

Danfoss Turbocor Magnet Insertion Process



Team 5

March 31, 2014

Team Leader:
Coordinator/Financial Advisor:
Webmaster:

Jaro Volny
Henry Ferree
Timothy Blum

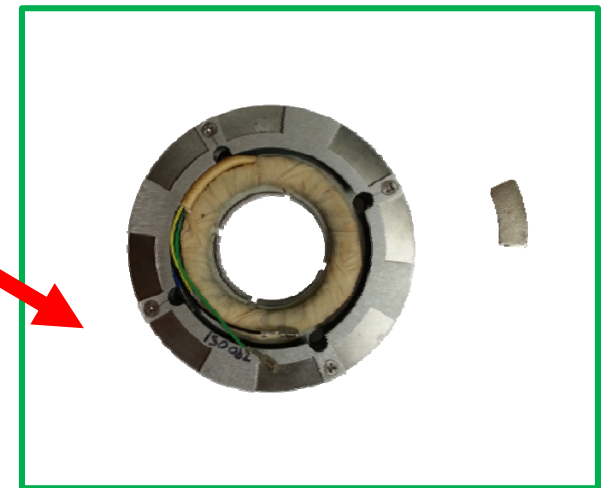
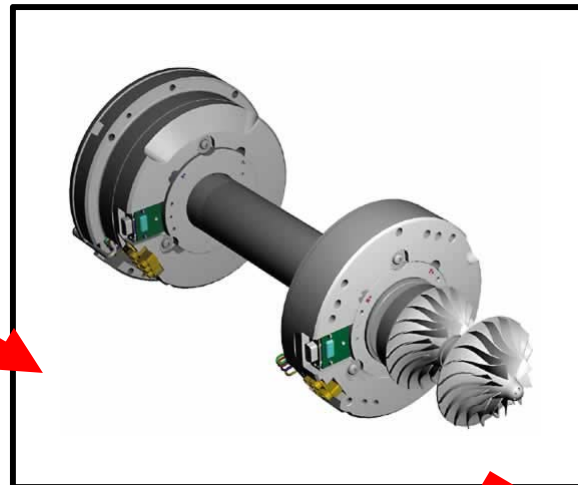
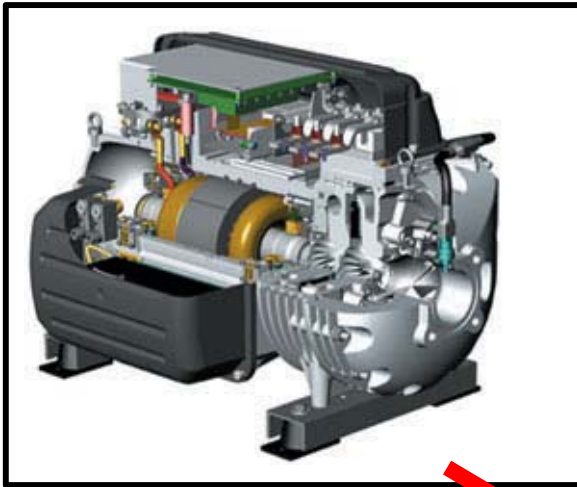
Mentor:
Liaison Engineer:

Dr. Simone Hruda
Paul Lulgjuraj

Agenda

- 1. Project Overview and Background
- 2. Bearing and Magnet Review
- 3. Machine Overview
- 4. Electronics and Logic Selection
- 5. Operational Flow
- 6. Material List and Budget
- 7. Schedule and Future Plans

Project Overview



Project Overview

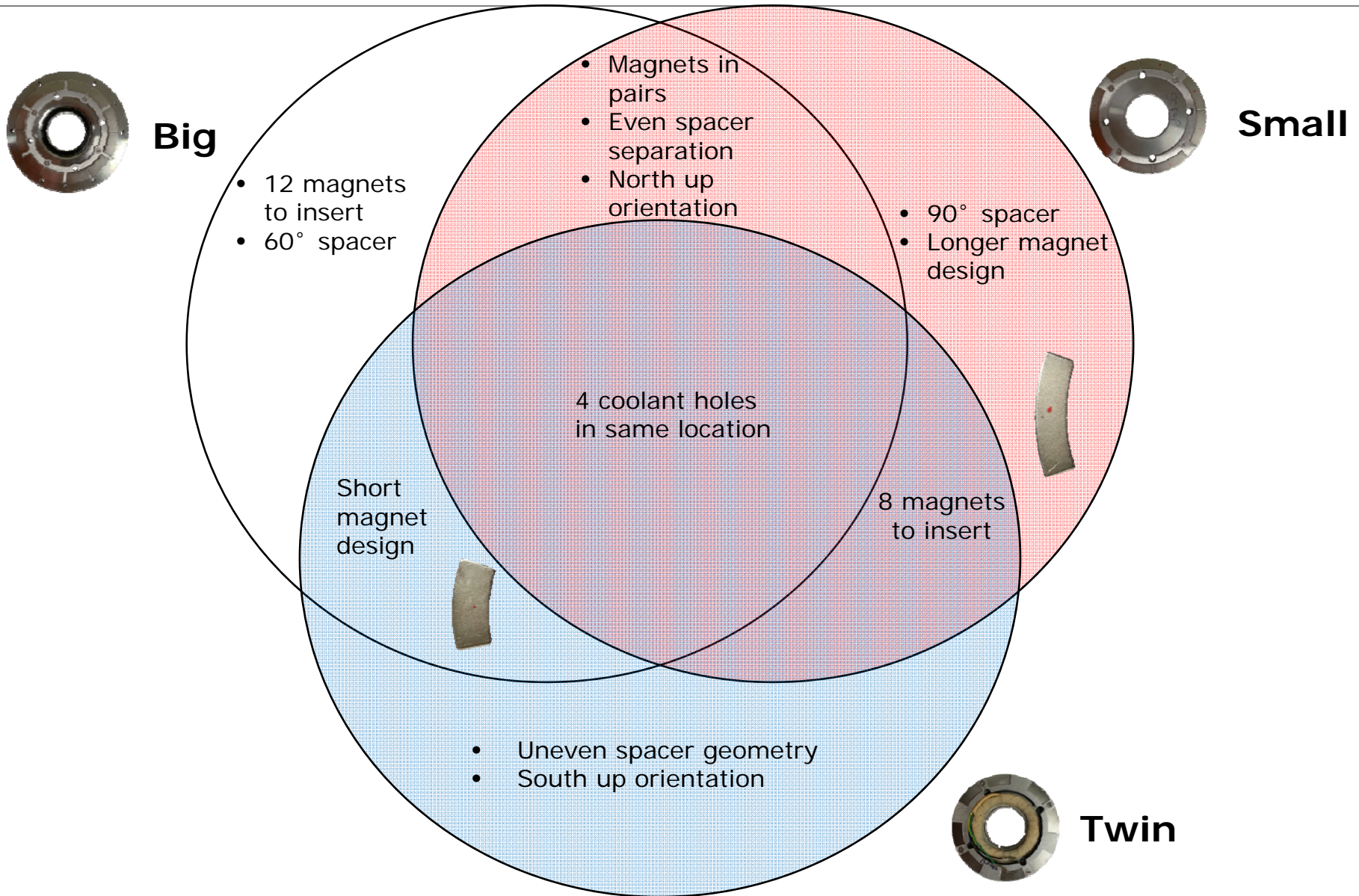
- Problem Statement:

- “There is a need for an ergonomic and efficient magnet insertion process for properly placing magnets on axial bearings.”

- Project Scope:

- Currently a technician inserts the magnets manually
- Issues with quality, operator fatigue, operator downtime

Bearing and Magnet Review



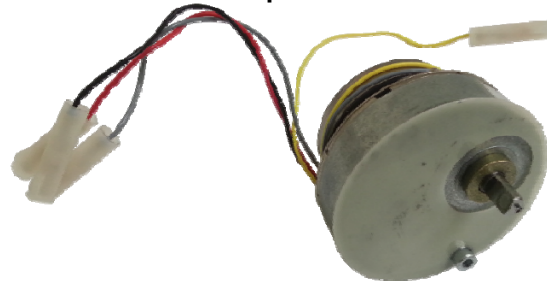
Fall Semester Highlights

- Determined key areas of importance:
 - Indexing
 - Insertion
 - Polarity

- Generated concepts and moved forward with Geneva Mechanism

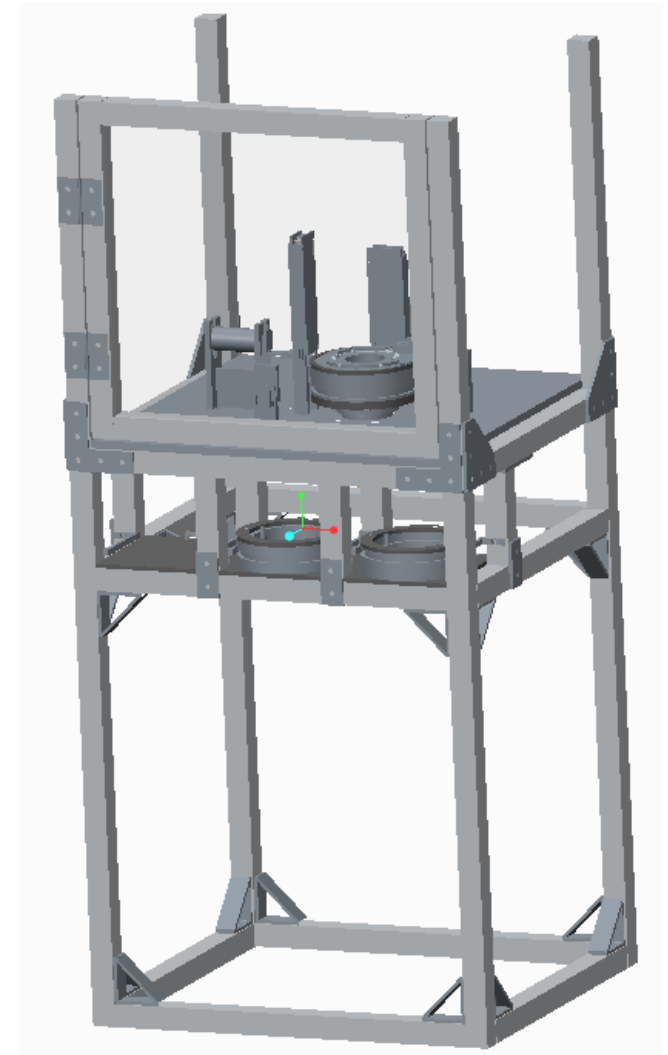
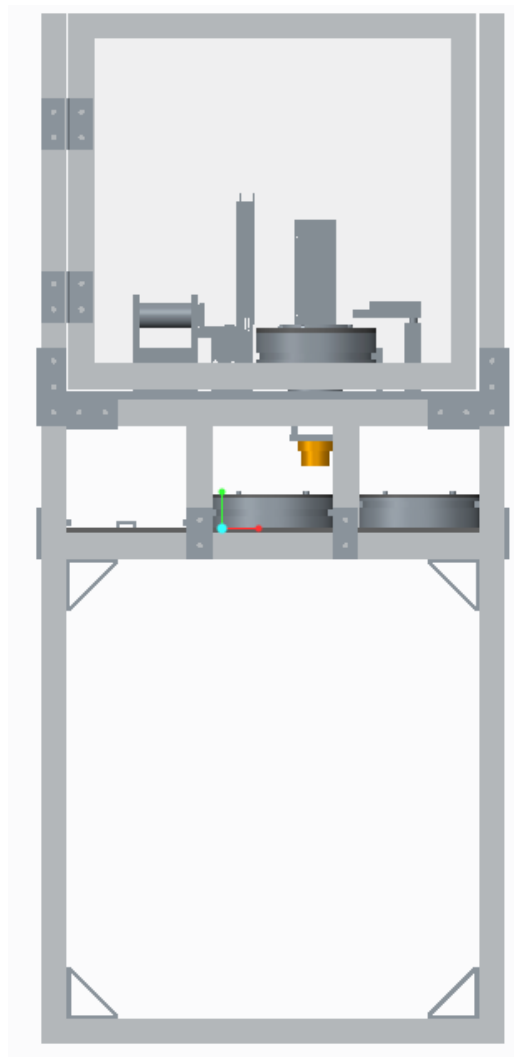
- **Scope changed:** issues with mechanism if bearings changed

- Design changed to automated process with use of a programmable stepper motor



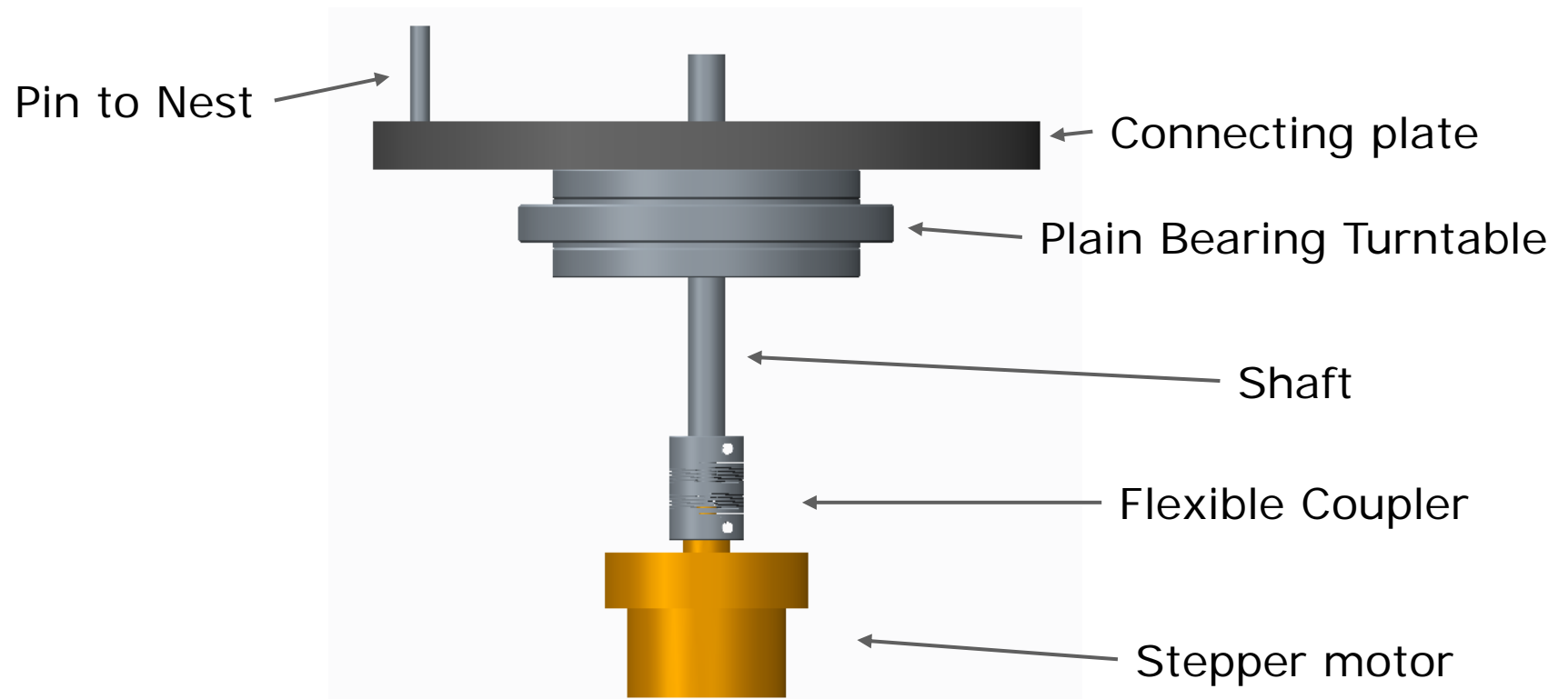
Finalizing Design – Full Assembly

- Total height: 5 feet
- Will stand at operating height of 3 feet
- Not pictured:
 - Side enclosures
 - Door handle
 - Electronic mounting
 - Locking casters



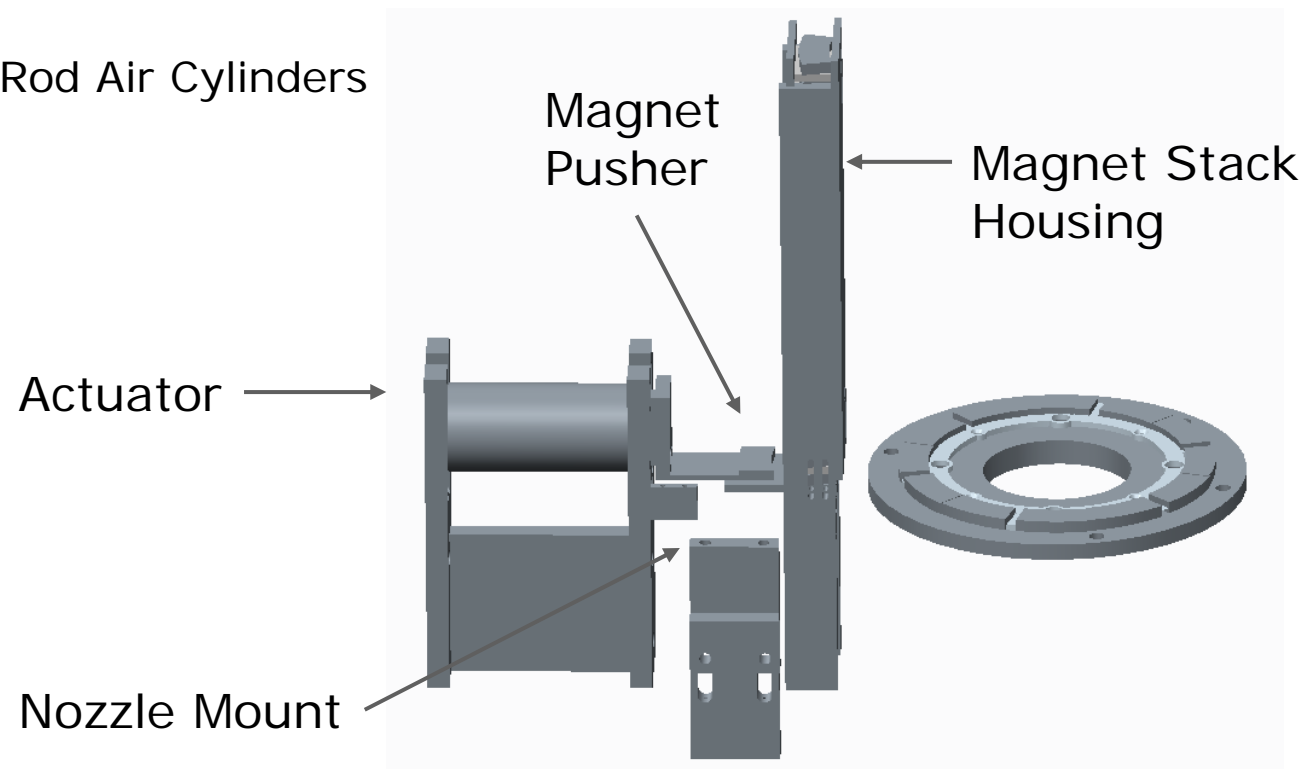
Finalizing Design - Indexing

- Accomplished by stepper motor controlled with DragonBoard
 - Code structure is completed



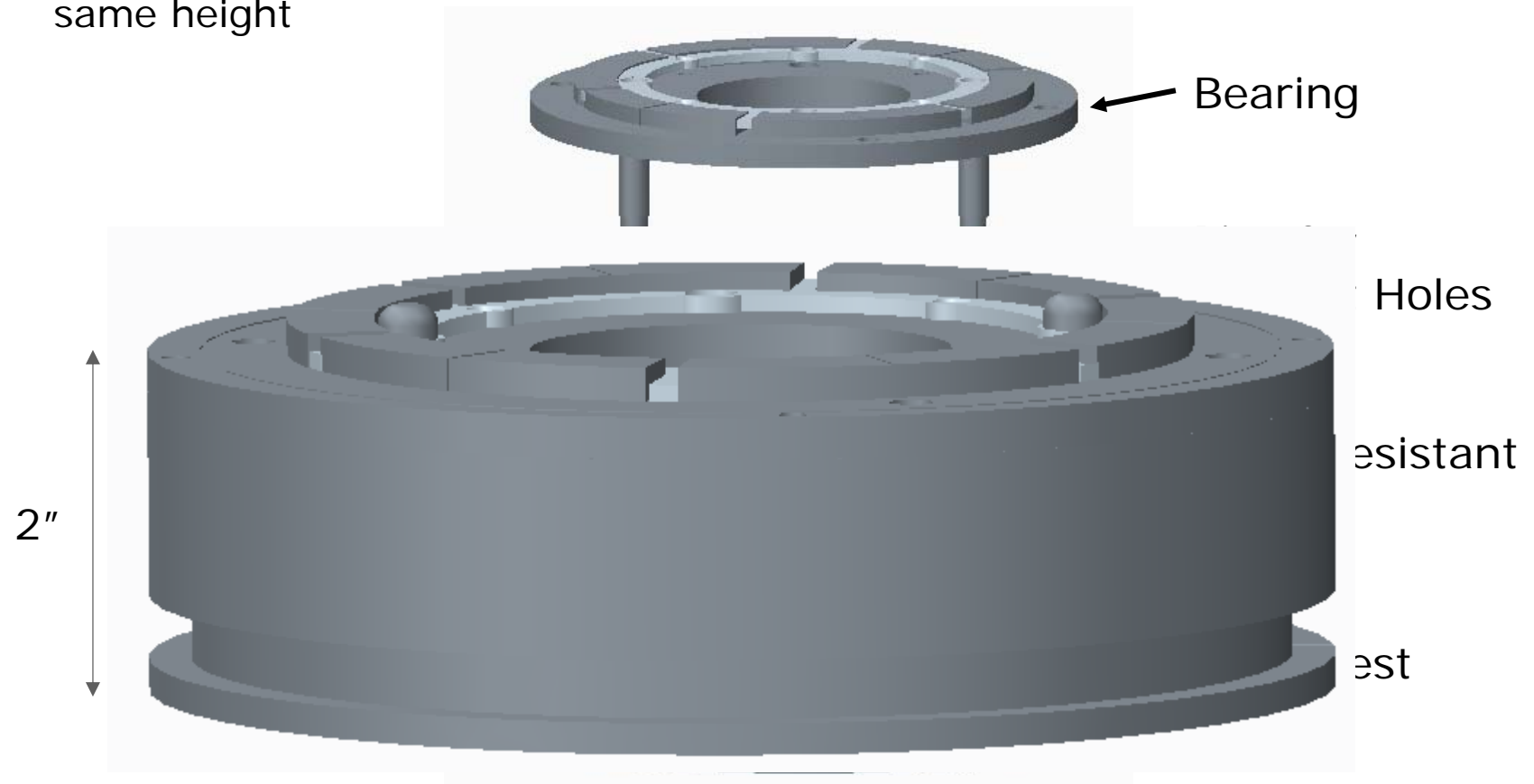
Finalizing Design - Insertion

- Pneumatic actuators controlled by solenoid valves
 - Solenoid valves controlled by Dragonboard used to trigger actuator stroke
- McMaster Tie Rod Air Cylinders



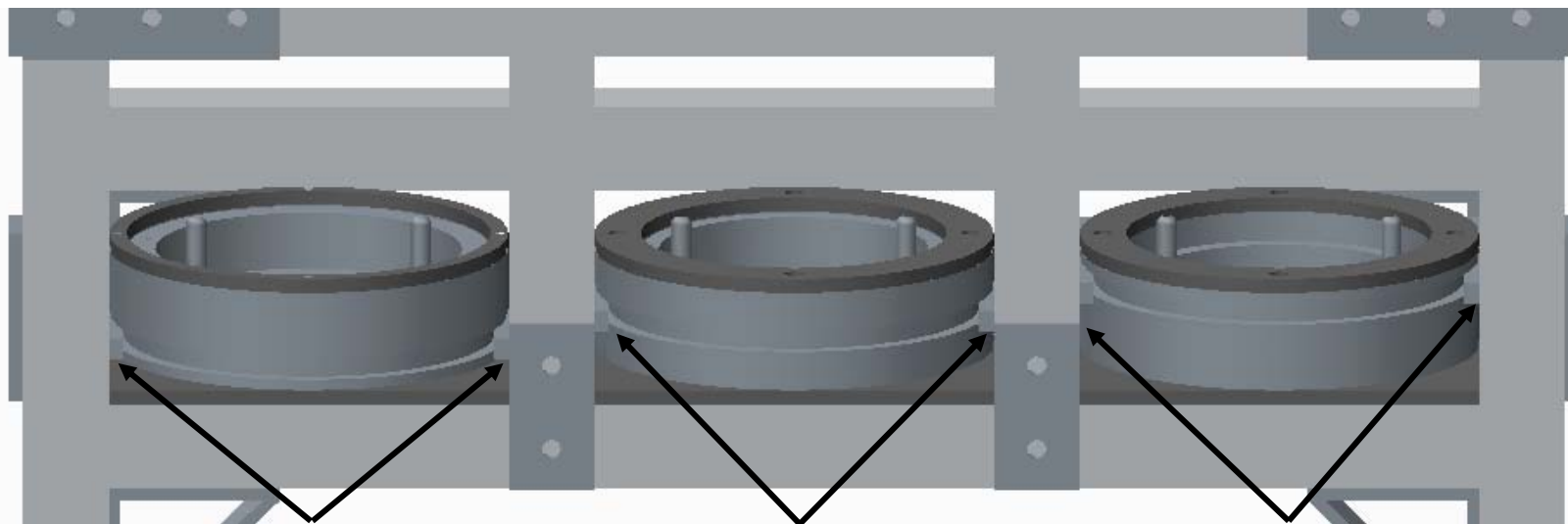
Finalizing Design - Insertion

- “Nests” were designed to ensure different bearing thickness reach the same height



Finalizing Design – Frame Nest Housings

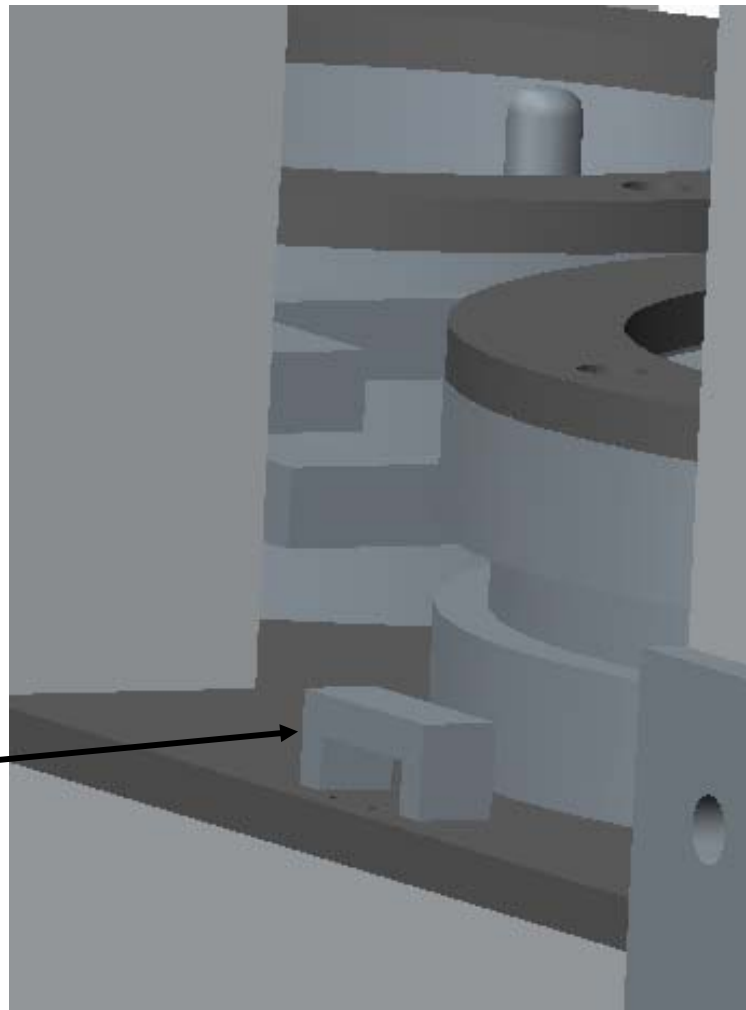
- Nests have keyed slots that are unique to their bearing
- Allows Dragonboard to determine which nest has been removed via limit switches and only runs that bearings insertion program



Keyed slots

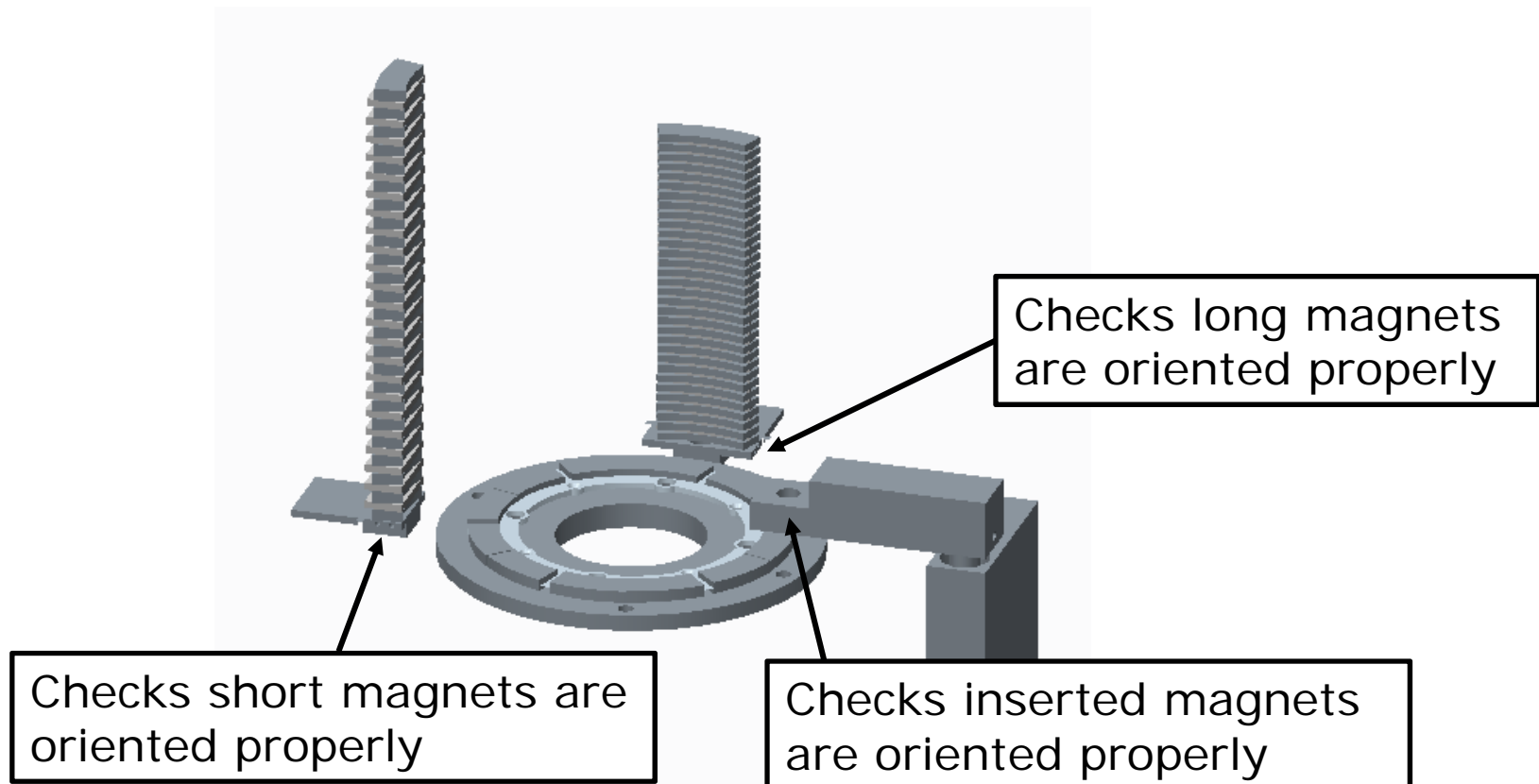
Finalizing Design – Frame Nest Housings

Sensor housing
protects limit switch
used to determine
whether nest is present



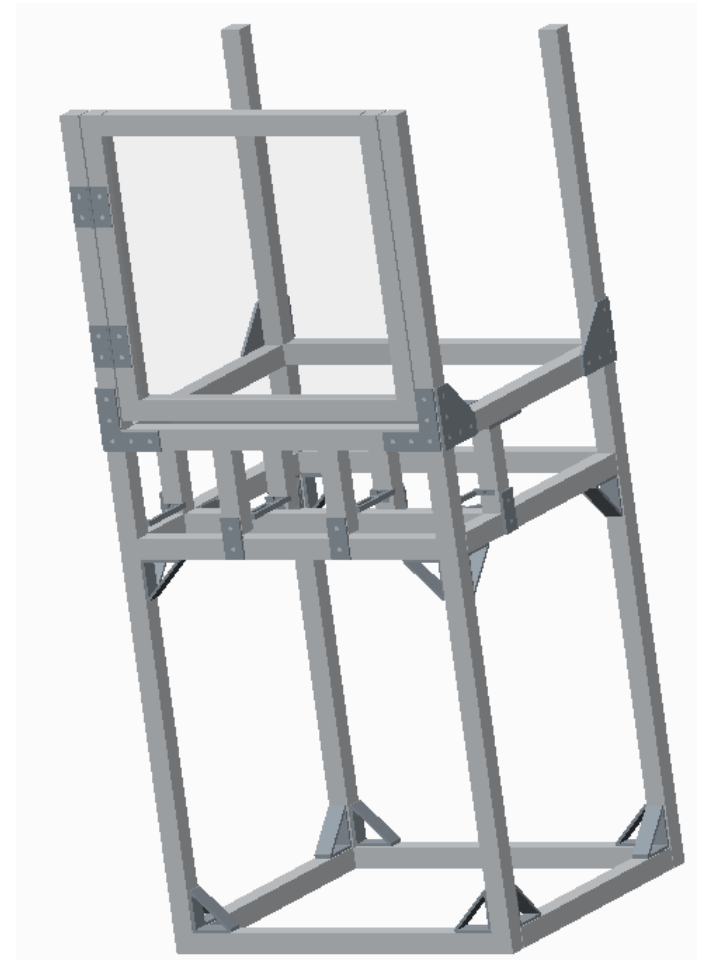
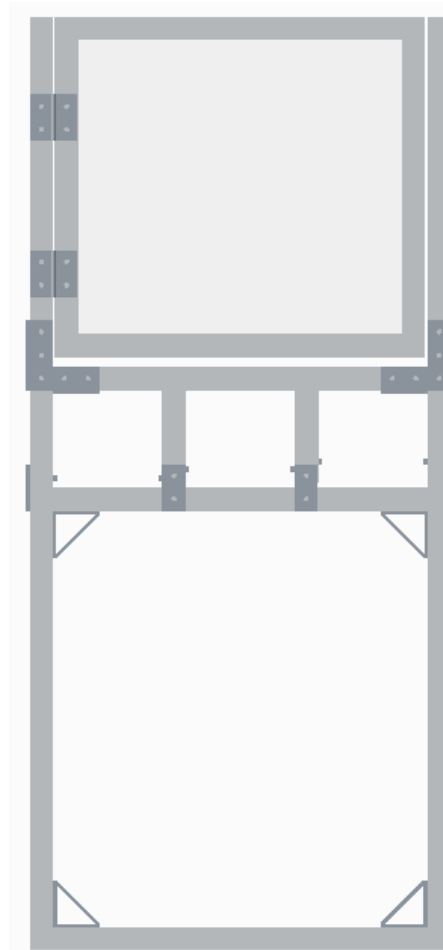
Finalizing Design - Polarity

- Polarity will be checked by sensors resting over the magnet area



Finalizing Design - Frame

- Stand Alone Structure
- Vendor: 80/20



Sensors

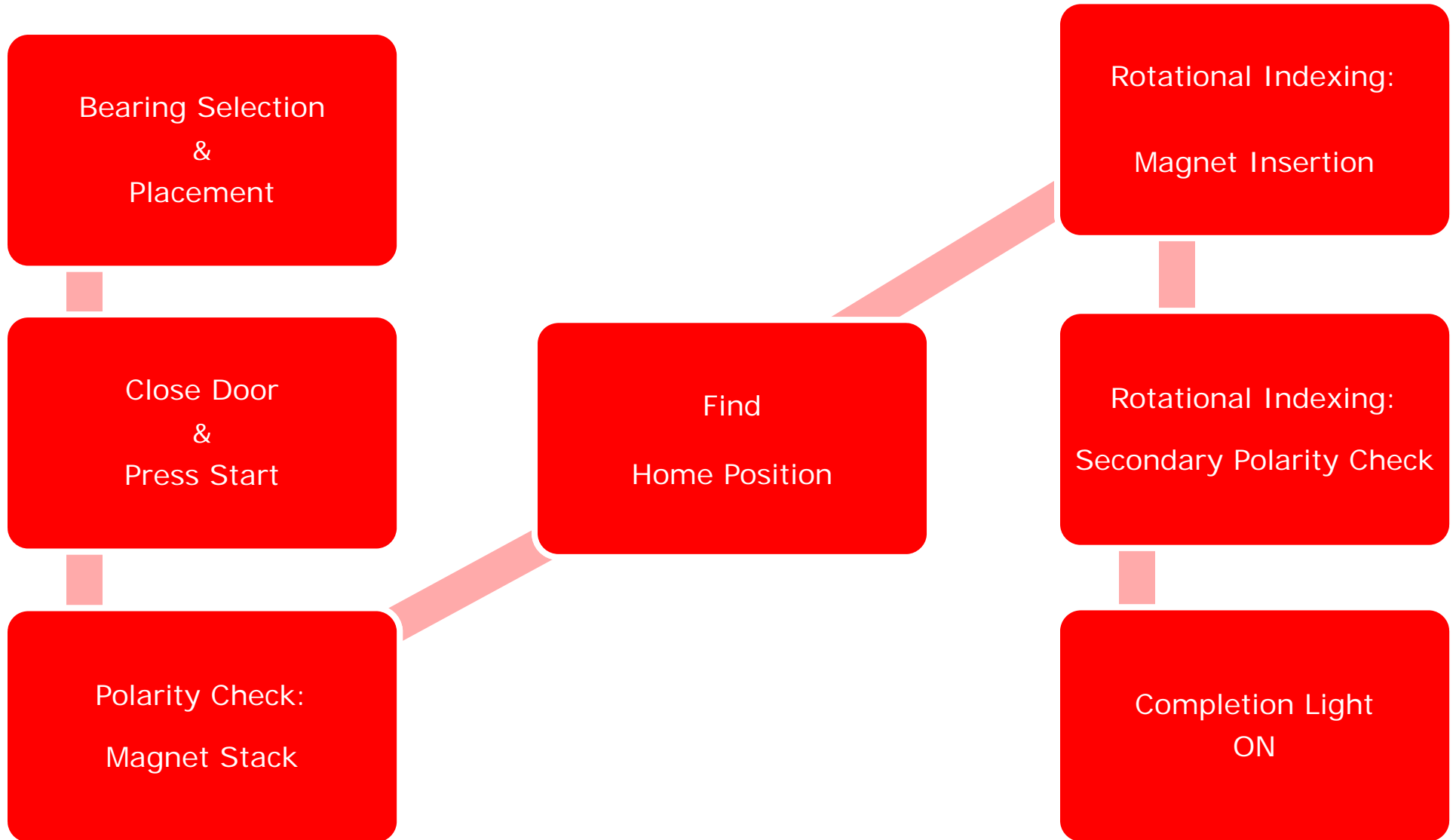
- 1. Limit switches:
 - Nest presence (x3)
 - Door closure (x1)

- 2. Polarity sensor
 - Check magnet polarity before and after insertion (x3)

- 3. Magnetic sensor to detect nest home position
 - Finds ferrous material place inside nest (x1)



Basic Operational Flow



Potential Challenges/Risks

- DragonBoard voltage requirements and communication with switches
 - 5V, 12V and 24V involved
- Stepping the motor
 - Code completed and works
 - Doesn't simulate real operation loads and requirements
- Sensor compatibility and data quality
- Rejecting the spacer from magnet stack
- Machining nests to tight tolerances
- Lack of experience with pneumatic and electrical diagrams
- Attempted to eliminate operator error
 - More issues may arise in assembly

Material List and Budget

- Most parts ready to order
- Some items still need finalizing
- Most lead times are known
- Budget increased from 2000 to 2500
- In house items drastically reduce bottom line cost

#	Item	Quantity	Price	Vendor	Part #	Lead Time
1	80/20	1	\$664.05	8020		1 week
2	Aluminum Baseplate	1	\$316.94	Misumi	L-PNLNM-609.5-609.5-12	4-8 days
3	Plain Bearing					
3	Turntable	1	\$215.27	McMaster Carr	8700K1	1 week
4	Nest Material	1	\$162.60	McMaster Carr	1610T73	1 week
5	Actuators	2	\$139.74	McMaster Carr	5036K12	1 week
6	3/8 Aluminum Sheet	1	\$123.25	McMaster Carr	89155K28	1 week
7	DC Solid State PNP Switch	2	\$104.00	McMaster Carr	4211K302	1 week
8	Polarity Checker	3	\$72.75	Allied Electronics	720207637	3-4 days
9	Rubber Tubing	1	\$67.50	Festo	567948	7-10 days
10	Control Box	1	\$59.38	Allied Electronics	70066992	3-4 days
11	ABS Plastic for Nest Surface	1	\$49.74	McMaster Carr	8586K471	1 week
12	Precision Adjust Air Flow Control Valves	2	\$47.56	McMaster Carr	4076K23	1 week
13	Air Nozzle	2	\$36.00	McMaster Carr	5329K63	1 week
14	Magnetic Sensor	1	\$35.35	Automation Direct	PFM1-AP-3H	In stock, Atlanta
15	Proximity Sensor	16	\$17.44	Mouser	101-61-05-033ST-Q-EV	Ships now
16	1/8 Aluminum Sheet	1	\$14.82	Online Metals		1 week
17	Wear Resistant Steel	1	\$6.94	McMaster Carr	8116K38	1 week
18	10 mm Aluminum rod	1	\$6.89	McMaster Carr	4634T16	1 week
19	3 position switch	1	\$5.99	Auber Instruments	SW5	Ships USPS

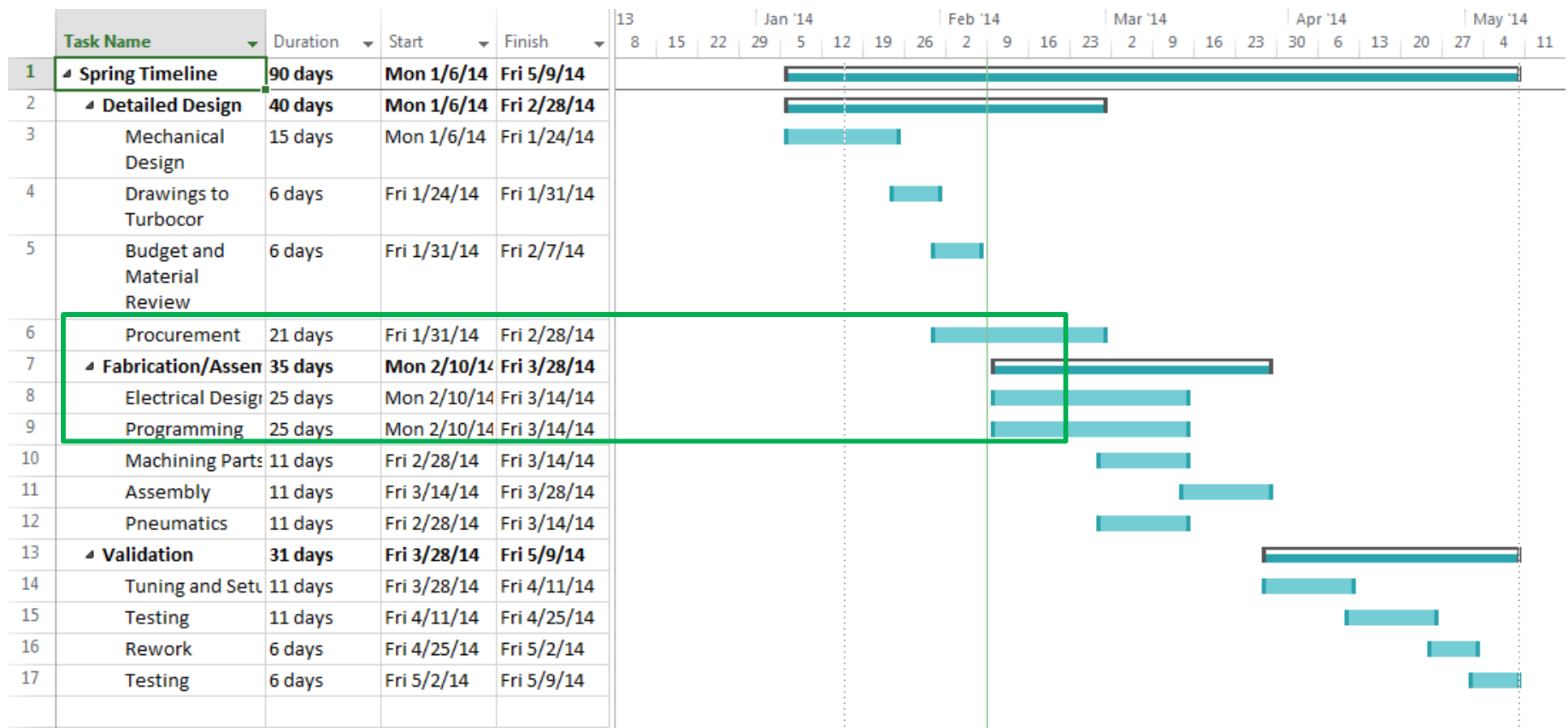
20	Dragonboard	1	\$55.00	EVBplus.com		1 week
21	Motor Driver	1	\$20.00	EVBplus.com		1 week
22	Wiring/Electronics	1	\$50.00	Unknown		
23	Power Supply	1	\$99.00	Automation Direct	PSM24-090S	In stock, Atlanta

1	Motor
2	Flexible Coupling
3	Pneumatic Hoses
4	Machining
5	Buttons/Switches
6	Dinrail
7	Triple Regulator
8	Solenoid Switches

TOTAL	\$2,370.21
--------------	-------------------

Gantt Chart

■ Fabrication and assembling phase about to begin



Questions, Comments, Suggestions, Advice

