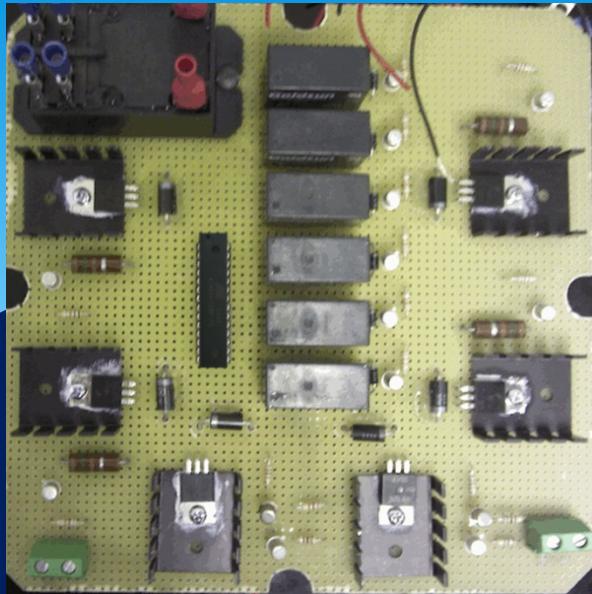


Control Block Diagram Forward Path

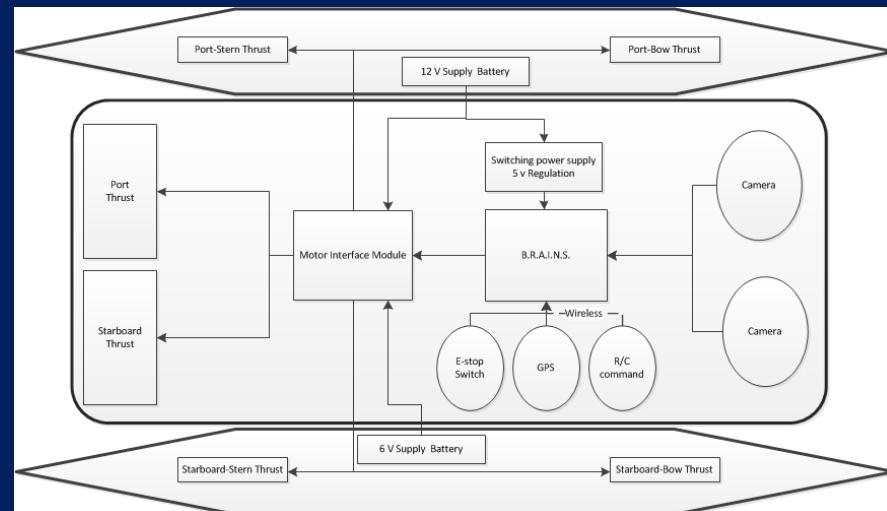
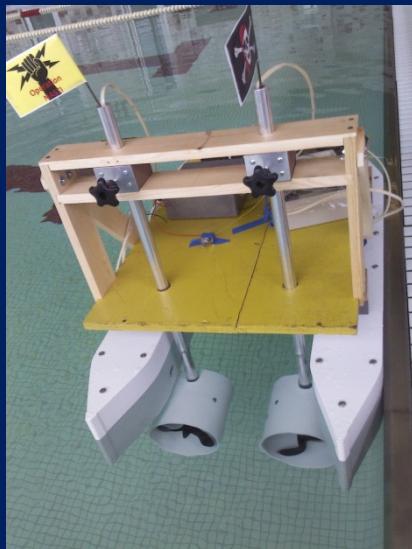
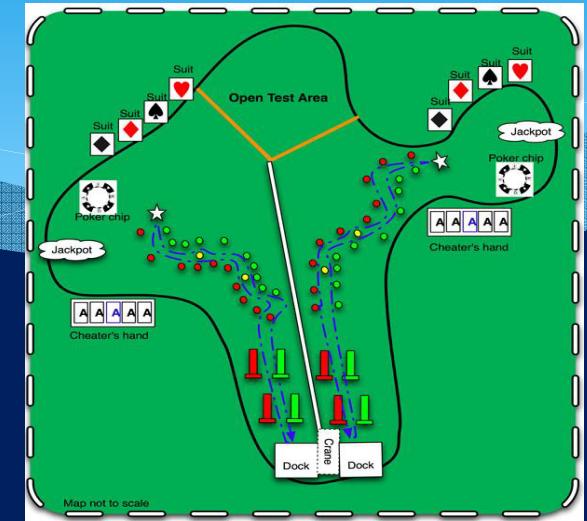


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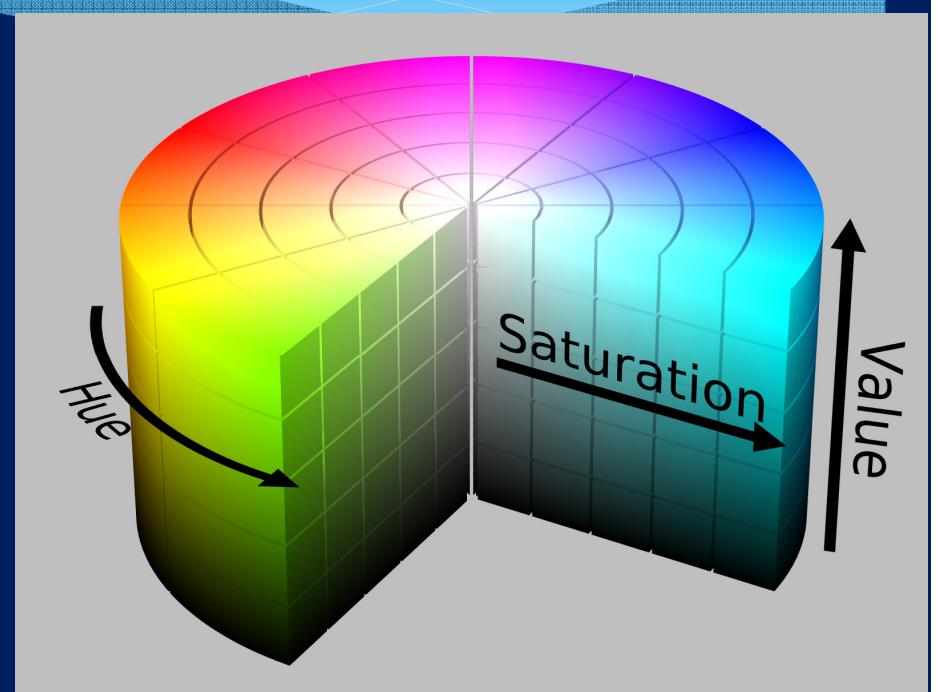
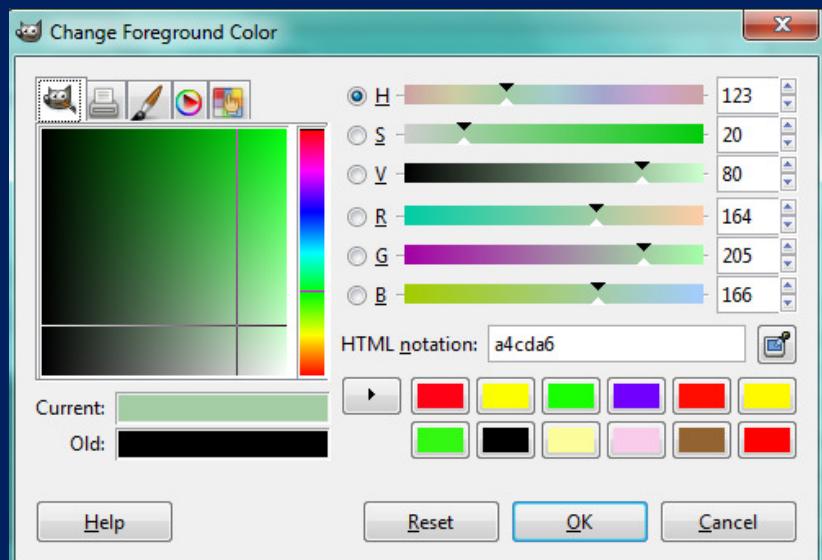
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Questions?



HSV chart



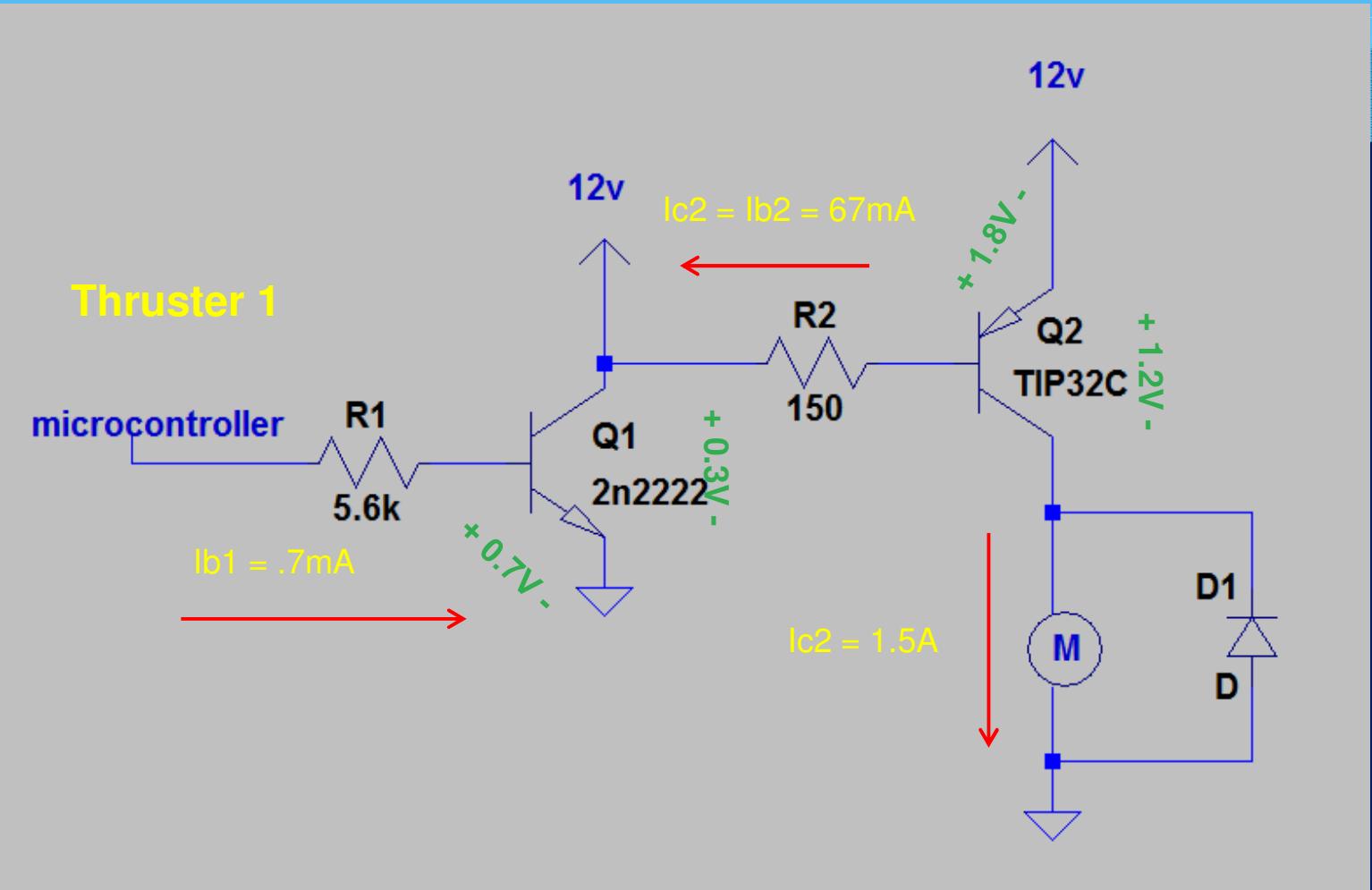
Serial Communication

- TTL vs RS-232 voltage levels
- Three pins RX, TX, and GND
- Multiple Baud Rates
- Baud Rate vs Bit Rate
- Computing Baud Rate error
- Baud rate test method

$$UBBR = \frac{f_{clk}}{\text{Baud_rate} * 16} - 1$$

$$\text{Baud}_{rate} = \frac{f_{clk}}{16 * (\text{UBBR} + 1)}$$

Circuit Calculation



Structures

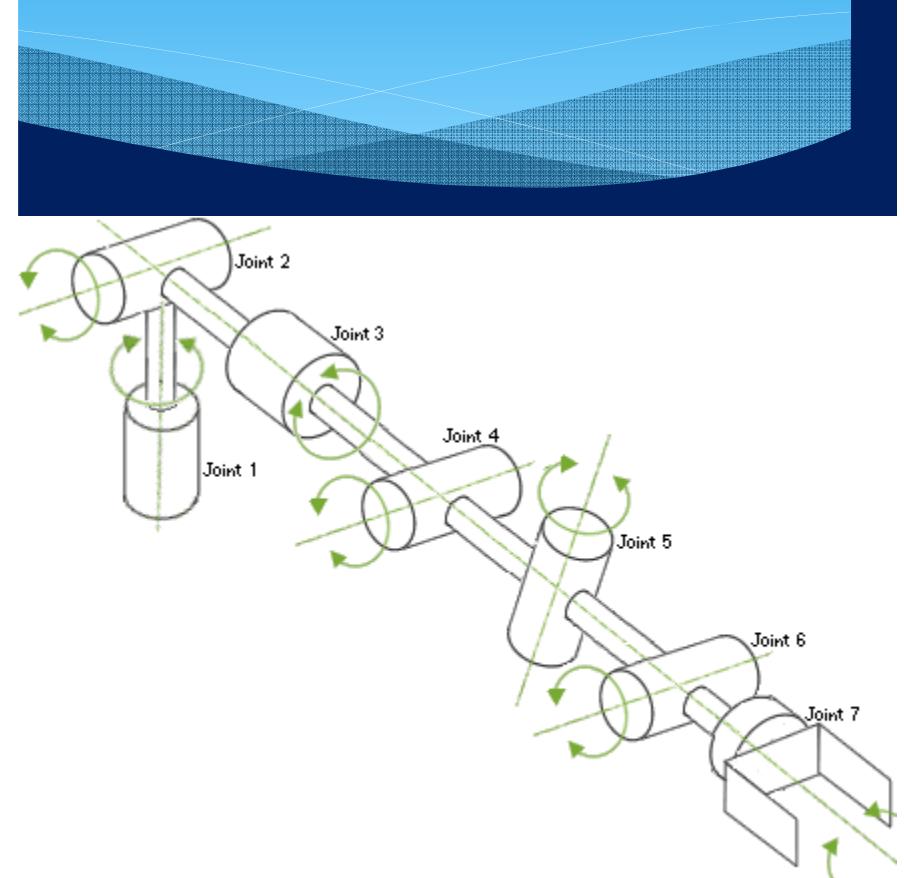
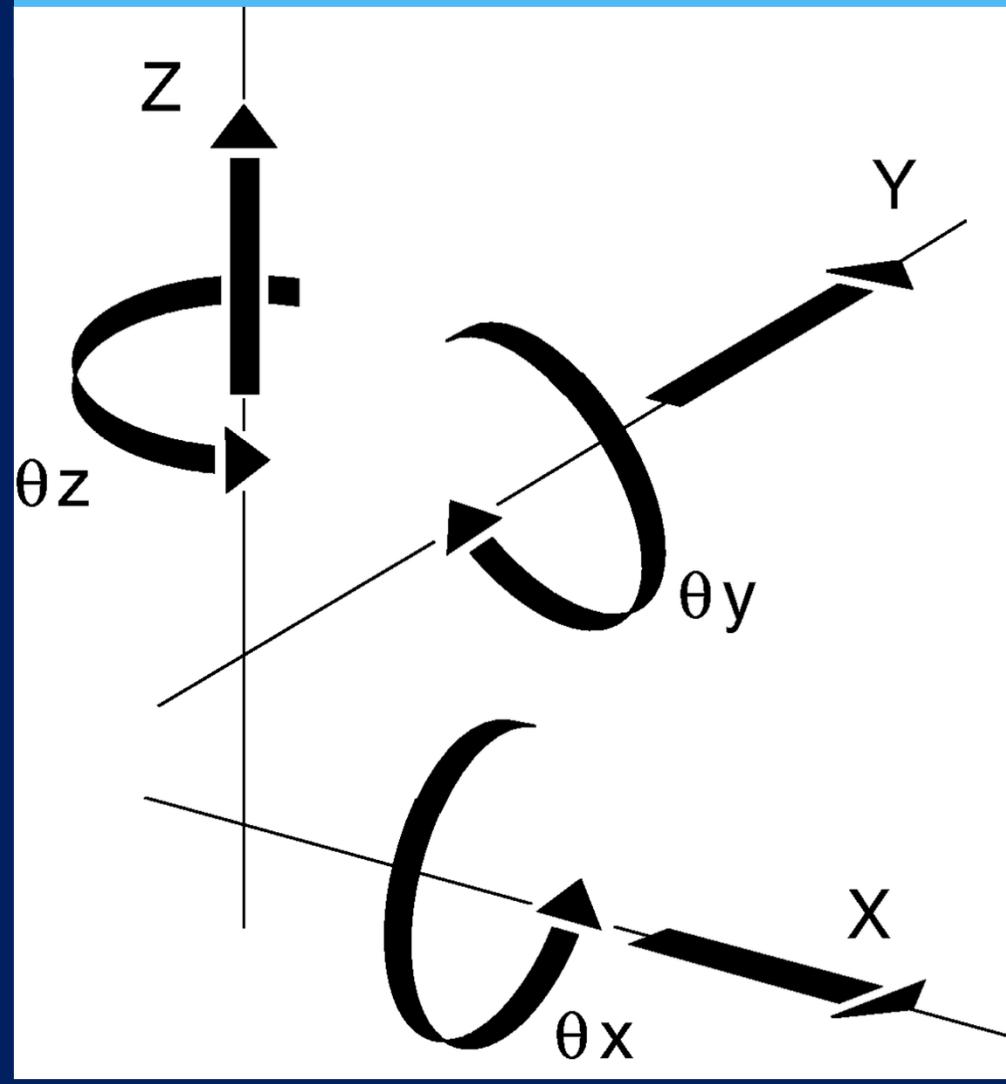
```
41 typedef struct
42 {
43     float x;
44     float y;
45     float radius;
46 } buoy;
47
```

```
56 typedef struct
57 {
58     CvPoint farEnd;
59     CvPoint nearEnd;
60 } wall;
```

```
48 typedef struct
49 {
50     CvPoint green;
51     CvPoint red;
52     CvPoint yellow;
53     CvPoint goal;
54 } gate;
55
```

```
62 typedef struct
63 {
64     CvPoint farEnd;
65     CvPoint nearEnd;
66     float slope;
67     float length;
68 } path;
```

Degrees of Freedom



Floating point values

- * BeagleBoard is 32 bit ->32 bit value.
 - * Same as int, less than a double
 - * $\pm 3.4 \times 10^{-38}$ roughly 7 bits of precision
- * ARM – A8 contains a NEON coprocessor
 - * Dedicated to floating point operations
 - * 1 instruction/cycle

Sources

- * [1] “*The Five Card Draw*” 5th RoboBoat Competition - Preliminary Rules Arlington, VA: AUVSIfoundation. PDF.