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Team 05:

Automatic Antenna Boresight Mast



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Problem Statement

For electromagnetic compatibility (EMC) measurements, an automatic antenna tower is used to move (or scan) a receive antenna from a height of 0.5 meters to 4 meters. There are requirements for certain tests that the antenna should be boresighting (constantly pointing) to a Device Under Test (DUT) which is located at a certain distance away from the antenna tower (2.5 to 10 meters). Essentially, the antenna on the tower needs to tilt and maintain an angle, depending on distance from the DUT, as the antenna moves up and down the tower. Since this is used to measure radio-frequency signals in a radio-frequency-quiet anechoic chamber, consideration must be given to reduce spurious emissions from the motor and controller unit.

Specifications

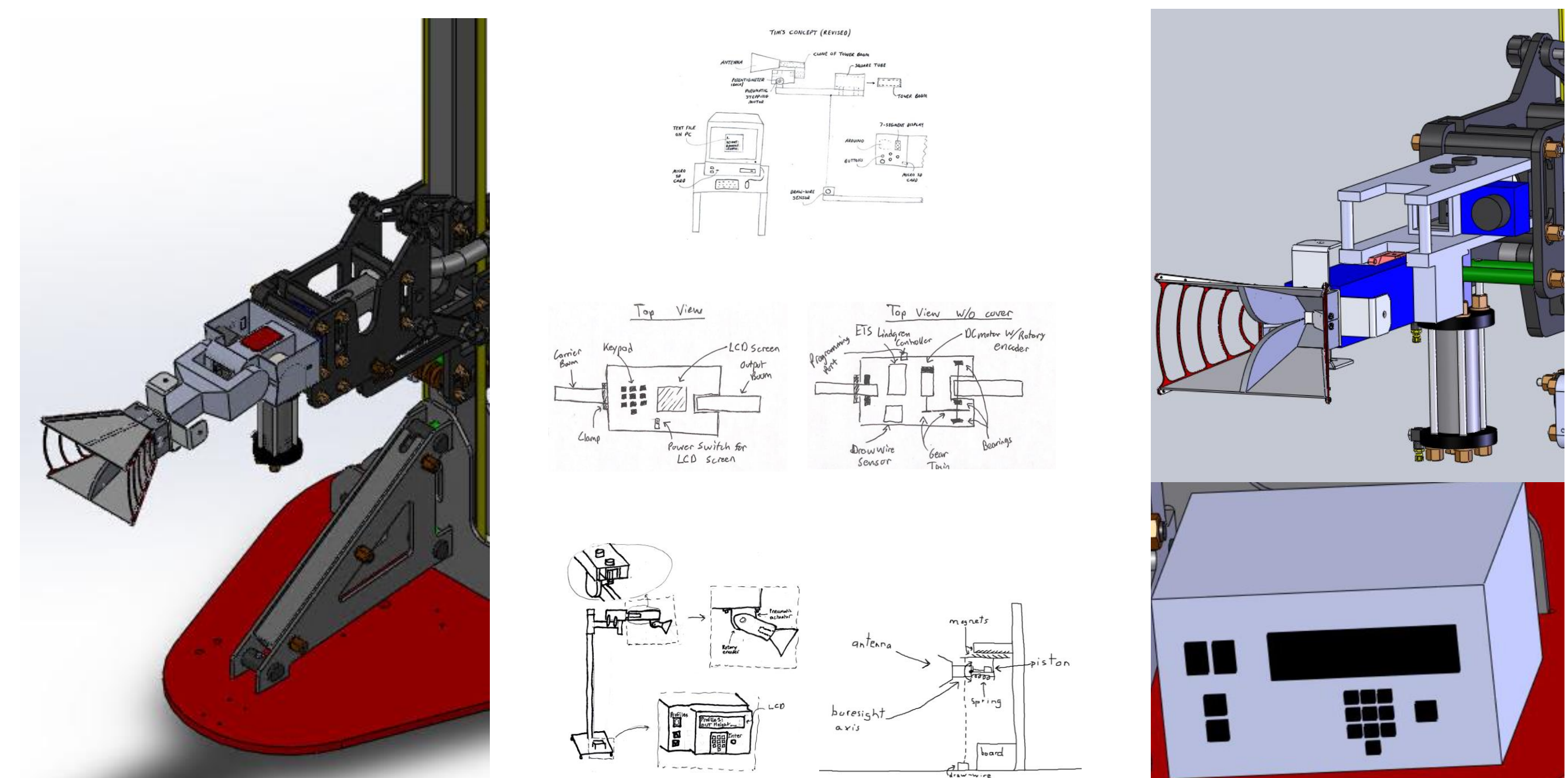
The Device must maintain its aim while:

- the Device moves vertically at a speed of up to a constant speed of 10 cm/s, after a maximum acceleration of 10 cm/s².
- supporting an antenna up to 15 pounds and 40 cm long.

The Device also must:

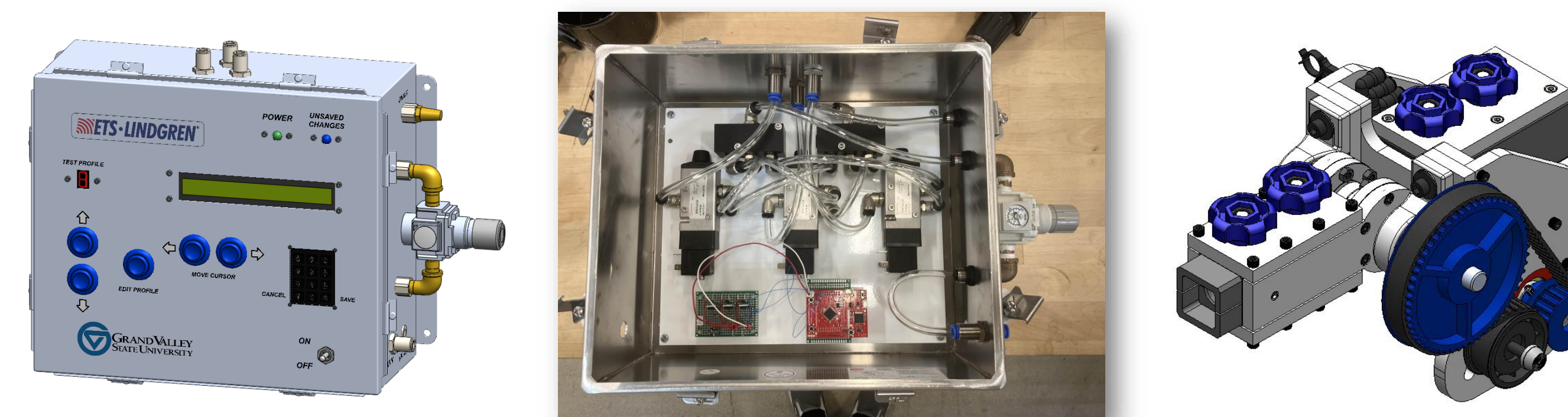
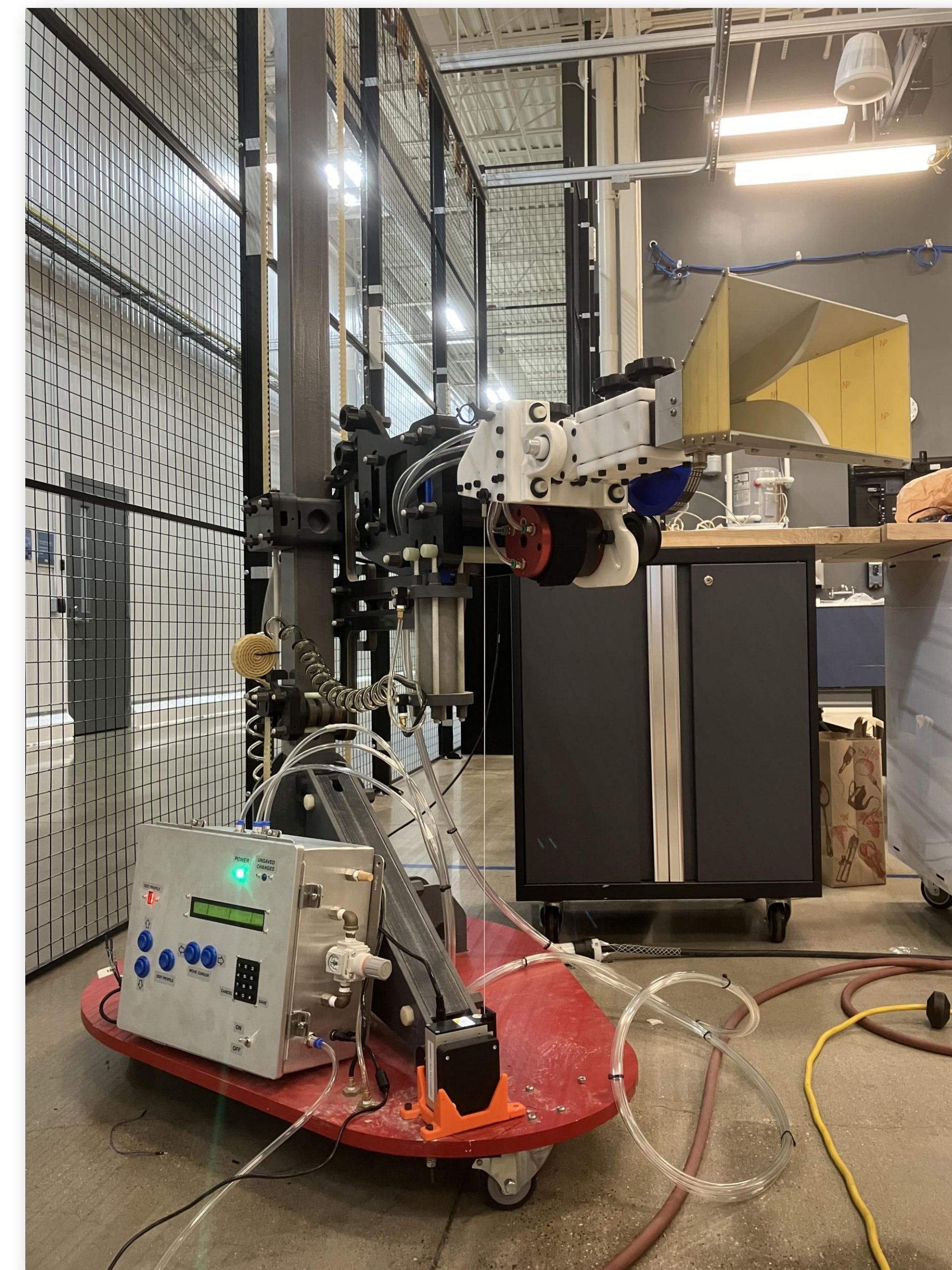
- maintain its aim at the DUT target within a right circular cone with an apex angle of 4°, apex at the axis of antenna rotation, and axis coaxial with the antenna boresight, at any Device height between 0.5 meters and 4 meters.
- not physically obstruct any signal from the DUT to the antenna.

Initial Concept Sketches

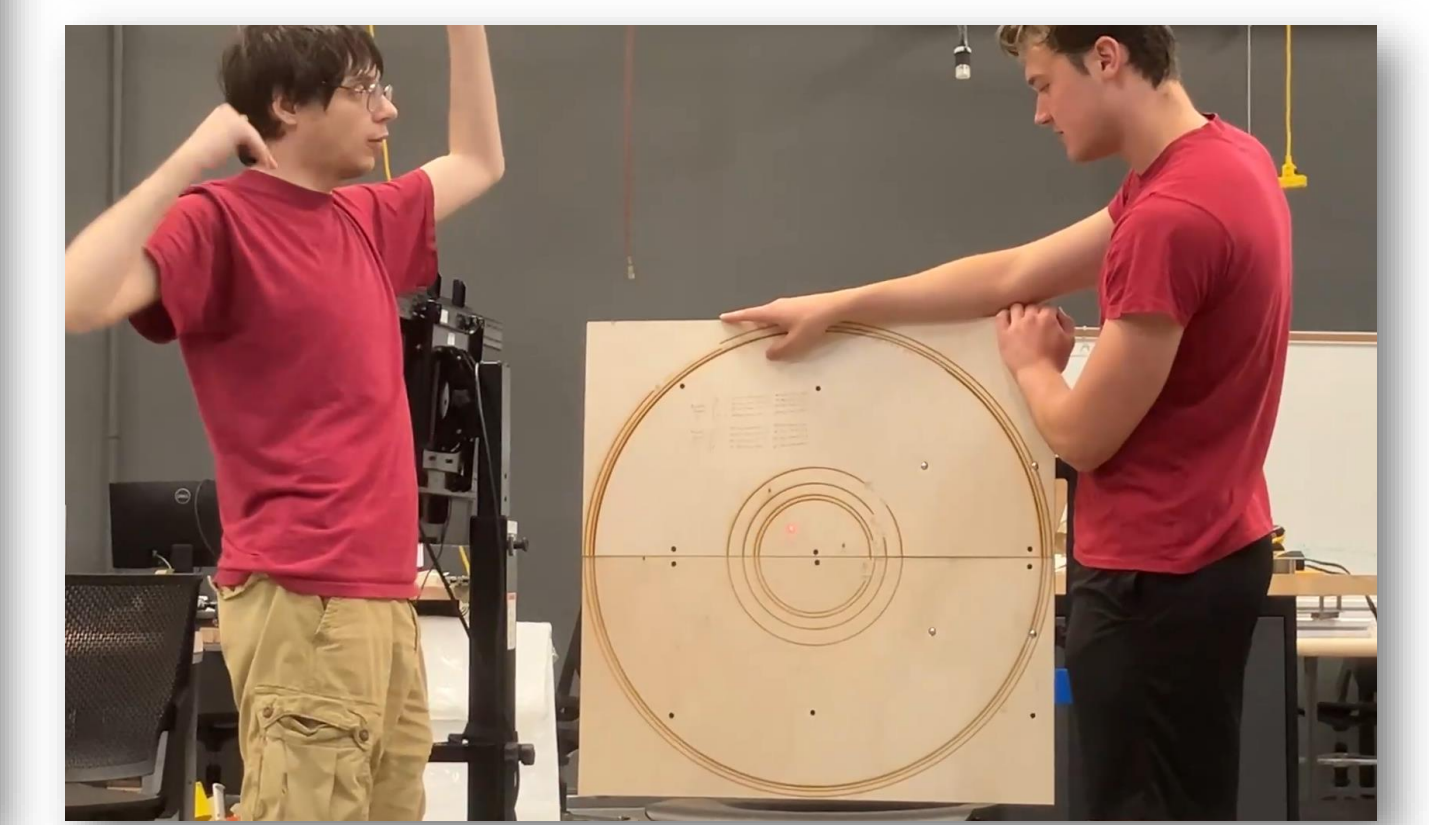
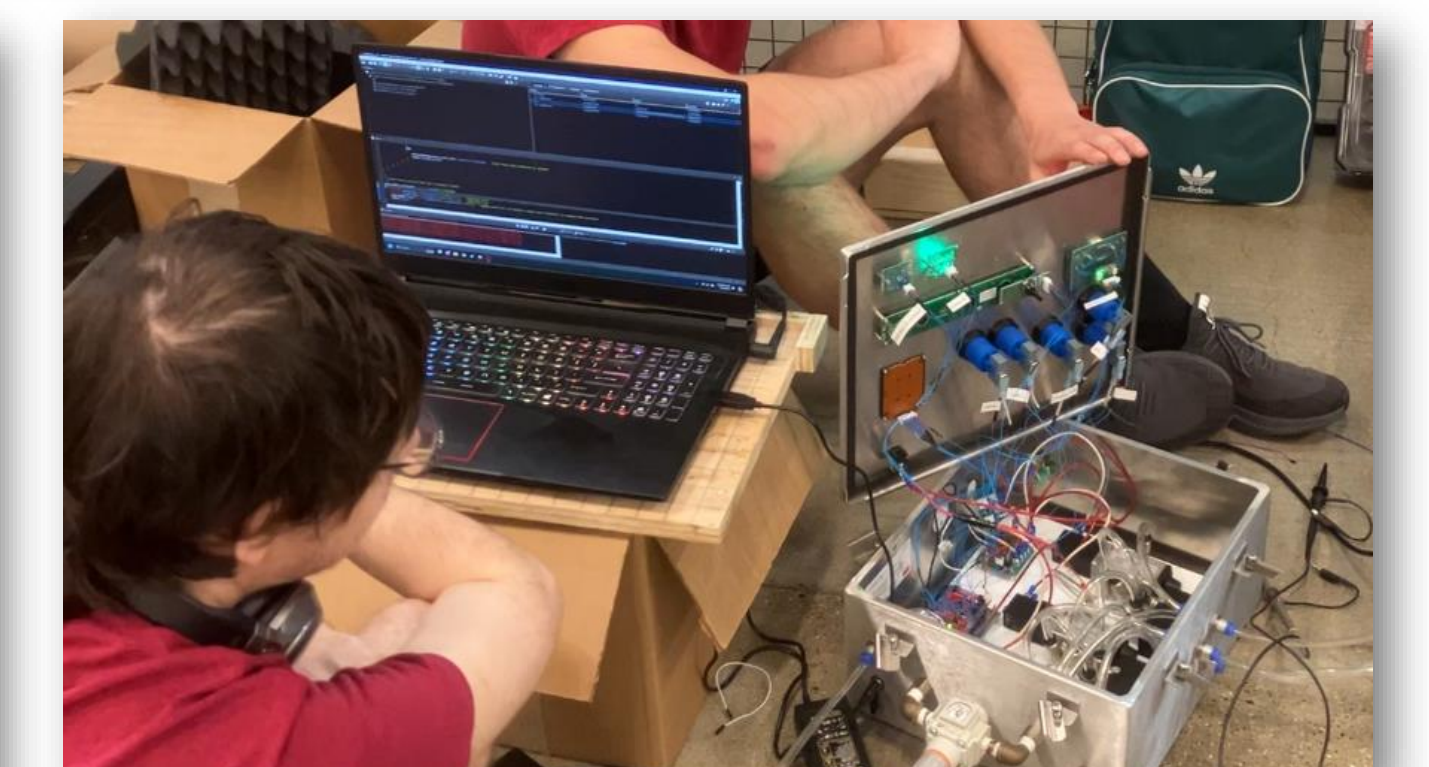
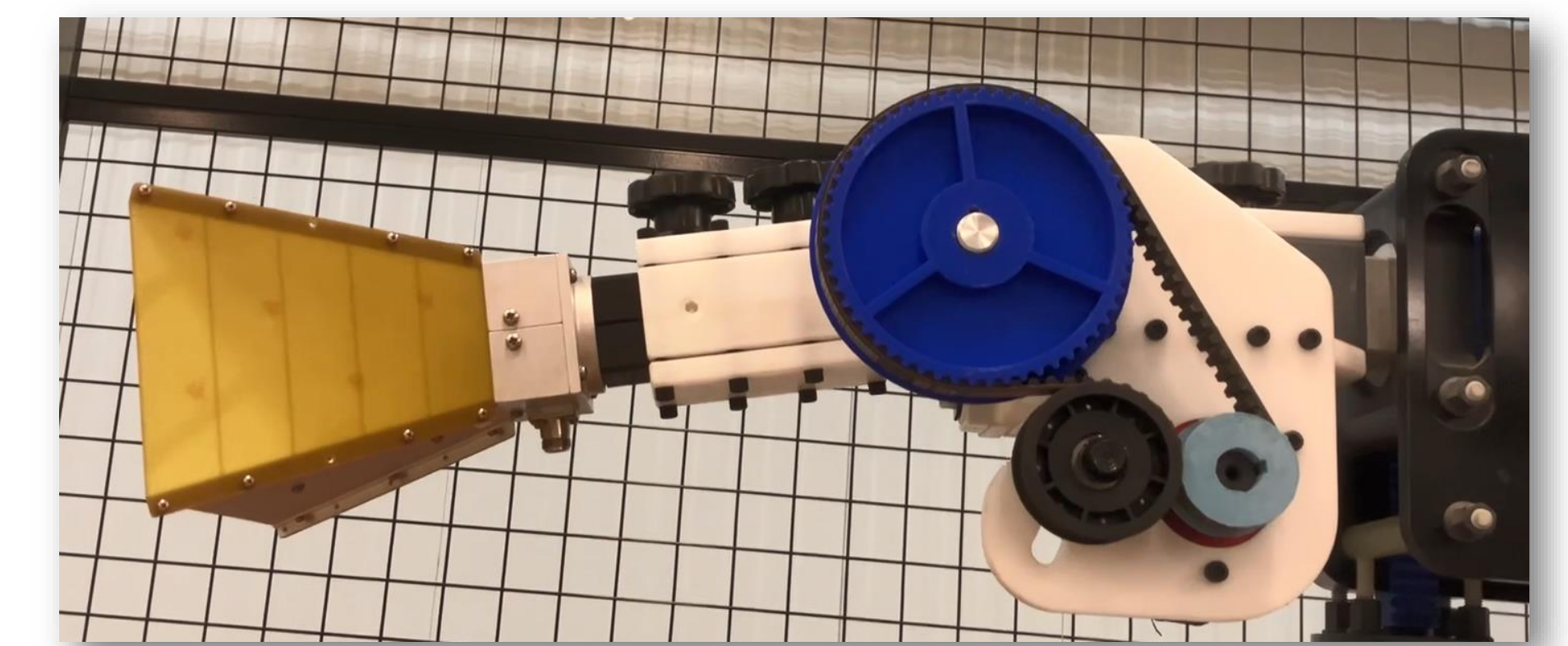


Refined Concept

The final concept utilized a variety of components and methods from each of the initial concepts. The final concept utilizes a draw-wire sensor to read the height of the antenna. A microcontroller is used to control an interface where the user can change between and customize profiles for different test parameters such as varying DUT heights, DUT horizontal distances, and antenna lengths. The control interface is user-friendly and intuitive to use. The aiming device mounts on the end of the current boom. With exception of the pneumatic motor, shaft, and several other critical components, the aiming device is made from Delrin and other dielectric materials. The pneumatic motor is a pneumatic stepper motor which utilizes three 3/2 valves to rotate the motor. The aiming device mimics the current mounting style for the stinger antenna design. This allows for seamless implementation in the field.



Testing



Videos



URL:
<https://www.tobiasengineeringstudios.com/academic-research/boresight-project>



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