Trackoscope: a low-cost open tracking scope for STEM
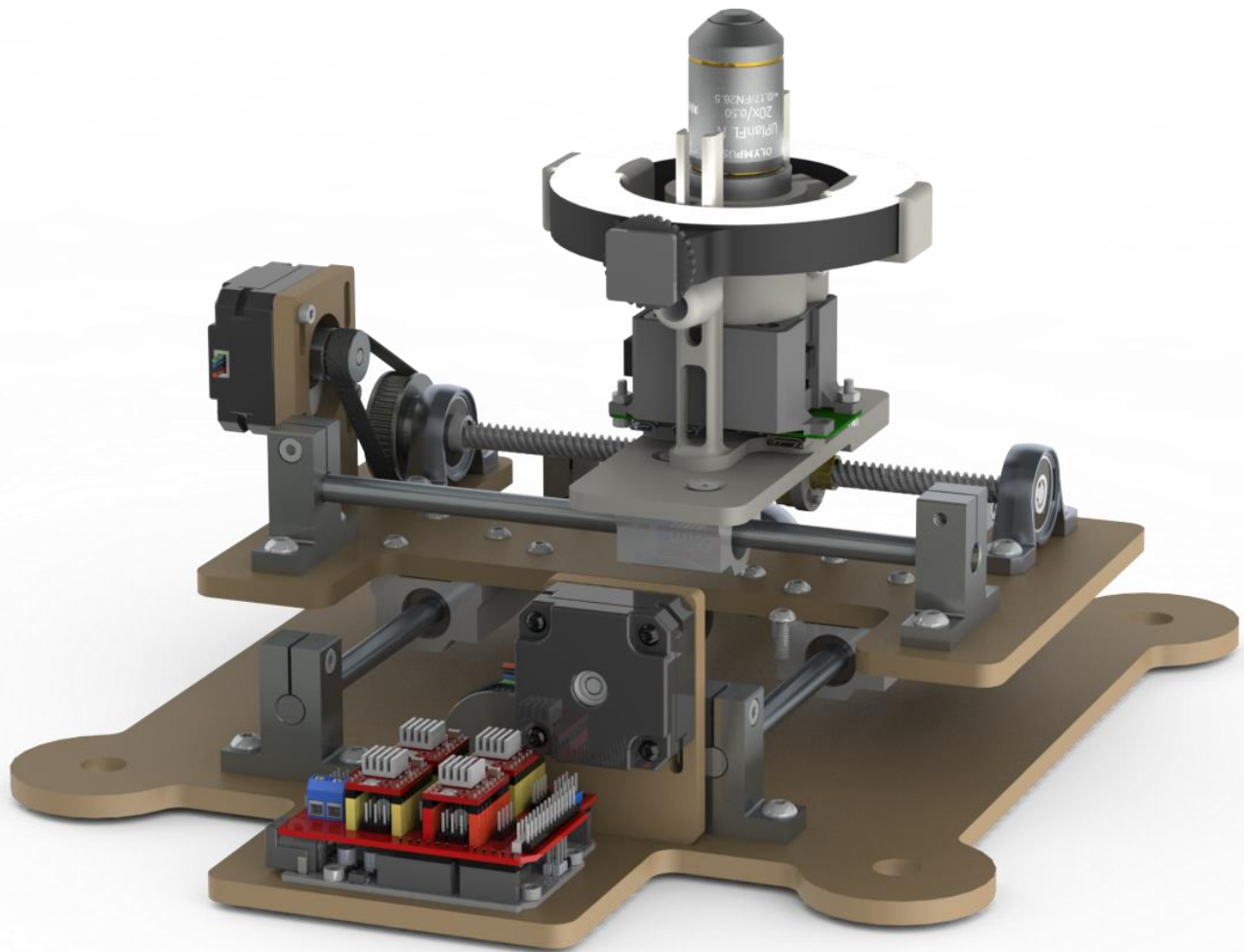
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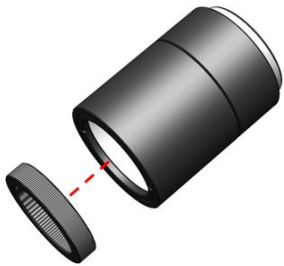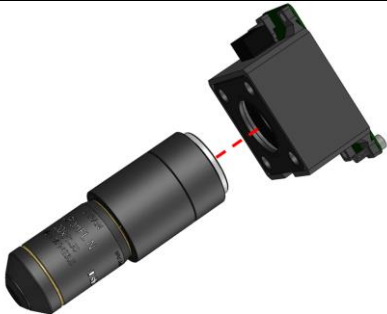
Trackoscope Assembly Instructions

A. Optics Module

Parts

- 1x Raspberry Pi Zero
- 1x SM1L05 Lens Tube
- 2x M3-10 Socket Head Bolt
- 1x SM1RR Ring
- 1x SM1L10 Lens Tube
- 2x M3 Nut
- 1x 3D Printed Top Case
- 1x Achromatic Doublet Lens
- 1x 3D Printed Bottom Case
- 1x Cage Plate
- 1x Raspberry Pi HQ Camera
- 1x Objective Lens

|		
1. Press the Raspberry Pi HQ Camera inside the two 3D printed pieces	2. Attach the Raspberry Pi Zero with two M3 bolts. Attach nuts after building	3. Press the cage plate into the sensor side of the camera
4. Screw the retaining ring midway into 0.5" lens tube.	5. Place the lens into lens tube, convex face facing down.	6. Screw the 1" lens tube to the 0.5" lens tube. Be sure to screw onto the side where the convex face of the lens is.

7. Screw a retaining ring into the lens tube set	8. Screw an objective lens to the lens tube set	9. Screw the lens system to the cage plate

B. Z-Axis Module
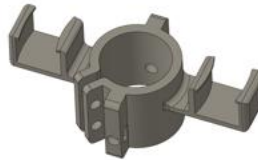
Parts

- 1x Optics Module
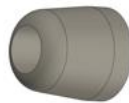
- 2x 3D Printed Knobs

- 10x 6mm Neodymium Magnets

- 1x Ring Light
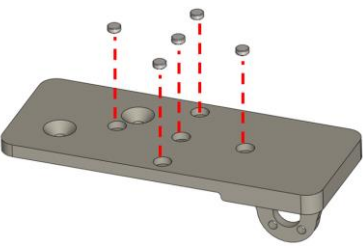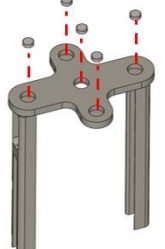
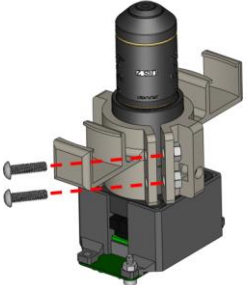- 1x 3D Printed Combined Hold

- 1x 3D Printed Stand
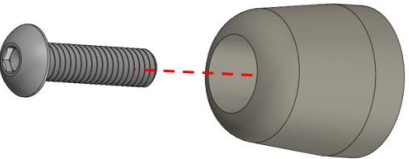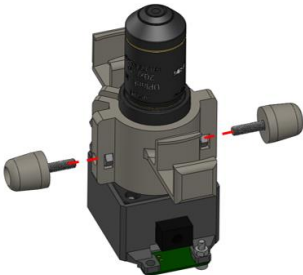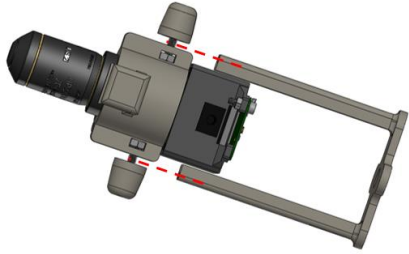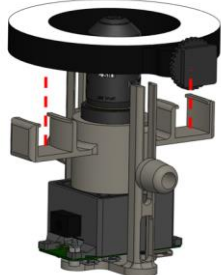
- 4x M4-14 Flat Head Bolt

- 4x M4 Nut

- 1x 3D Printed Base

1. Glue 5 magnets into the base portion (ensure magnet polarity is the same)	2. Glue 5 magnets into the stand portion (ensure magnet polarity is the same and opposite of base magnets)	3. Slide the optics unit into the combined hold
4. Clamp the optics with 2 M4 bolts and nuts	5. Glue an M4 bolt into a knob. (repeat twice for the second knob)	6. Slide 2 M4 nuts into the gaps in the combined hold piece
7. Screw the knobs in slightly till they grasp onto the nut	8. Slide the combined module into the stand and screw in the knobs till the system is secure	9. Snap the ring light into the module

C. Y-Axis Module

Parts
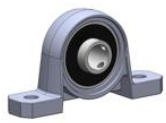
- 2x Pillow Block Bearing
- 1x Laser Cut Motor Mount
- 1x Timing Belt
- 2x Linear Shaft Mount
- 1x Optics Base
- 1x Linear Bearing
- 1x Laser Cut Y-Base
- 8x M5-10 Pan Head Bolt
- 1x Lead Screw Nut
- 1x GT2 48T Pulley
- 2x M3-10 Socket Head Bolt
- 1x NEMA 17 Stepper Motor
- 1x GT2 20T Pulley
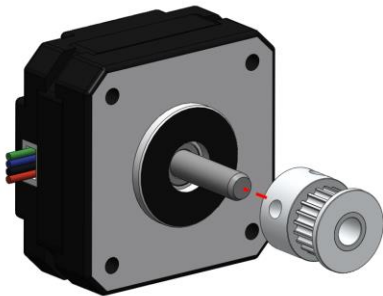- 8x M5 Nut
- 1x 200mm Threaded Rod
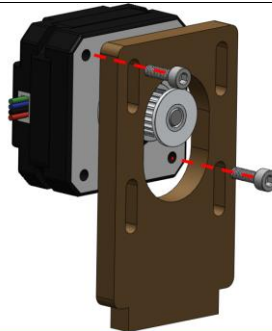- 1x 200mm Linear Shaft

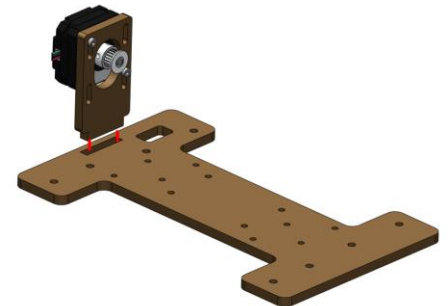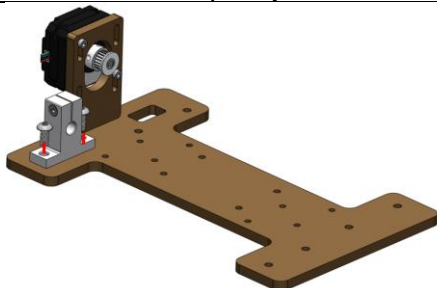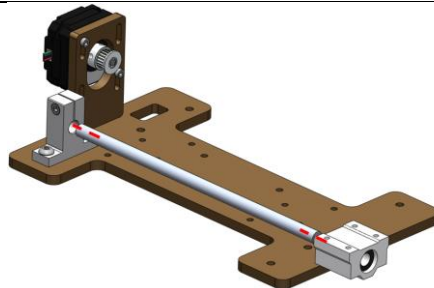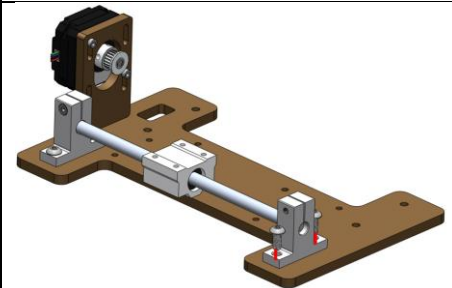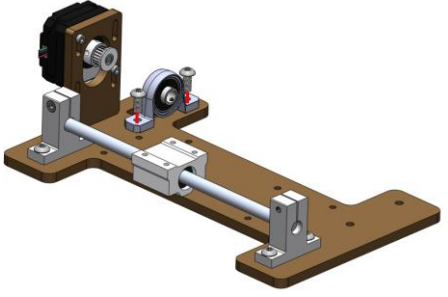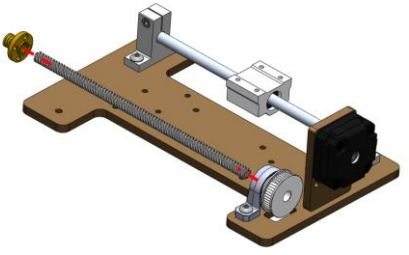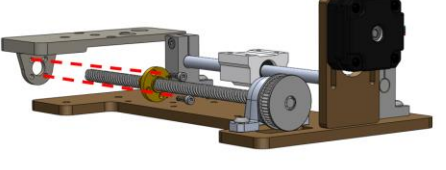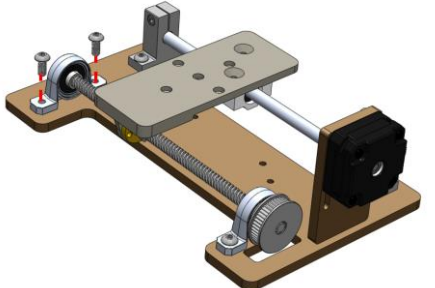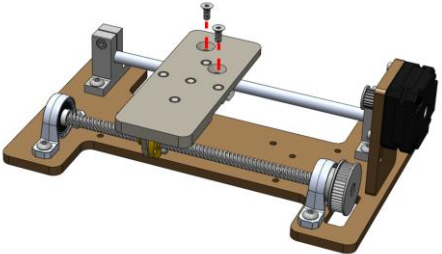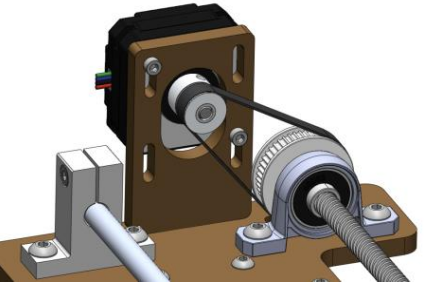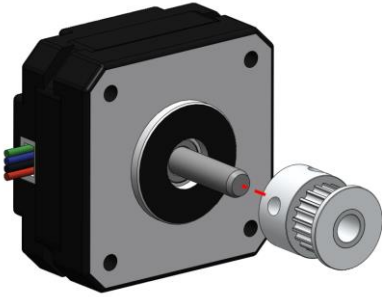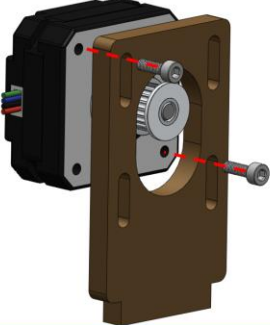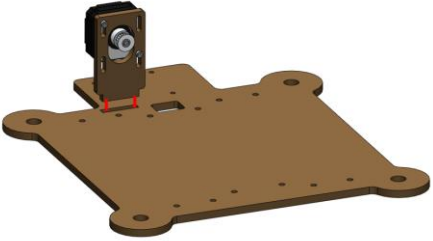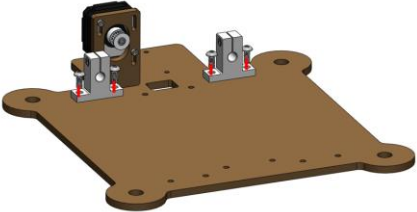|		
1. Slide the 20T pulley onto stepper motor shaft. Tighten the two set screws on the pulley.	2. Screw the stepper motor onto the laser cut motor mount.	3. Glue the motor mount into the laser cut y-axis base. Use super glue or epoxy. Let fully cure.
4. Screw a linear shaft mount onto the base with M5 bolts.	5. Slide the linear shaft into the mount and slide a bearing onto the shaft.	6. Screw a linear shaft mount onto the base with M5 bolts. Tighten the set screws in both linear shaft mounts.
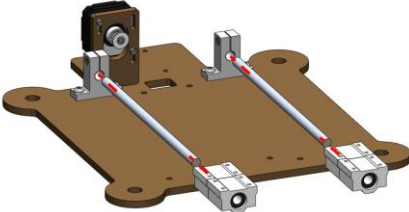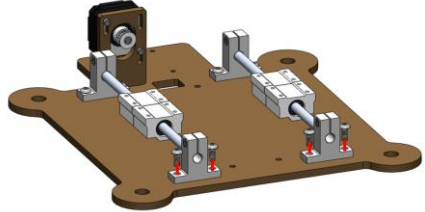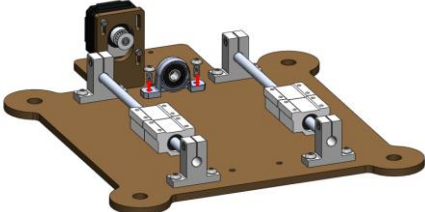
7. Screw a pillow block bearing onto the base with M5 bolts.	8. Place the belt on the 42T pulley and slide the threaded rod through the pillow block bearing and the pulley. Spin the lead nut onto the rod.	9. Screw the optics base to the lead screw nut using two M3 nuts and bolts.
10. Attach the pillow block bearing onto the base with M5 nuts and bolts.	11. Attach the optics base to the linear bearing with two M4 nuts.	12. Adjust the motor mount screws to maintain slight tension in the belt.

D. X-Axis Module

Parts

- 2x Pillow Block Bearing

- 1x Laser Cut Motor Mount

- 1x Timing Belt

- 4x Linear Shaft Mount

- 12x 3D Printed Connector

- 1x Laser Cut X-Base

- 12x M5-10 Pan Head Bolt

- 4x Linear Bearing

- 4x M3-10 Socket Head Bolt

- 1x Lead Screw Nut

- 1x GT2 48T Pulley

- 12x M5 Nut
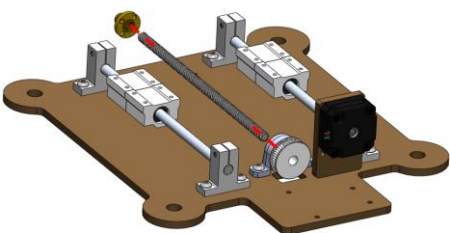
- 1x NEMA 17 Stepper Motor

- 1x GT2 20T Pulley

- 2x M3 Nut

- 1x 200mm Threaded Rod

- 2x 200mm Linear Shaft

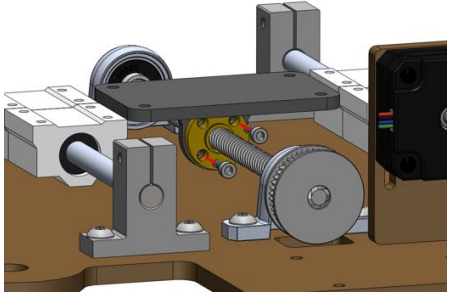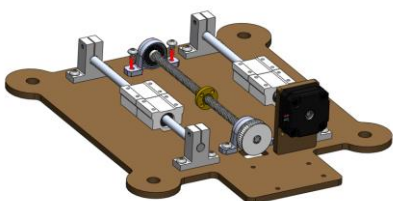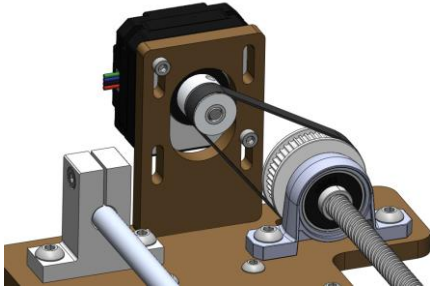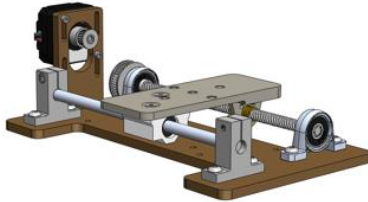|		
1. Slide the 20T pulley onto stepper motor shaft. Tighten the two set screws on the pulley.	2. Screw the stepper motor onto the laser cut motor mount.	3. Glue the motor mount into the laser cut x-axis base. Use super glue or epoxy. Let fully cure.
4. Screw two linear shaft mount onto the base with M5 bolts.	5. Slide the linear shafts into the mounts and slide two bearings onto each shaft.	6. Screw two linear shaft mount onto the base with M5 bolts. Tighten the set screws in all linear shaft mounts.
7. Screw a pillow block bearing onto the base with M5 bolts.	8. Place the belt on the 42T pulley and slide the threaded rod through the pillow block bearing and the pulley. Spin the lead screw nut onto the rod.	9. Slide the XY connector onto the threaded rod and secure onto the lead screw nut with 2 M3 bolts and 2 M3 nuts.
10. Screw a pillow block bearing onto the base with M5 bolts. Tighten the set screws on the pillow block bearings.	11. Adjust the motor mount screws to maintain slight tension in the belt.	

E. Overall Assembly

Parts
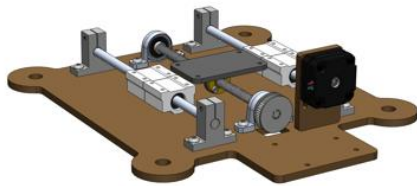
- 1x X-Axis Module
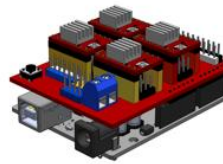
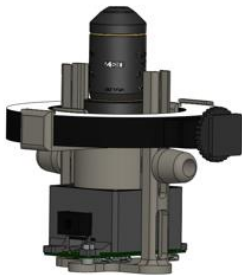- 1x Arduino Uno + CNC Shield

- 14x M4-12 Socket Head Bolt

- 1x Y-Axis Module

- 4x M2-14 Socket Head Bolt

- 4x M3 Nut

- 1x Z-Axis Stand

- 4x M4 Nut

1. Place 12 M4 bolts into the holes on the y-base. If needed place the included spacers between the x and y axes.	2. Screw the bolts into the x-axis linear bearings. Back the bolts in the xy-connector with M4 bolts.	3. Snap the optics z-axis stand onto the y-axis.
4. Screw the Arduino Uno to the x-base with 4 M3 bolts.	5. Add support legs to the actuator if needed.	