Unique Signal Interlock

Los Alamos NATIONAL LABORATORY | DESIGN CENTER COLORADO

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Our Mission:

Develop a two-factor authentication electromechanical locking device, intentionally difficult for untrained users to operate, for use in high-security environments

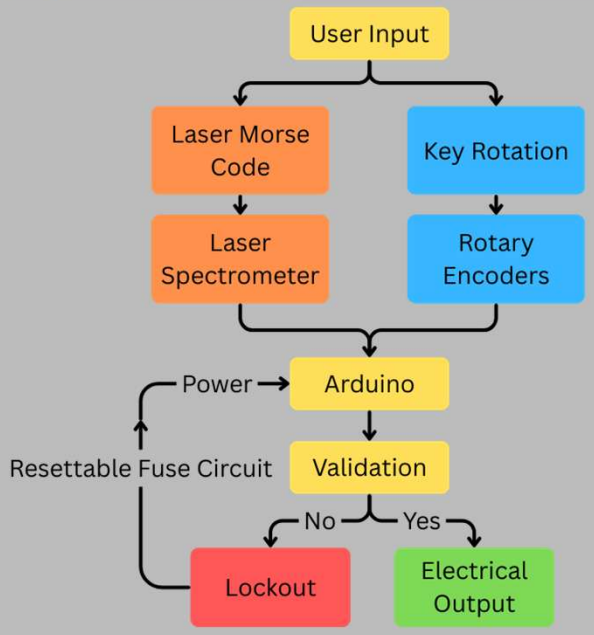
Design Requirements:

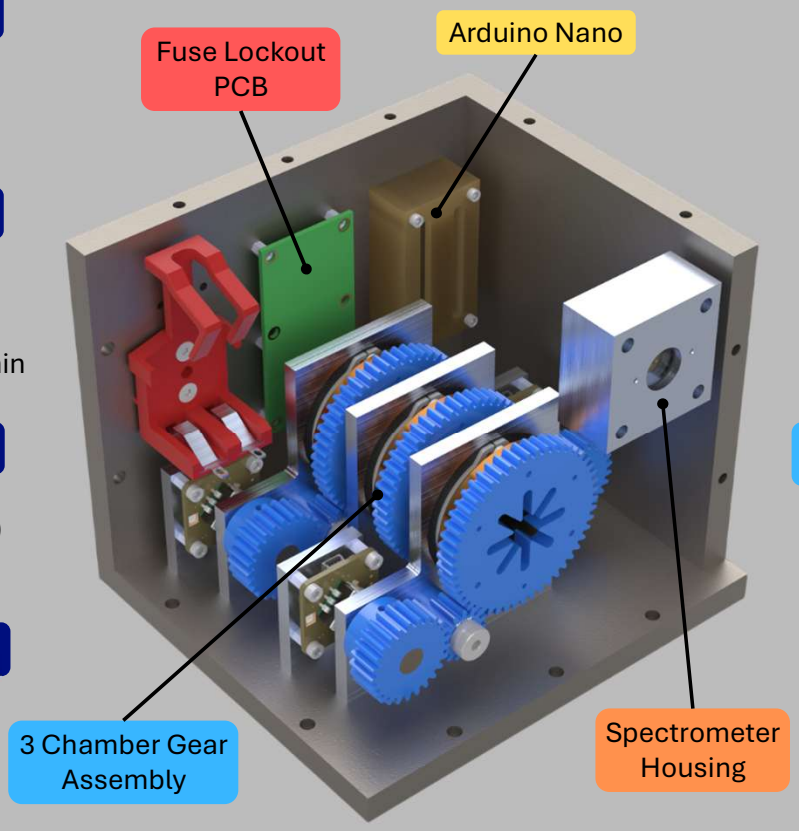
- ☑ Maximum 6” x 6” x 6” volume
- ☑ 8-bit electrical and 8-bit mechanical input
- ☑ Single attempt only – lockout fail state
- ☑ Physically resettable from lockout within 10 min
- ☑ 95% reliability for trained users

Environmental Requirements:

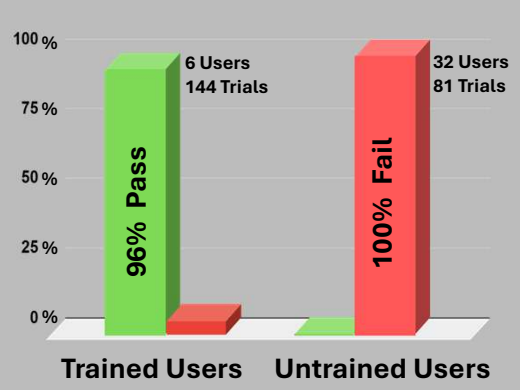
- ☑ Withstand static load of 250 lbf
- ☒ Water jet ingress protection (IP: X5 equivalent)
- ☑ Dust ingress protection (IP: 5X equivalent)
- ☑ Vibration at 0.5–1 g from 10-200 Hz

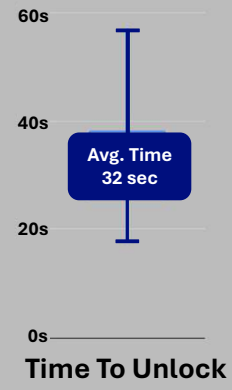
System Flow Diagram:





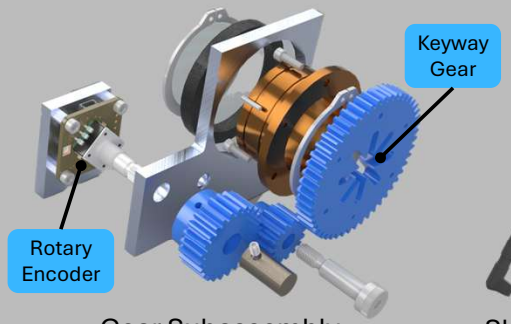
Reliability Testing:





Mechanical Input:

- R2D2-inspired
- 3 gear assemblies
- Rotary encoders to verify alignment
- 3D printed skeleton key to rotate gears



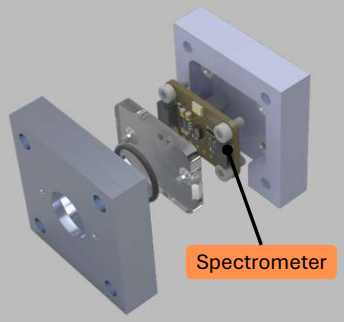
Gear Subassembly

Skeleton Key

Electrical Input:

- 3D printed laser remote inputs ‘dot’ and ‘dash’
- Spectrometer to validate “Morse” code
- Filters used to correct the intensity of laser

Laser Remote



Laser Subassembly

Future Work:

- Scale down to a 3” x 3” x 3” volume
- Increase security
- Implement seams/O-rings on wall interfaces to improve water and dust protection

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