

Rubik's Cube robot solver

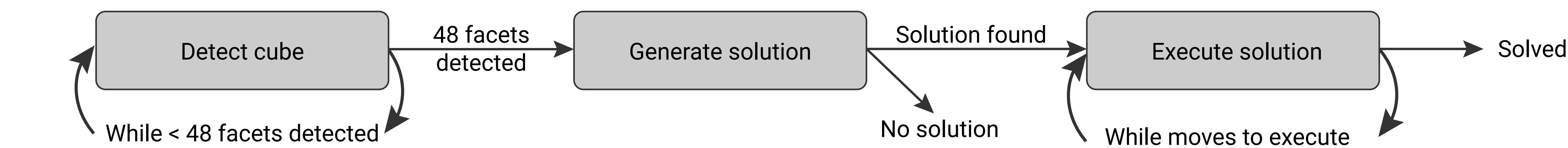
Alexandre PALO - ME 6405 Intro. to Mechatronics

Project description

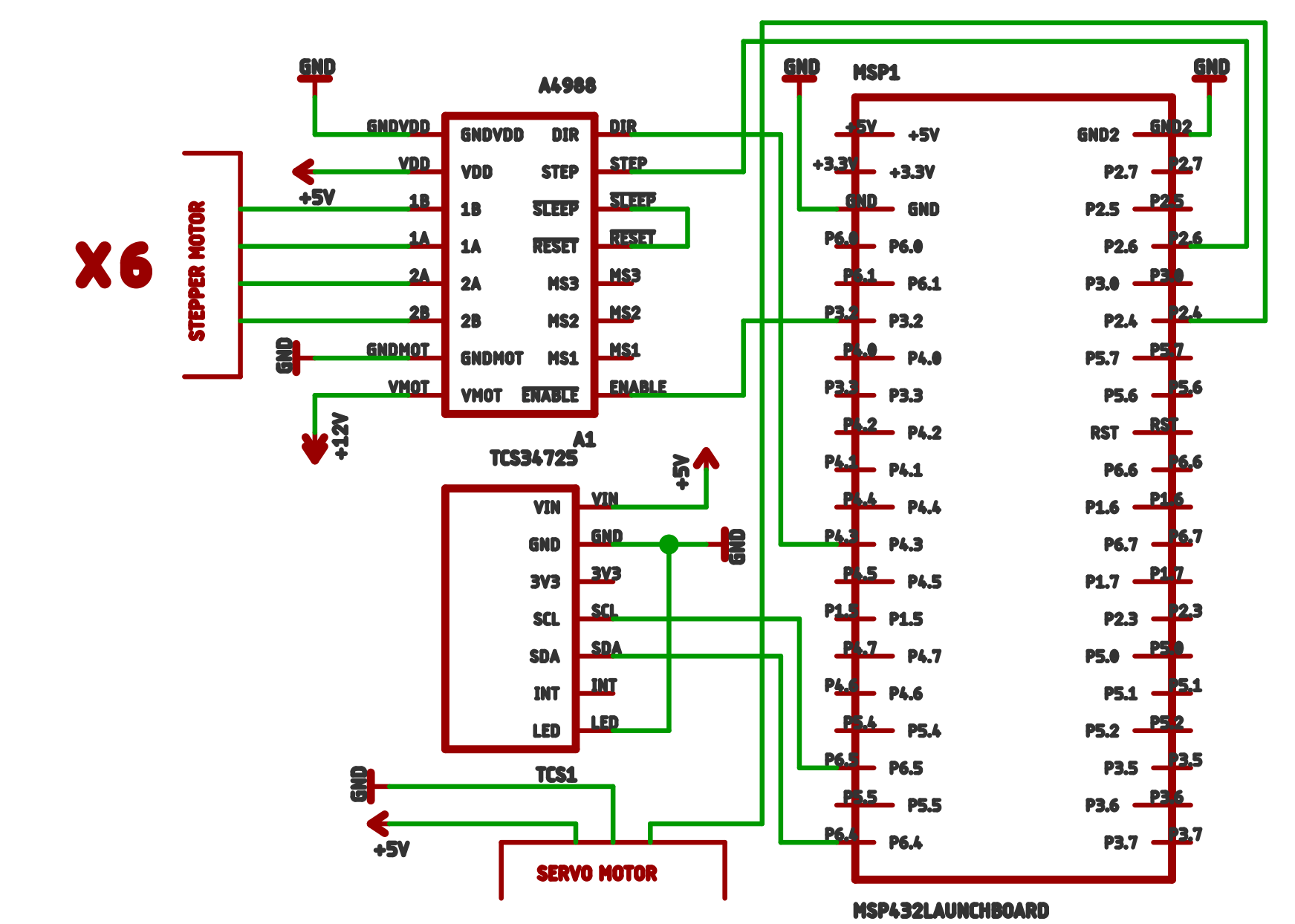
- Objectives:**
- Identify colors of a cube,
 - Search a solution with an algorithm,
 - Solve the real cube.

Possible improvements

- Close loop on stepper motors: ensure 90° rotation
- Multiply color sensors: accelerate color detection
- Implement a better algorithm: reduce number of moves

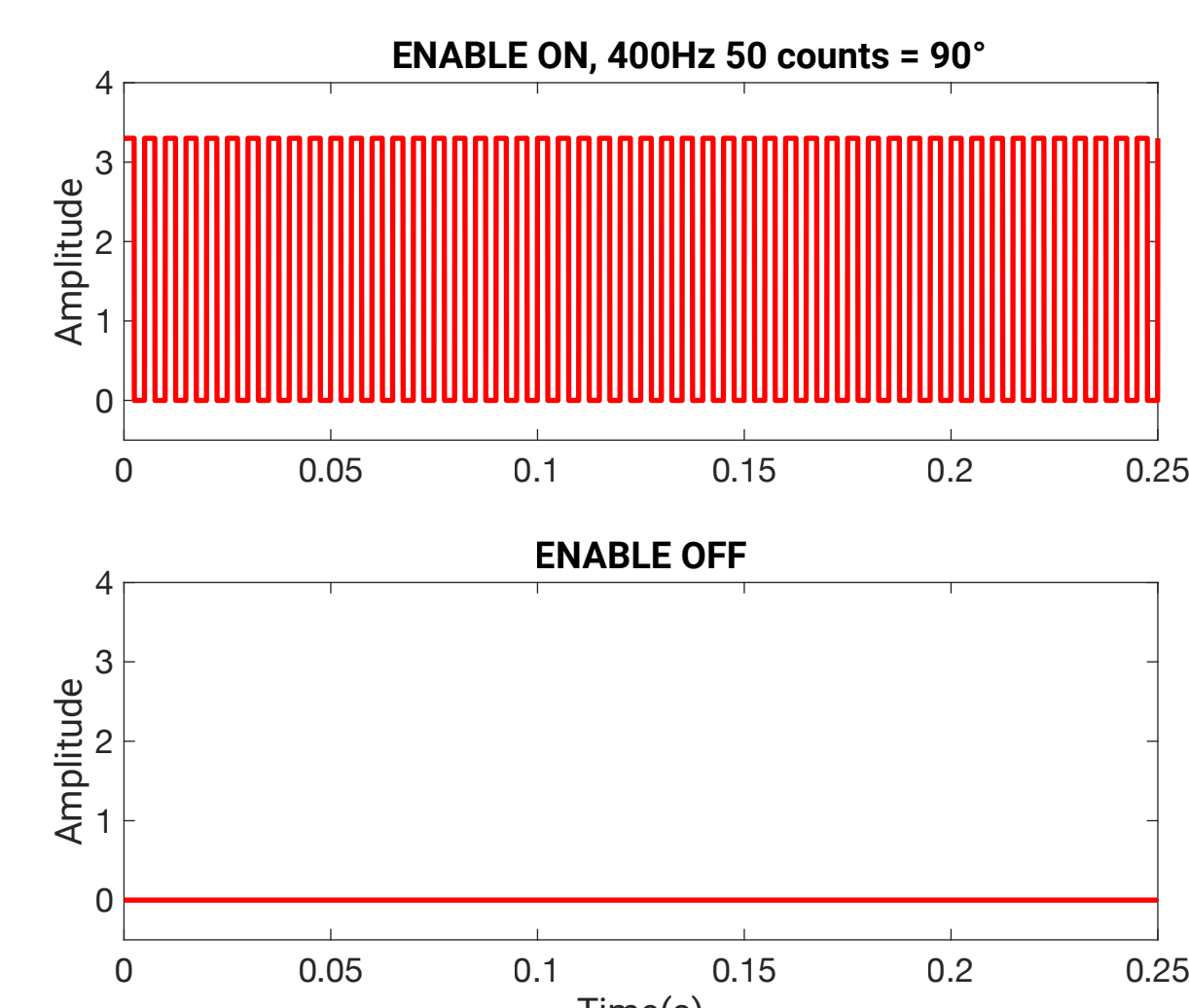
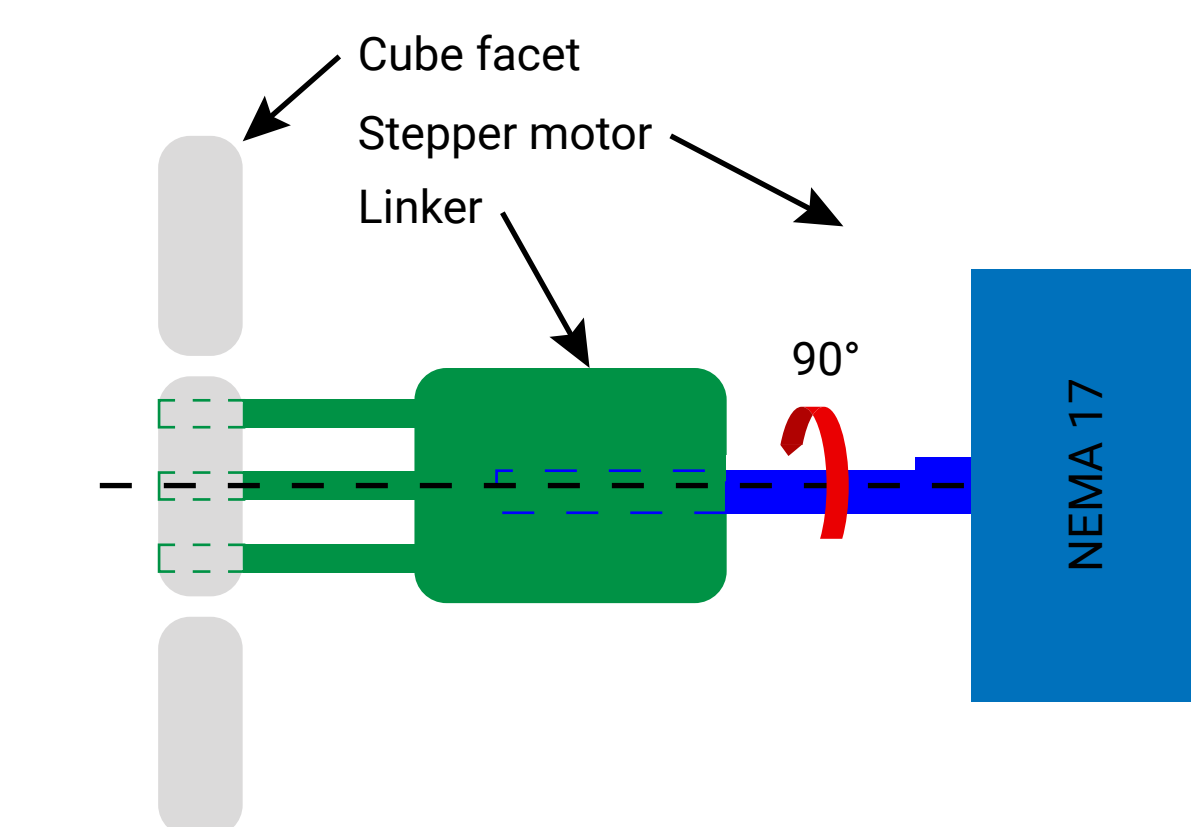


Electronics

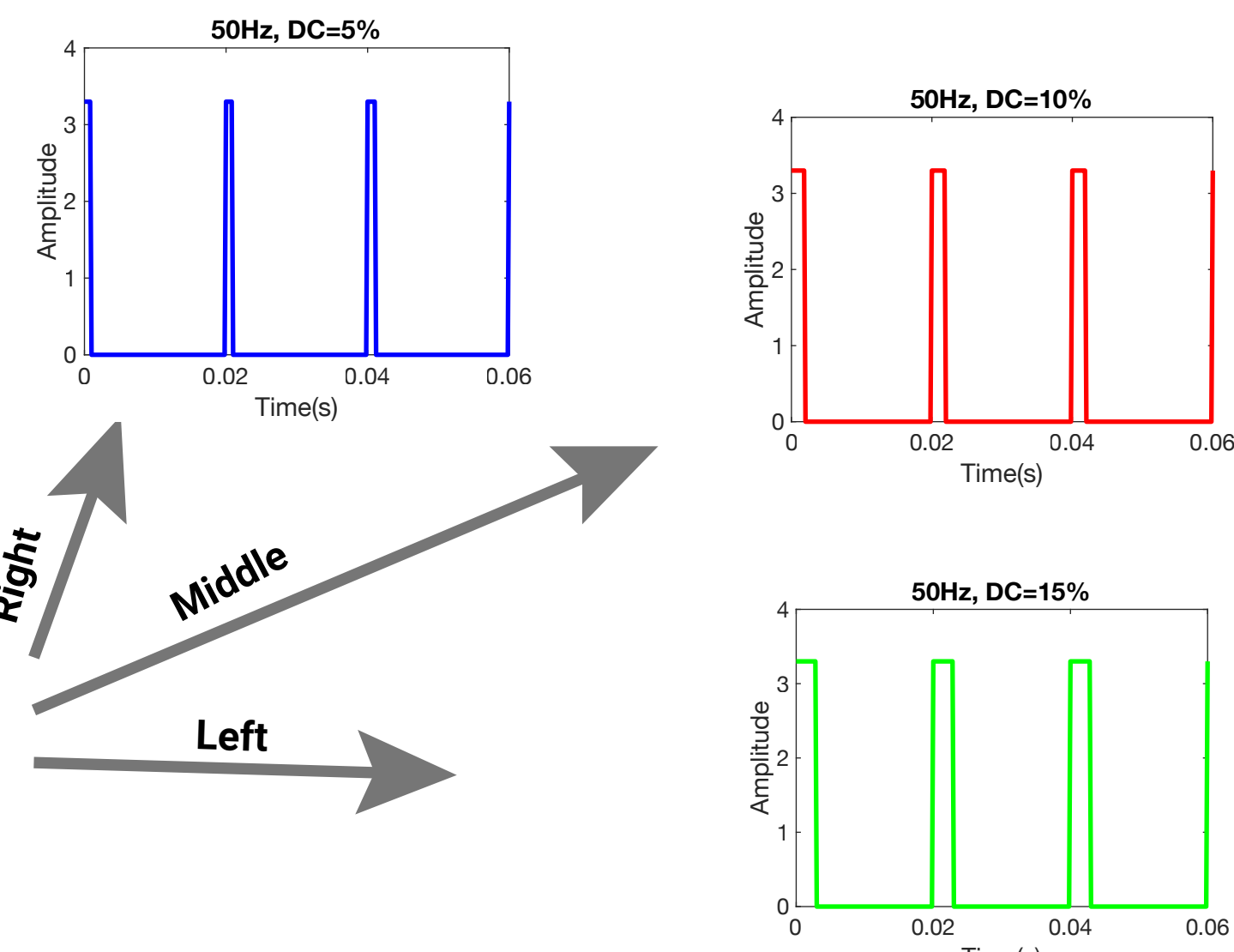
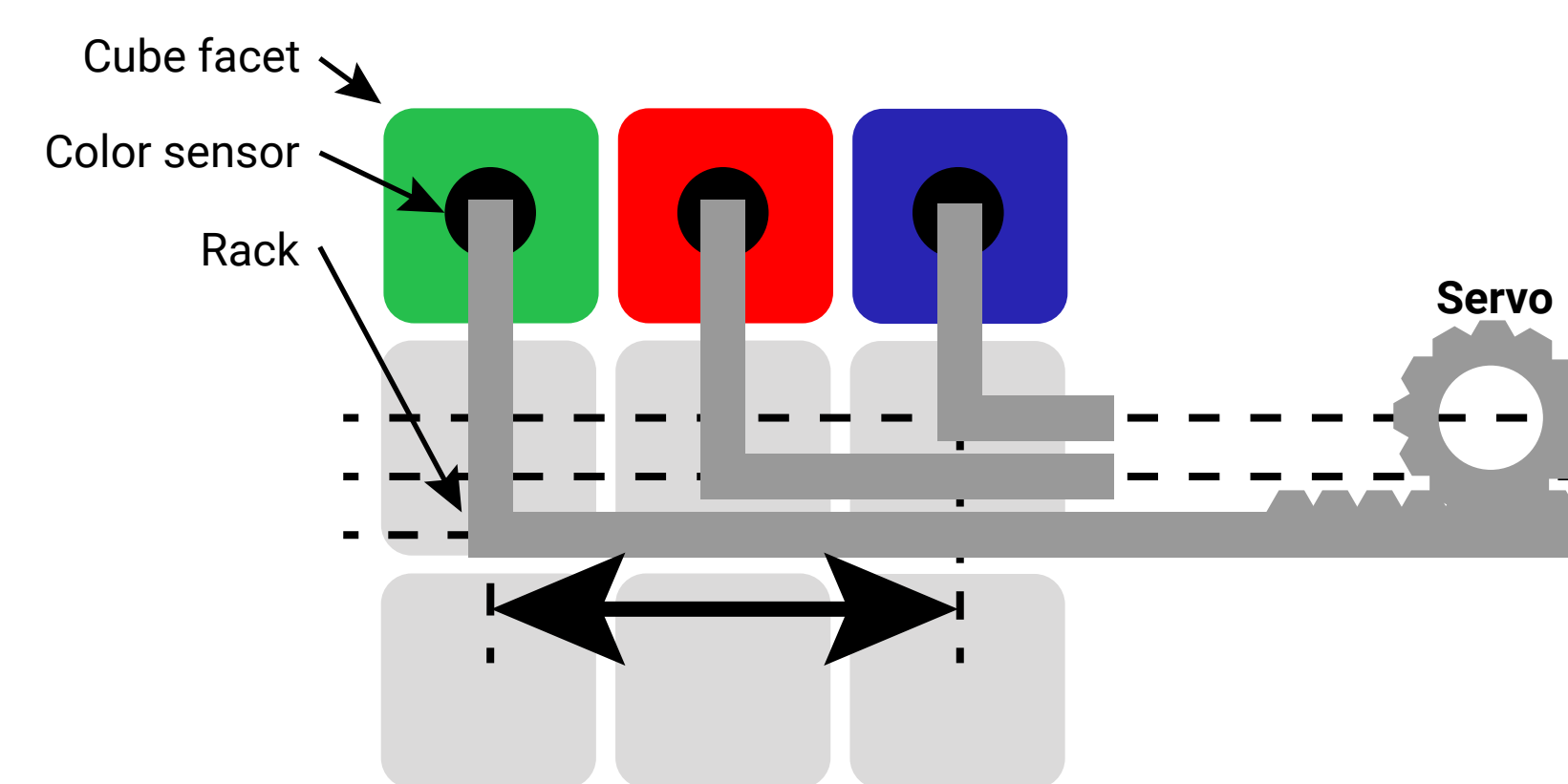


Components	Quantity	
NEMA 17 stepper torque 51 N.cm	6	Rotate faces
A4988 motor driver	6	
SG90 9g Micro servo motor	1	Color detection
TCS34725 RGB color sensor	1	

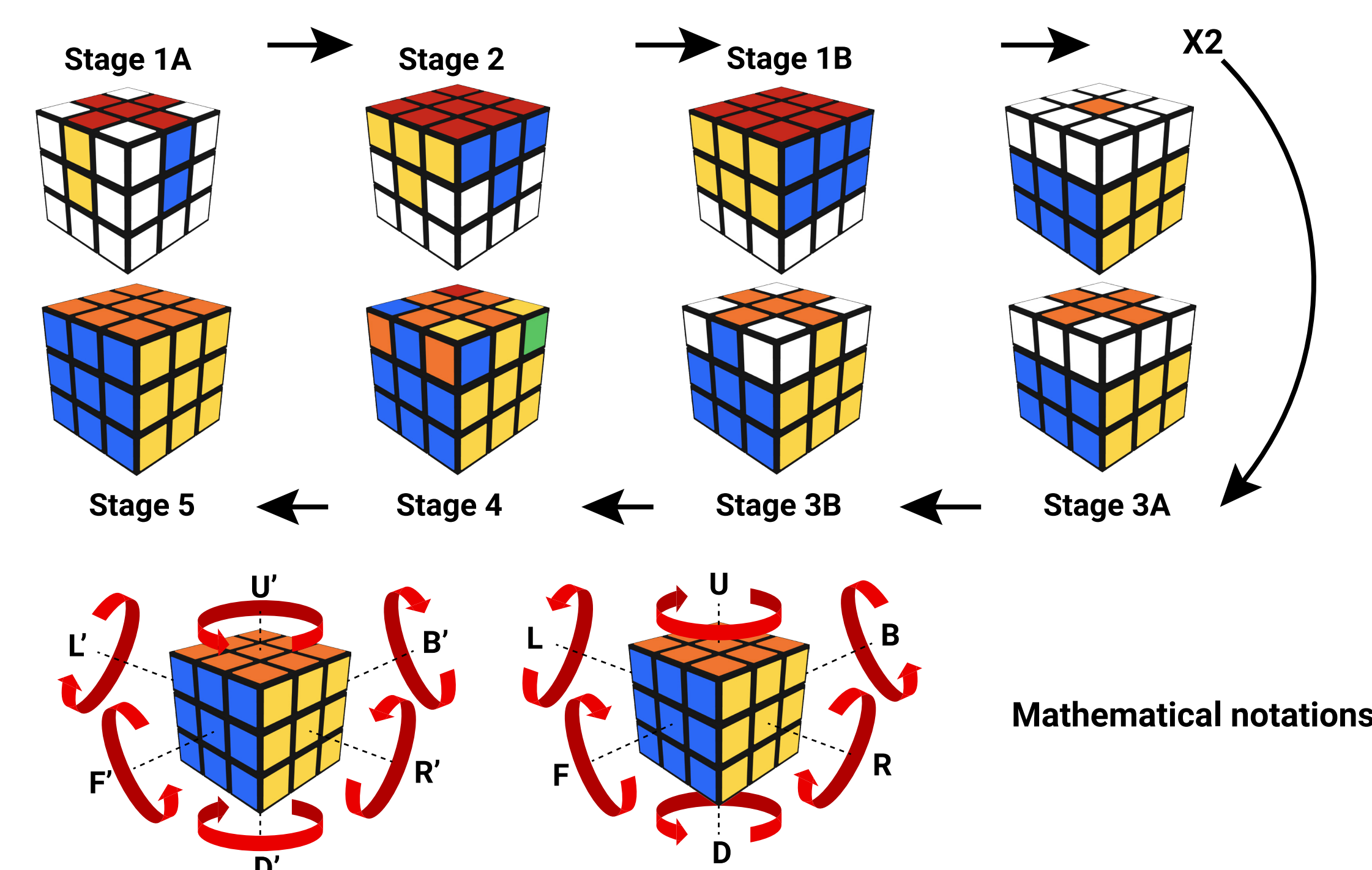
Stepper motor PWM to rotate a face of 90°
1 face = 1 stepper motor



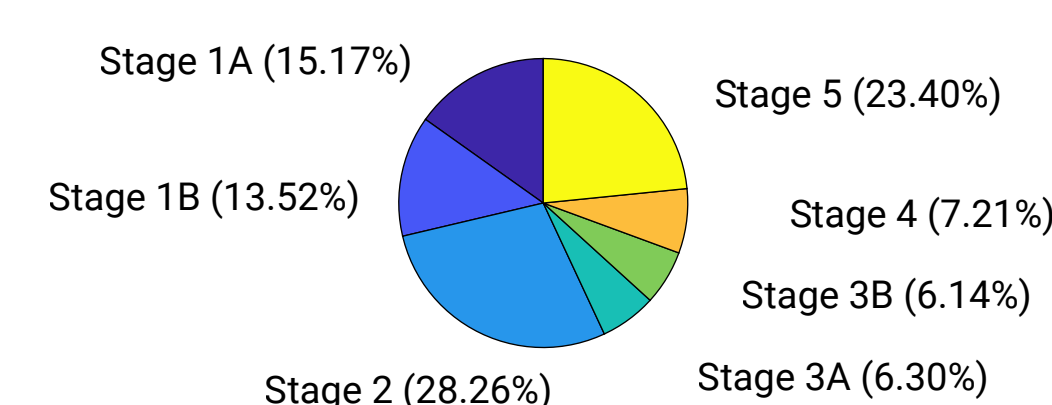
Servo motor PWM to control position of the color sensor



Resolution Algorithm

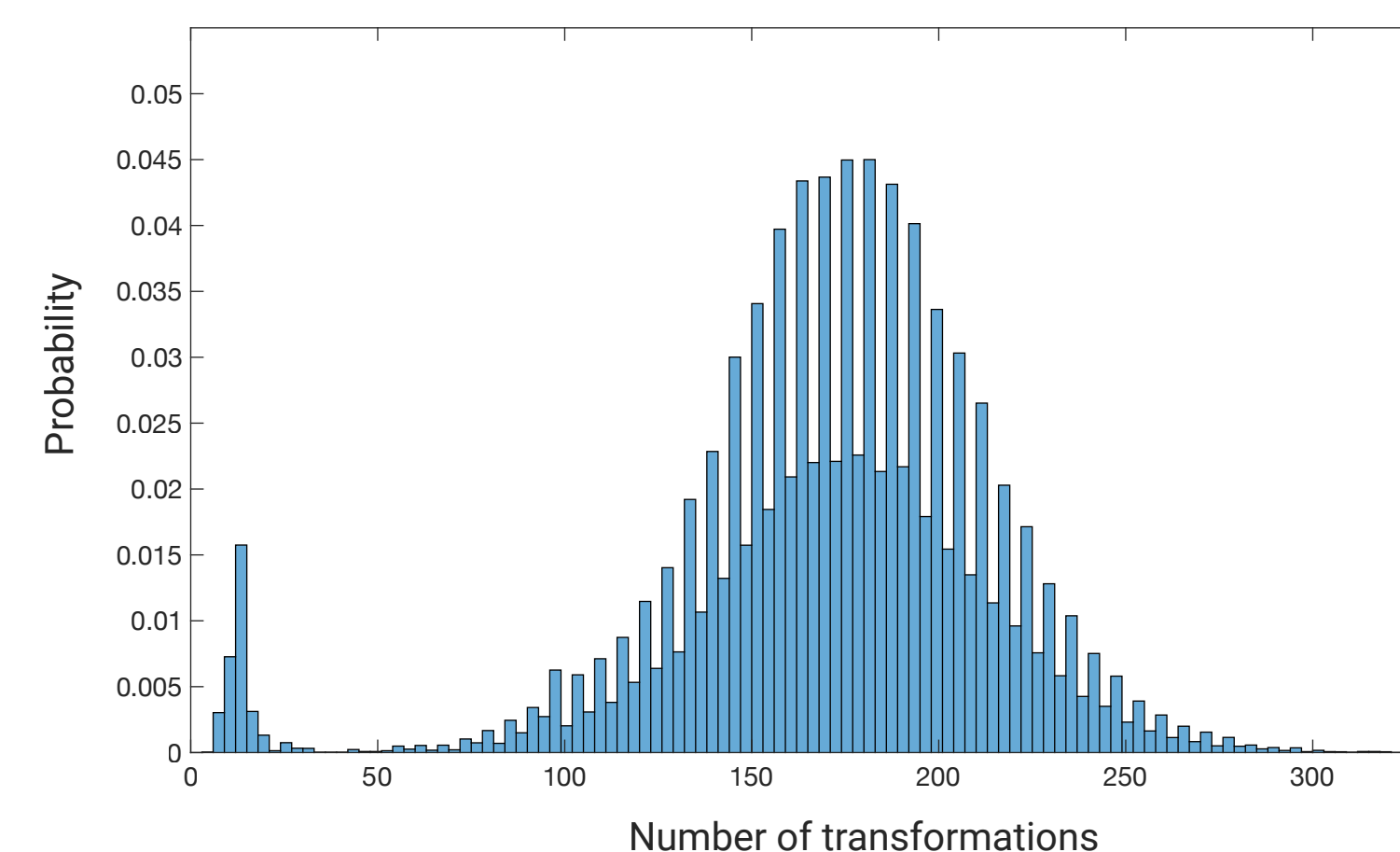


Proportion of each stage (10^6 tests)



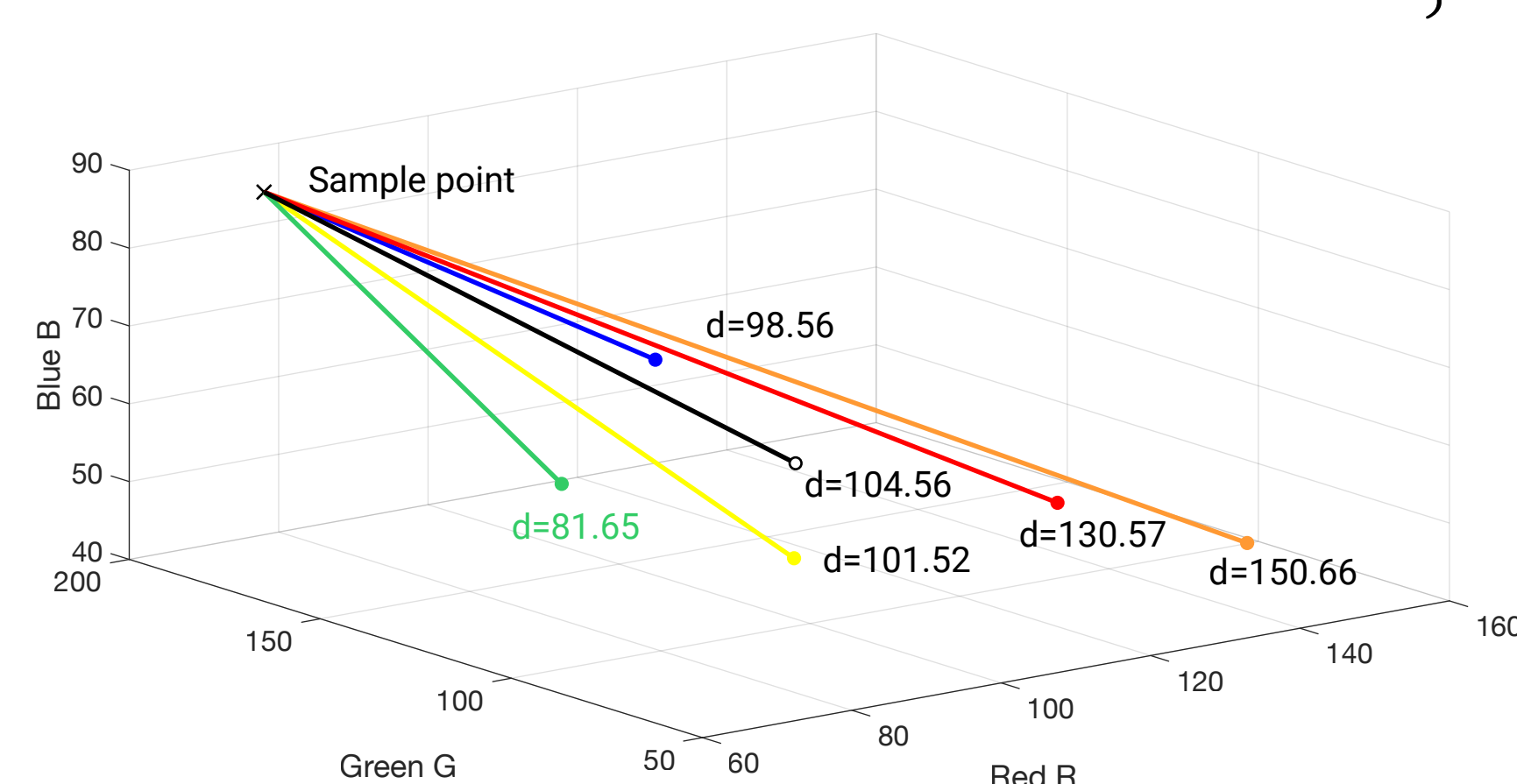
Human method:
ave. 185 moves
Robot algorithm:
ave. 170.2 moves

Total number of transformations (10^6 tests)



Color detection

$$distance = \min \left\{ \sqrt{(x_{sample} - x_{color})^2 + (y_{sample} - y_{color})^2 + (z_{sample} - z_{color})^2}, \right. \\ \left. color \in [red, blue, orange, white, green, yellow] \right\}$$



Color identification by minimum 3D distance

Average color identification success: 99.3%

	LED off	LED on
Red		
Orange		
White		
Green		
Yellow		
Blue		

LED on: better colors,
but Red equal Orange
→ LED set off

Success of color identification

