

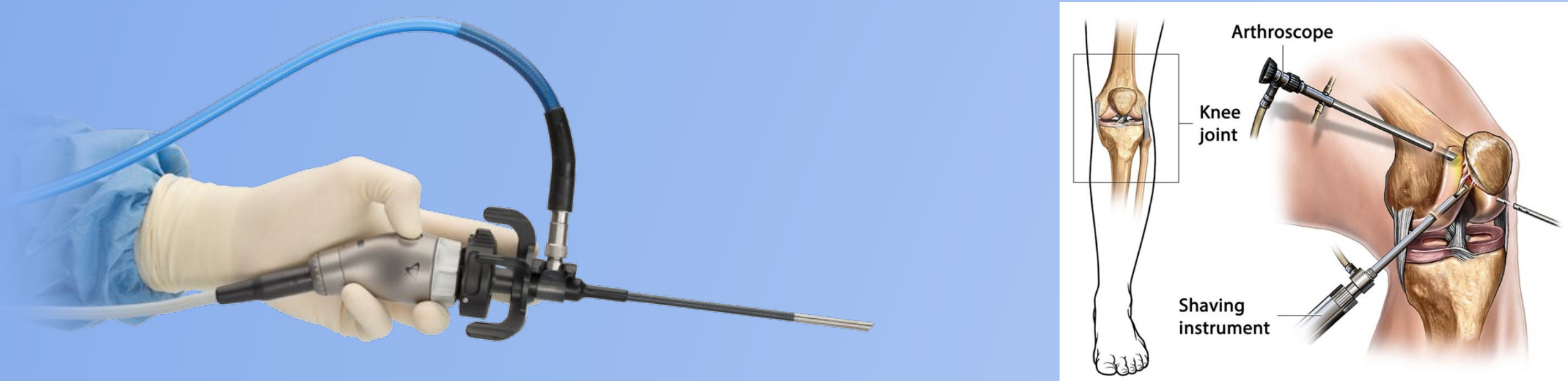


Automated Validation Platform for Arthroscopic Camera Systems

Akhila Johny | Daniel Palacios | Helen Samba | Nadav Stamper-Kurn | Chongyang Rao

Background

Cameras are critical to arthroscopic surgical procedures and must undergo extensive reliability testing before deployment. Current characterization and reliability test workflows require engineers to manually perform repetitive motion-based test cases, making the process time-consuming, difficult to reproduce, and dependent on operator technique.



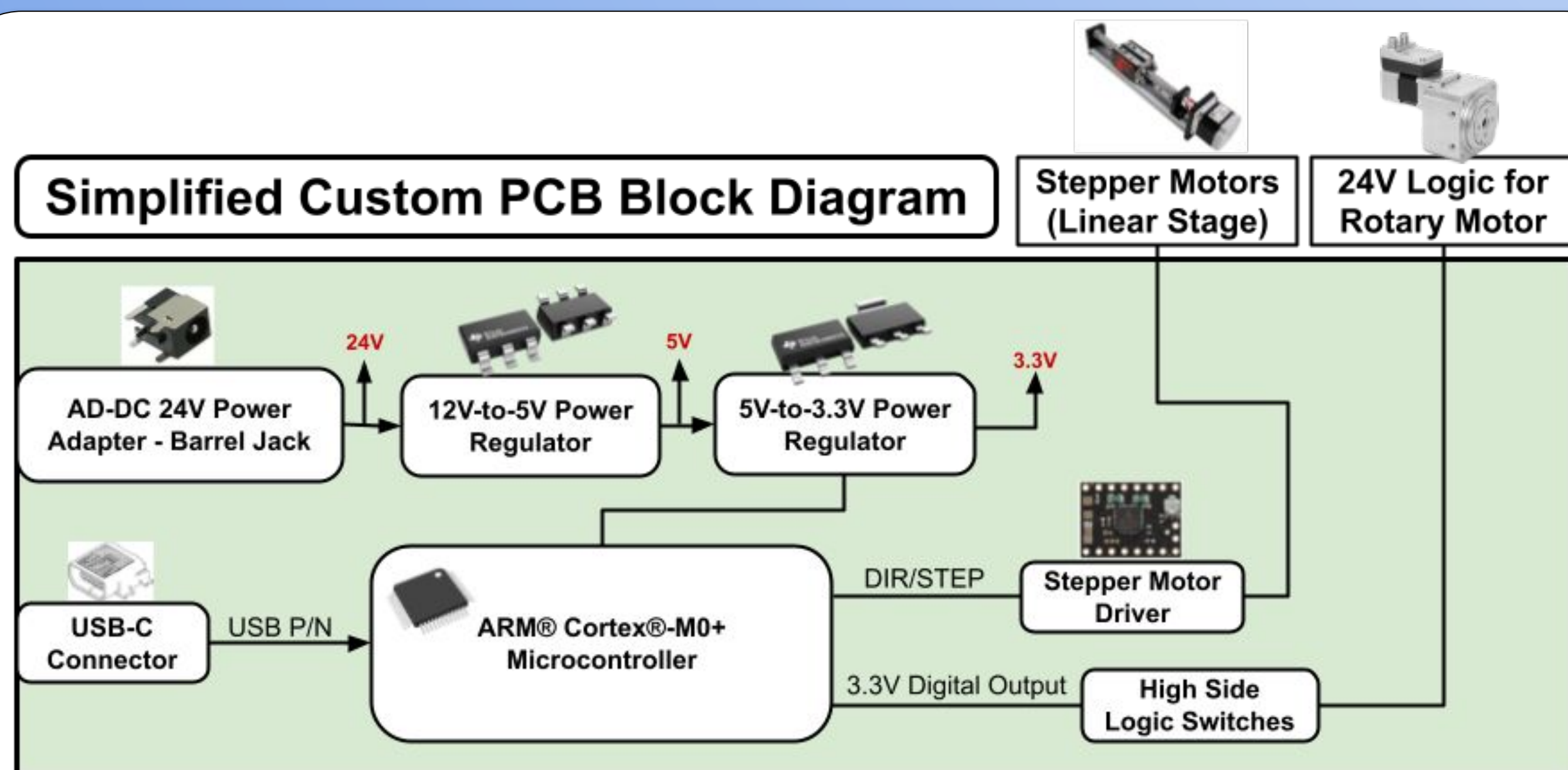
Project Goals

MockingBird addresses these challenges through an automated electromechanical testing platform that replicates surgical camera motion in a controlled and repeatable environment. By combining precision and durable motion stages, custom fixtures that support a variety of camera formats, and embedded control electronics, the system enables scalable and consistent reliability testing of Arthrex camera systems.

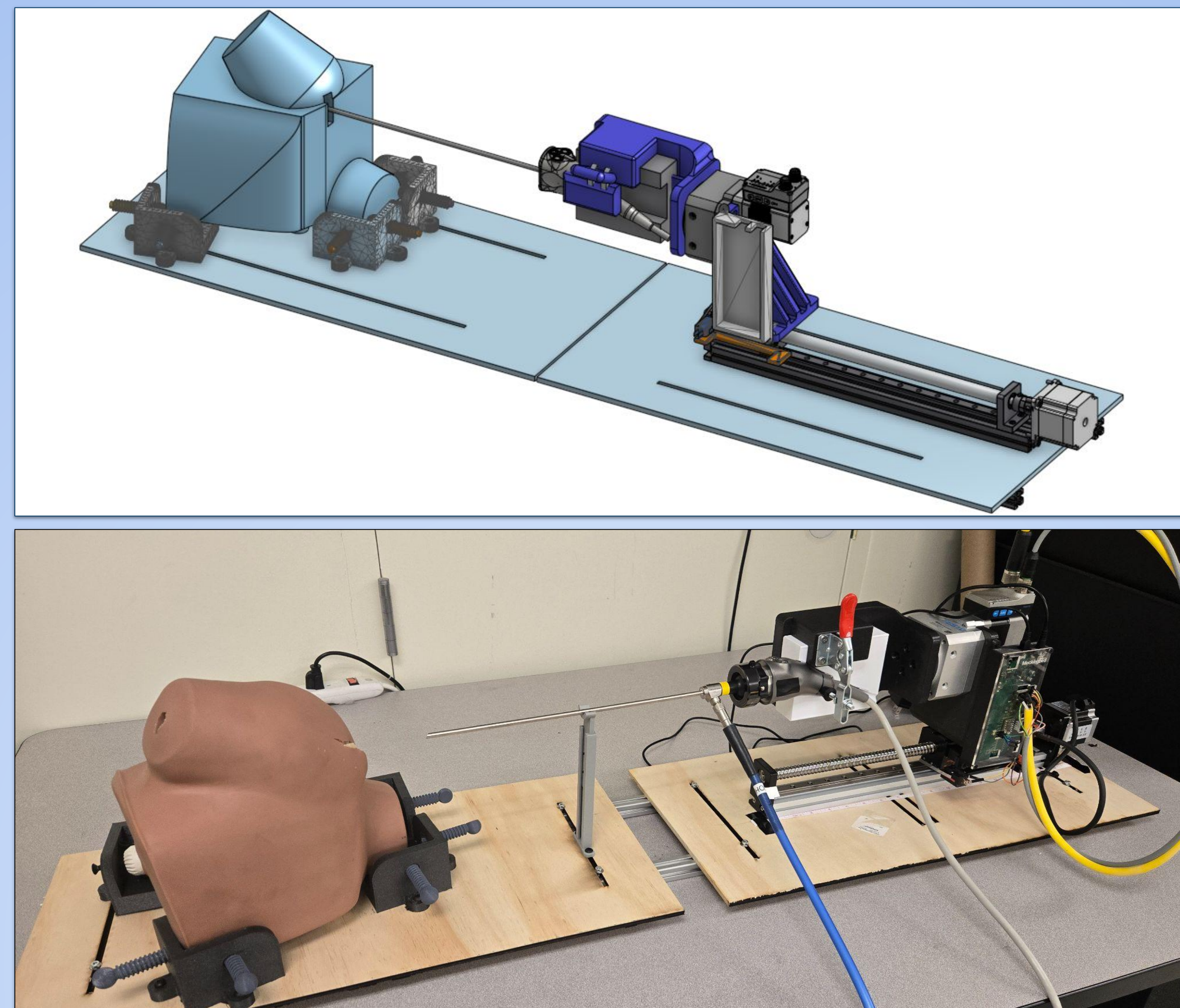
Key Objectives:

- Automate repetitive camera reliability test procedures
- Improve test repeatability and consistency
- Enable low-occurrence and edge-case bug reproduction
- Reduce engineering testing effort

System Architecture



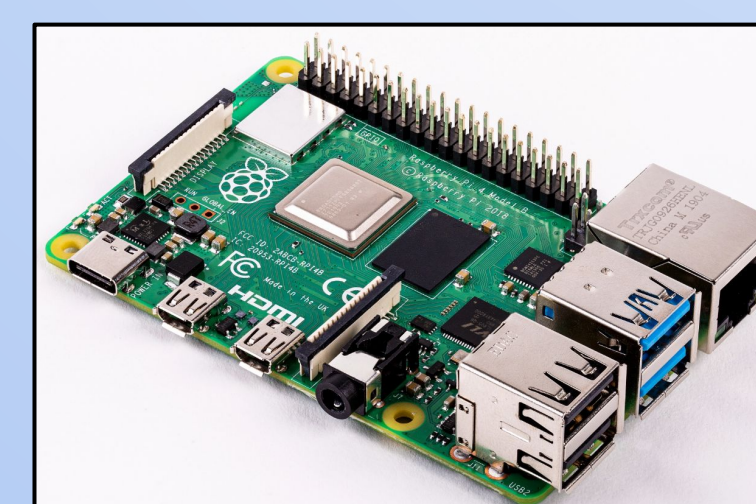
MockingBird Platform



MockingBird Validation Platform

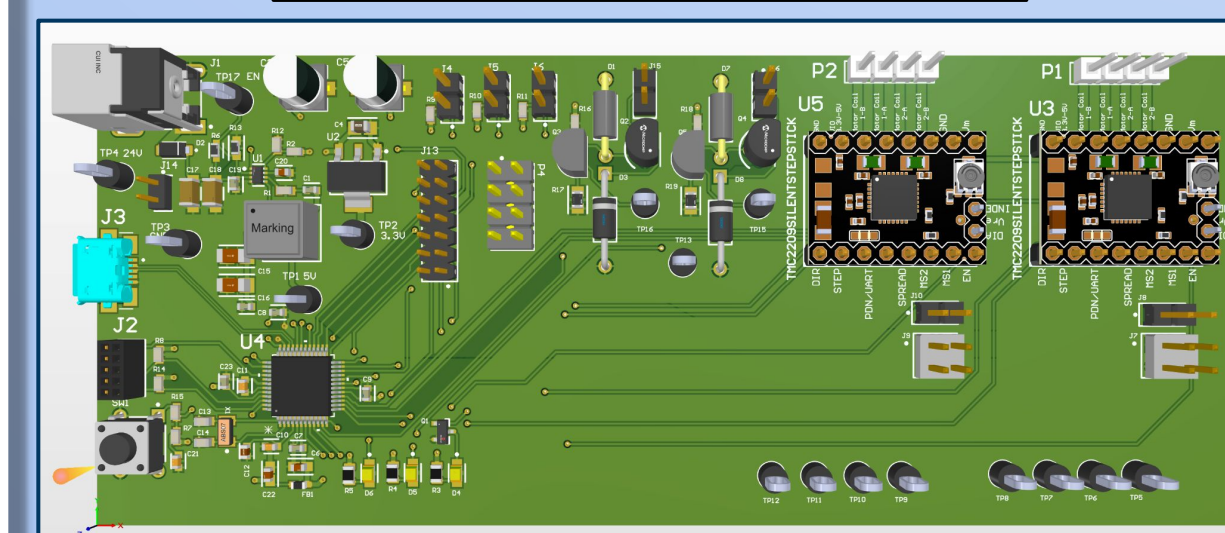
The complete MockingBird platform combines programmable motion control, interchangeable camera fixtures, and custom electronics into a unified testing system capable of autonomous reliability validation.

Hardware Components



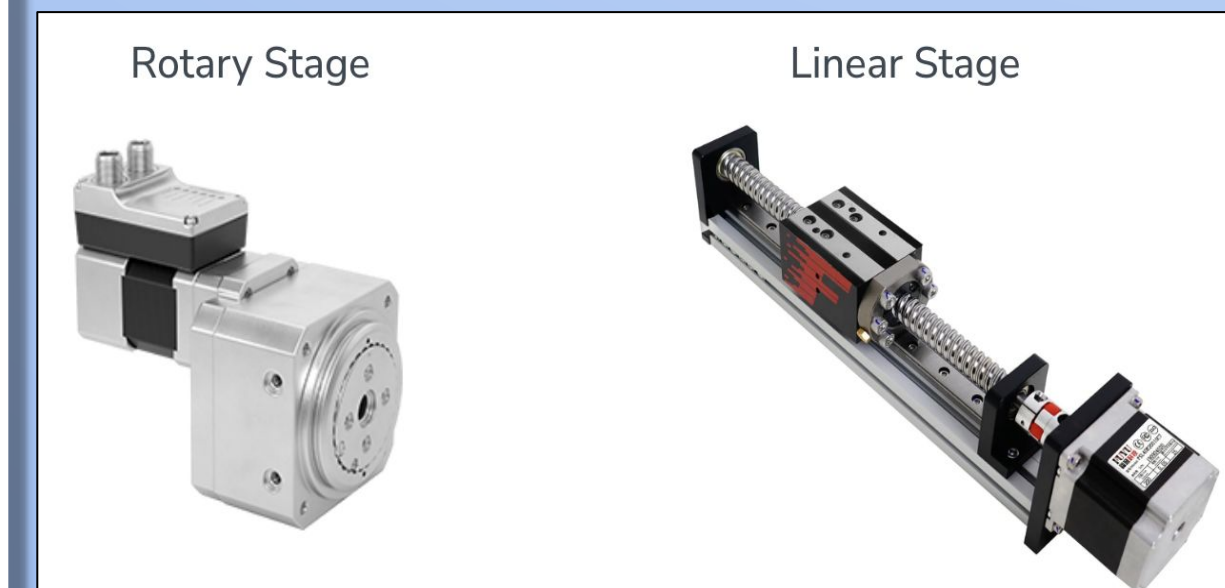
Raspberry Pi 4

- ❑ Central control device
- ❑ Linux OS
- ❑ Python Application



Custom PCB

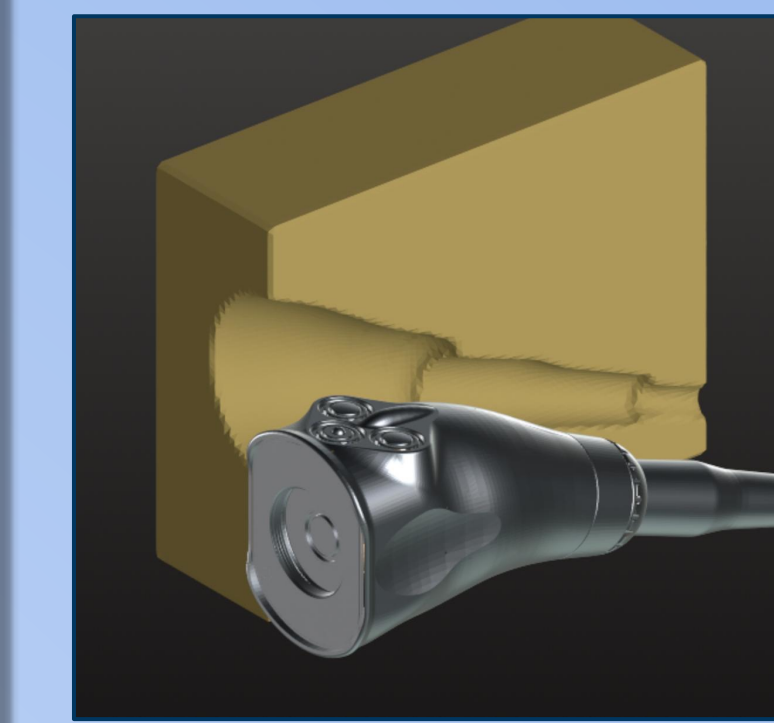
- ❑ Custom motor driver integration
- ❑ Embedded power regulation
- ❑ Peripheral connectivity
- ❑ Arduino Zero embedded microcontroller



Motion System

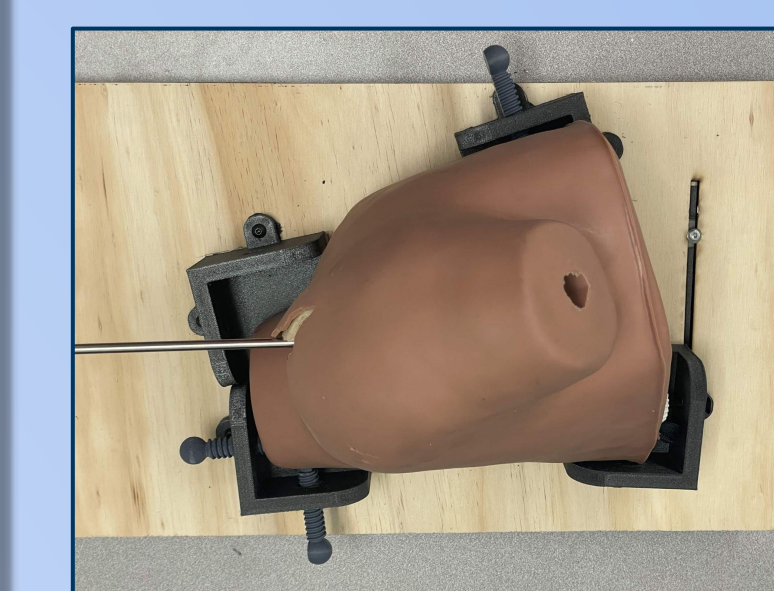
- ❑ High precision motorized movement
- ❑ Repeatable angular positioning
- ❑ Controlled surgical motion emulation

Fixture Optimization



Camera Fixture

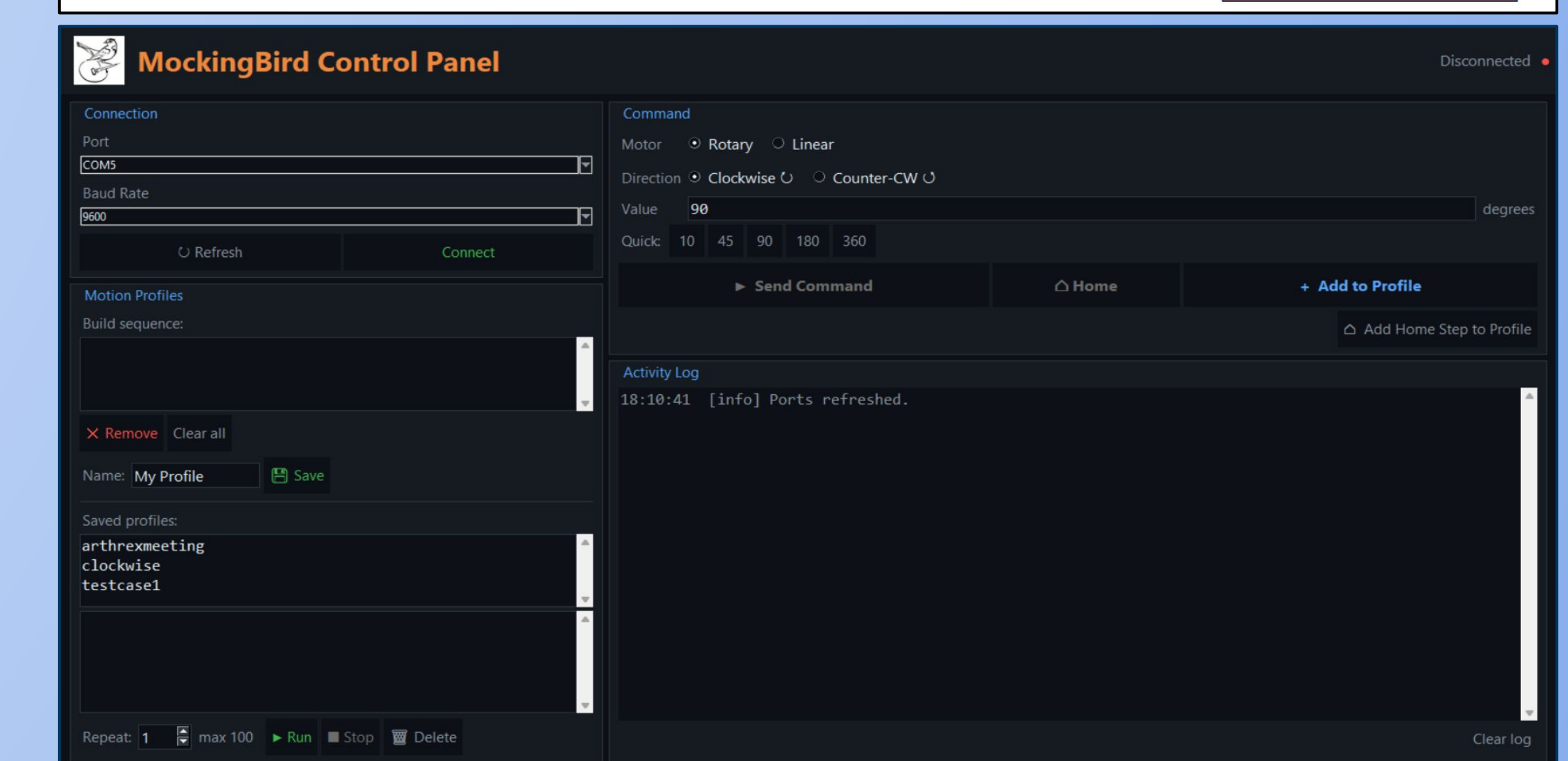
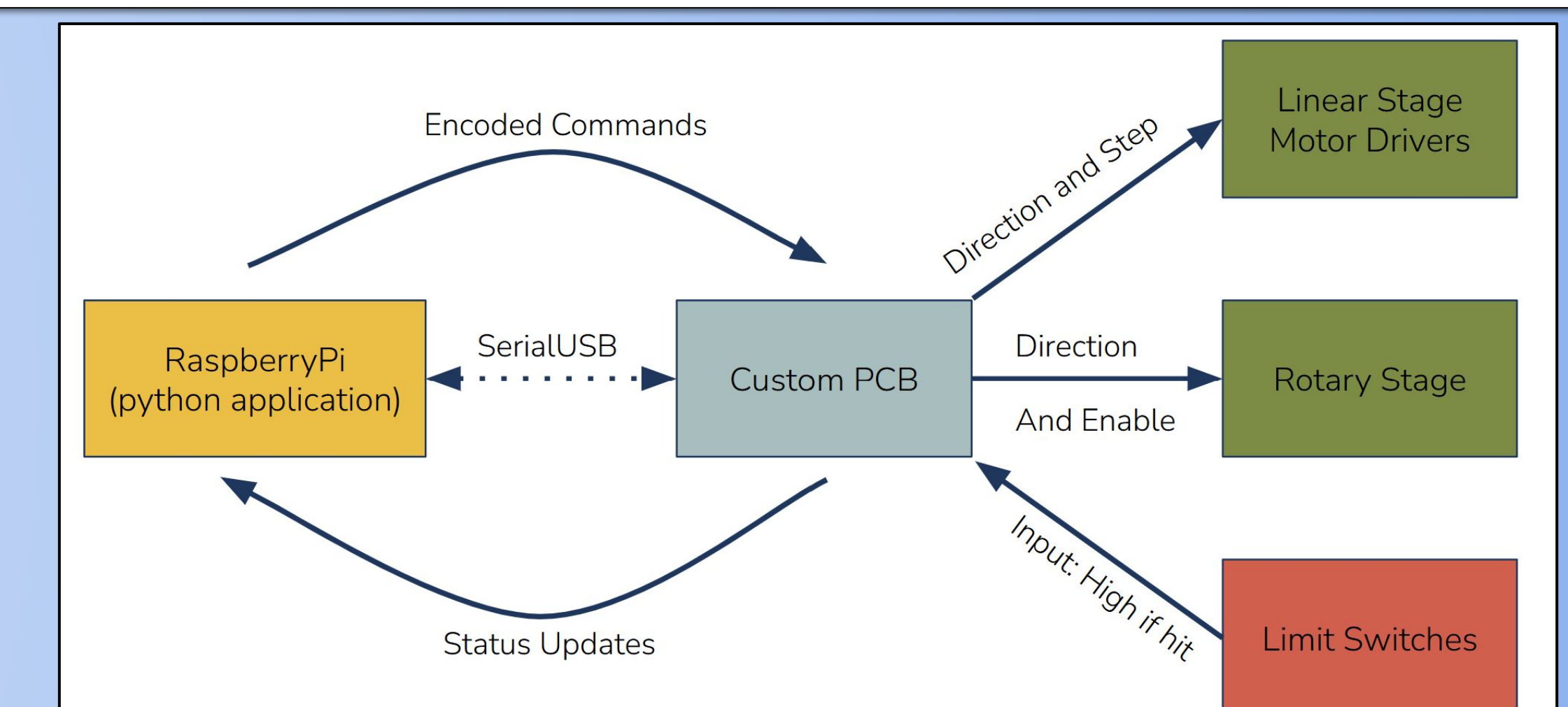
- ❑ Supports multiple arthroscopic camera configurations
- ❑ Form-fitting cradle geometry for secure retention
- ❑ Repeatable camera positioning during testing
- ❑ Quick installation and replacement



Anatomical Model Base

- ❑ Rigid mounting of shoulder anatomy model
- ❑ Consistent spatial alignment with camera trajectory
- ❑ Provides repeatable test environment for validation workflows

System Integration & Automation



Achievements

- ❑ Functional dual-axis motion control
- ❑ Successful Raspberry Pi-Arduino communication
- ❑ Custom PCB fabricated and assembled
- ❑ Integrated control interface developed
- ❑ Multi-camera fixture implementation

Benefits to Arthrex

- ❑ Reduced manual testing effort
- ❑ Improved test repeatability
- ❑ Faster reliability validation
- ❑ Consistent bug reproduction
- ❑ Scalable testing infrastructure

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