Autonomous Robots

TREK WARS

SpockBot Vs ForkBot

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Presentation Overview

➤ Project Background

➤ Project Requirements

➤ *SpockBot*

➡ Features ➡ FSM ➡ Pros/Cons ➡ Difficulties

➤ *ForkBot*

➡ Features ➡ FSM ➡ Pros/Cons ➡ Difficulties

➤ Weighted Objectives

➤ Conclusion

➤ Report 3 Progress
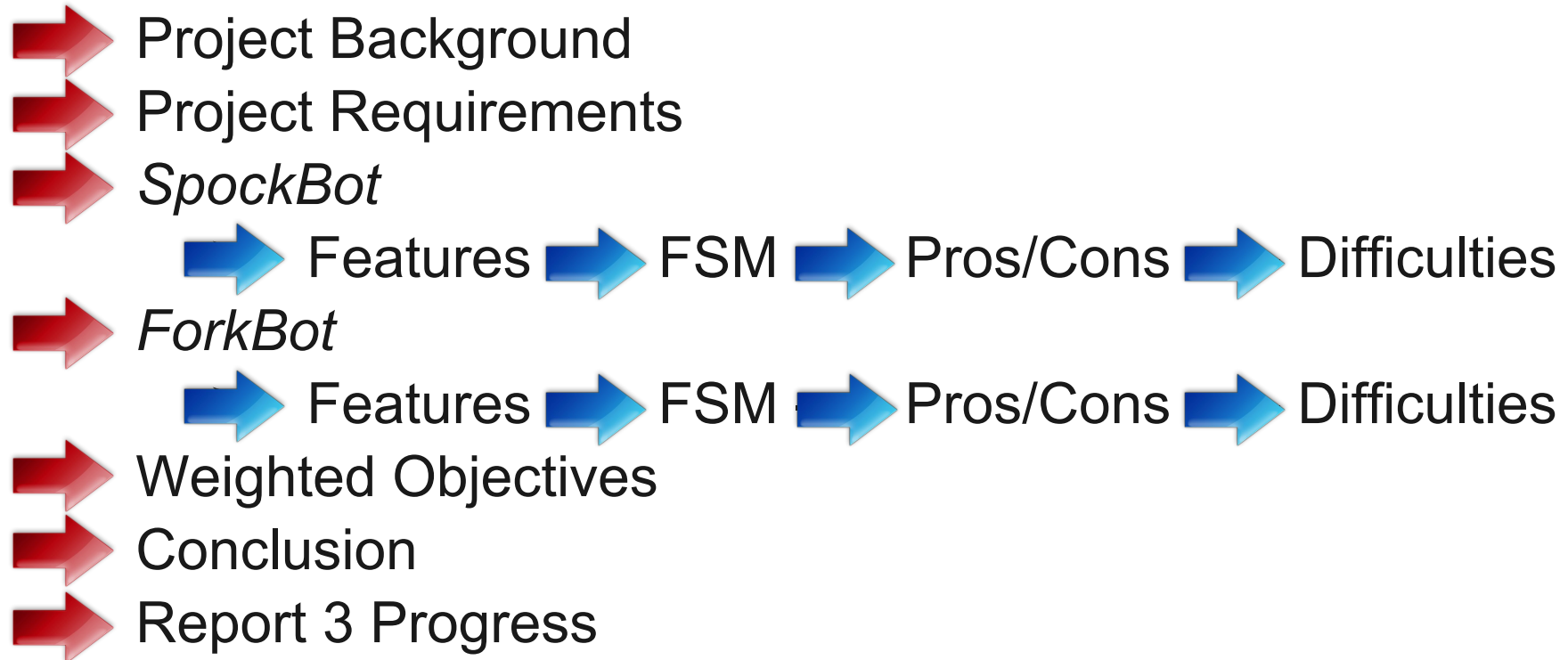
Project Background

- Post Fukushima Daiichi nuclear disaster cleanup

- Small scale autonomous radioactive waste disposal robot

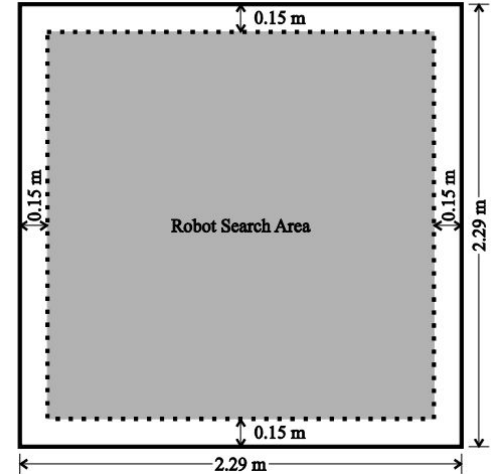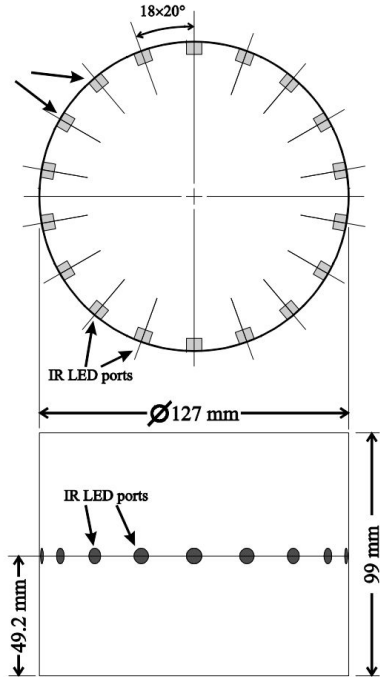- Innovation Canada is looking for candidate robot designs

Project Requirements

Overview

Construct a robot to neutralize a radioactive object within a search area
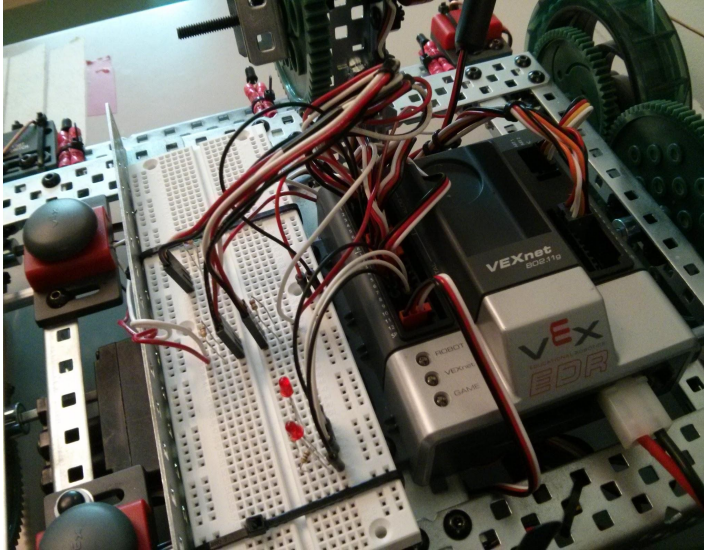
Objectives

- Locate an infrared beacon
- Pick up object on beacon
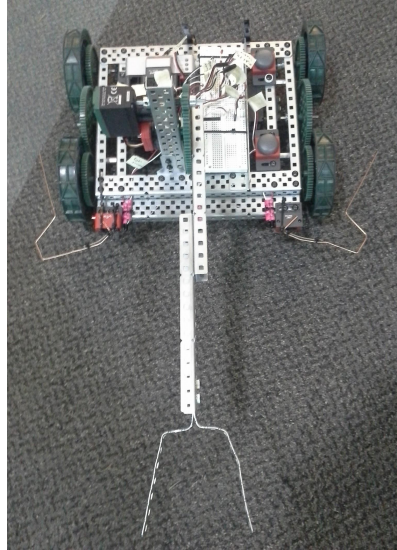- Dispose object outside search area
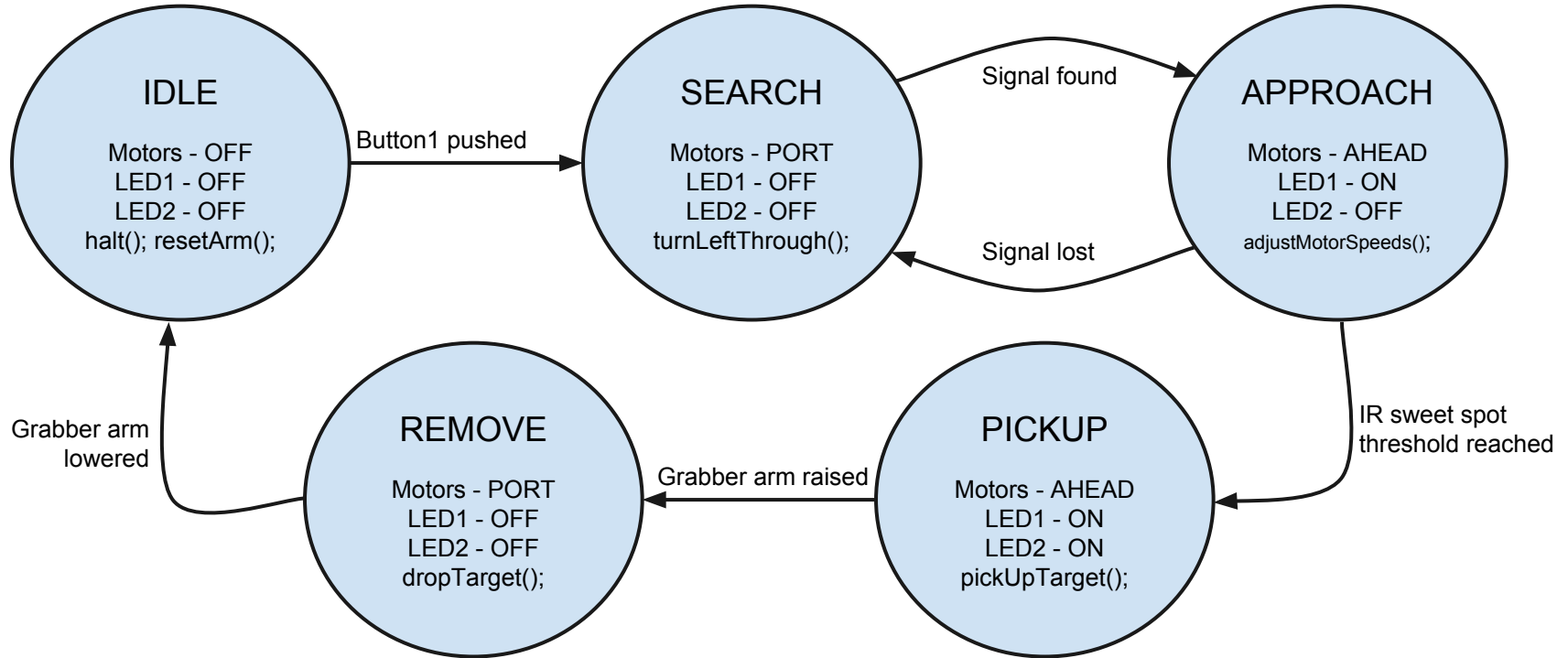
SpockBot

Wiring and Vex Kit

Top View

Target Object

SpockBot features

◈ Motor normalization software for straight movement

◈ 3 IR sensors

◈ 4 wheels, 2 motors with encoders

◈ long-arm pickup with potentiometer

◈ IR threshold stepping for long distance sensing

◈ Emergency stop button

SpockBot Finite State Machine

SpockBot Pros/Cons

Pros

- ✓ Self-correcting approach
- ✓ Cost-effective design
- ✓ Organized code
- ✓ Tight turning radius

Cons

- ✗ IR threshold stepping slowed operation
- ✗ No detection other than IR

SpockBot Difficulties

- ❖ Limit switches readily broke with no available replacements

- ❖ Detected wall reflectance on close start to beacon

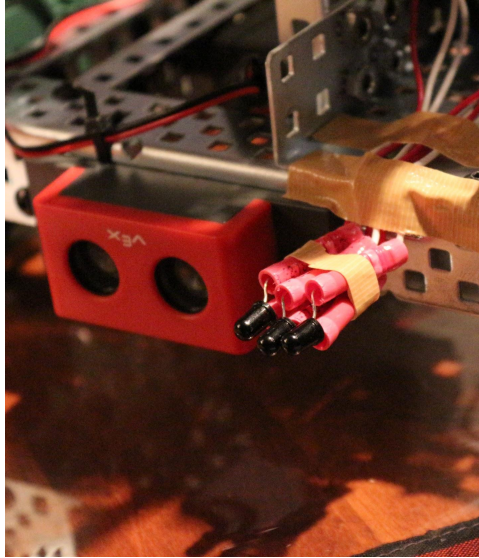- ❖ Unable to sufficiently correct when starting close to beacon

ForkBot

Figure 1 - Sensor layout
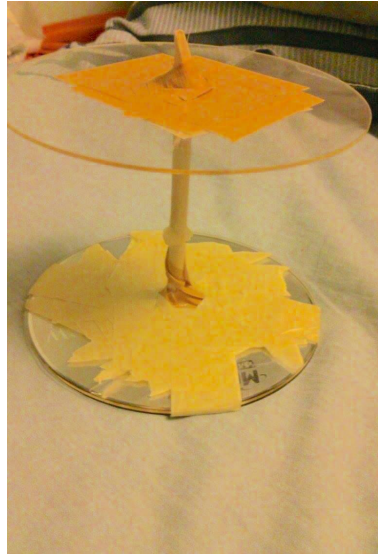

Figure 2 - Object
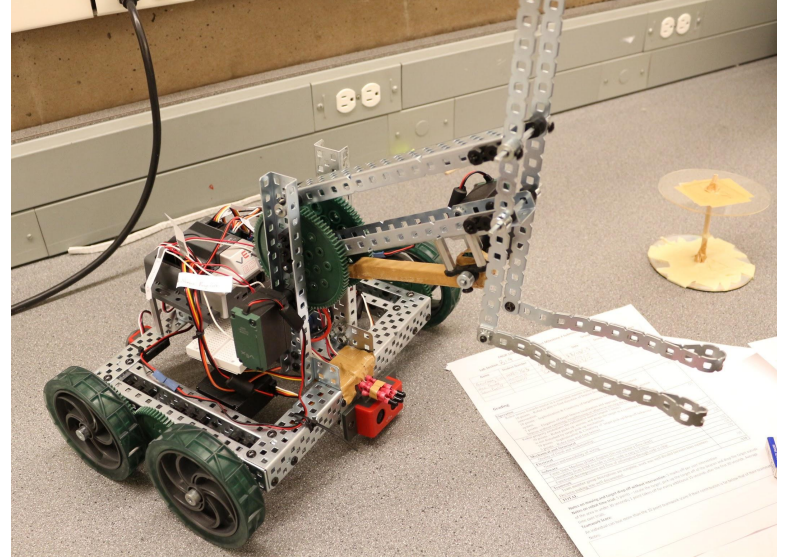

Figure 3 - Robot Overview

ForkBot features

◈ 3 IR sensors

◈ 4 wheels, 1 Motor for each side

◈ Long range forklift arm

◈ Item pusher

◈ Ultrasonic range finder

◈ Re-adjusts to face beacon

ForkBot Pros/Cons

Pros

- ✓ Organized code
- ✓ Stable object pick up
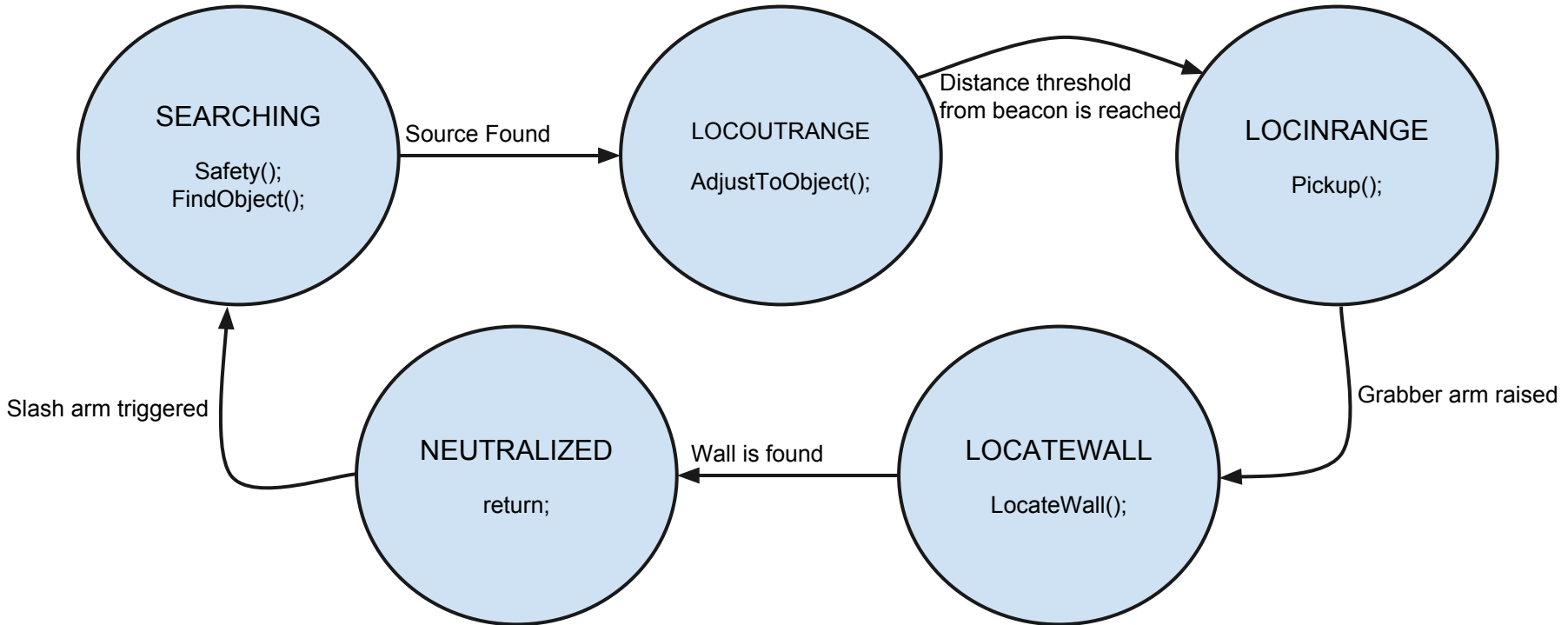- ✓ Very accurate IR sensors
- ✓ Tight turning radius

Cons

- ✗ Heavy forklift arm
- ✗ Body Imbalance

ForkBot Difficulties

- Inconsistent motor wheel speeds

  (due to hardware)

- Wheel skidding
- Crowded labs (poorly organized)

ForkBot FSM

Evaluation Parameters

	0	1	2	3	4	5
Efficiency (avg. task time)	> 40s	< 40s	< 35s	< 30s	< 25s	< 20s
Robot Speed	> 0.10m/s	> 0.25m/s	> 0.50m/s	> 0.75m/s	> 1.0m/s	> 1.25m/s
Additional Part(s) Cost	Over $30	Under $30	Under $25	Under $20	Under $15	Under $10
Code Complexity	> 1000 SLOC	< 850 SLOC	< 700 SLOC	< 550 SLOC	< 400 SLOC	< 250 SLOC
Turning Radius	> 5cm	< 5cm	< 4cm	< 3cm	< 2cm	< 1cm
Failsafes	0	1	2	3-4	5-6	7+
Maximum Carry Weight	<50g	100g	200g	300g	400g	450g+

Weighted Objectives Chart

Objective (criteria)	Weight	Measurement Parameter	SpockBot			Forkbot		
			Magnitude	Score	Value	Magnitude	Score	Value
Efficiency	0.4	Completion Time (s)	<30s	2	0.8	<30s	2	0.8
Robot Speed	0.15	m/s	1.10	4	0.6	1.15	4	0.6
Additional Part Cost	0.1	Dollars (CAD)	0$	5	0.5	0$	5	0.5
Code Complexity	0.1	KLOC	482 lines	3	0.3	441 lines	3	0.3
Turning Radius	0.1	Centimeters	0cm	5	0.5	0cm	5	0.5
Failsafes	0.1	# of Failsafes in code	5	4	0.5	2	2	0.2
Maximum Carry Weight	0.05	g	300g	3	0.15	0.591kg	5	0.25
Overall Utility Values:					3.35			3.15

Conclusion

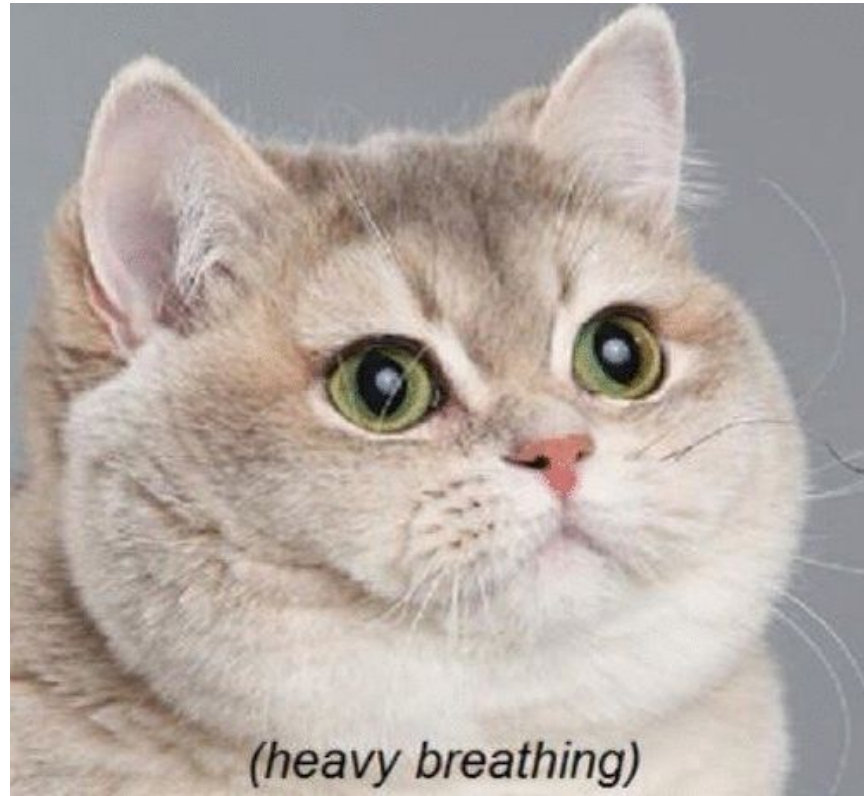Spockbot wins by a nose hair!

Report 3 Progress

Everything is going swimmingly

(heavy breathing)

Questions?!