ROBOTIC AUTONOMOUS CAMERAPERSON

Repurposing Old Hardware for New Purposes

Project Talos, Class of 2025
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Motivation

There are many day-to-day situations where important events are occurring and the inclusion of video would be welcome. However, high-quality video often requires constant human attention—something that is not always available given the ubiquity of cameras but shortage of trained operators.
Furthermore, hardware older than 10 years, though expensive to initially purchase, often quickly becomes outdated and forgotten.

Project Description

This project aims to develop an autonomous or semi-autonomous camera system using repurposed robotic arms, such as the Scorbot ER-V and ER-4pc, to enhance video capture in dynamic environments like college classrooms and live presentations.
By integrating modern cameras and software with older robotic platforms to create a system that will track and frame human subject automatically, quality autonomous camera systems can become more available while saving older hardware from being scrapped.

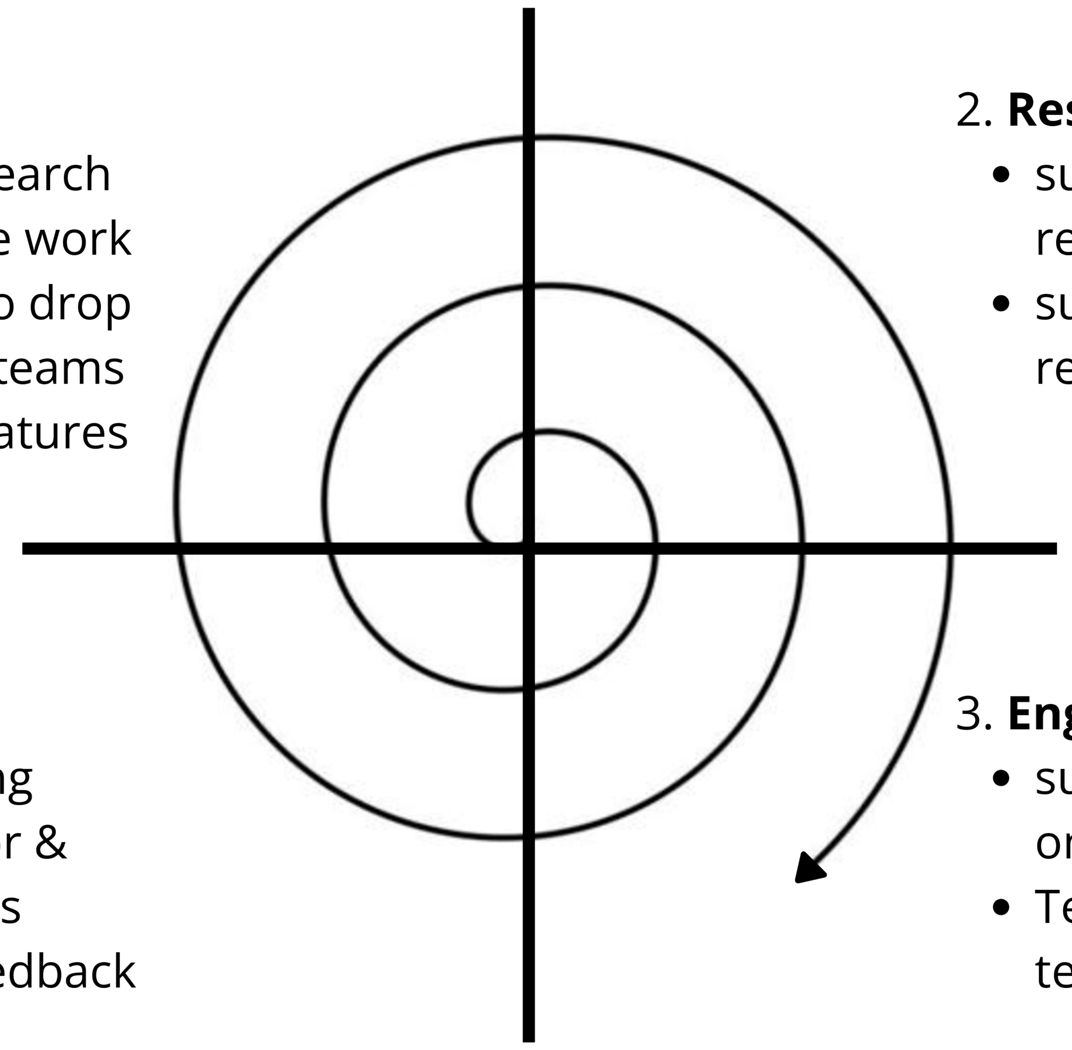
Process Methodology

Since the scope of features and capabilities of the hardware was unknown, the Spiral Model of research and development was chosen as our team's methodology as it enabled us to continuously iterate upon the prototype, allowing us to fail quickly and learn even faster.
The following spiral represents the 2-week cycle the team followed:

Spiral Methodology

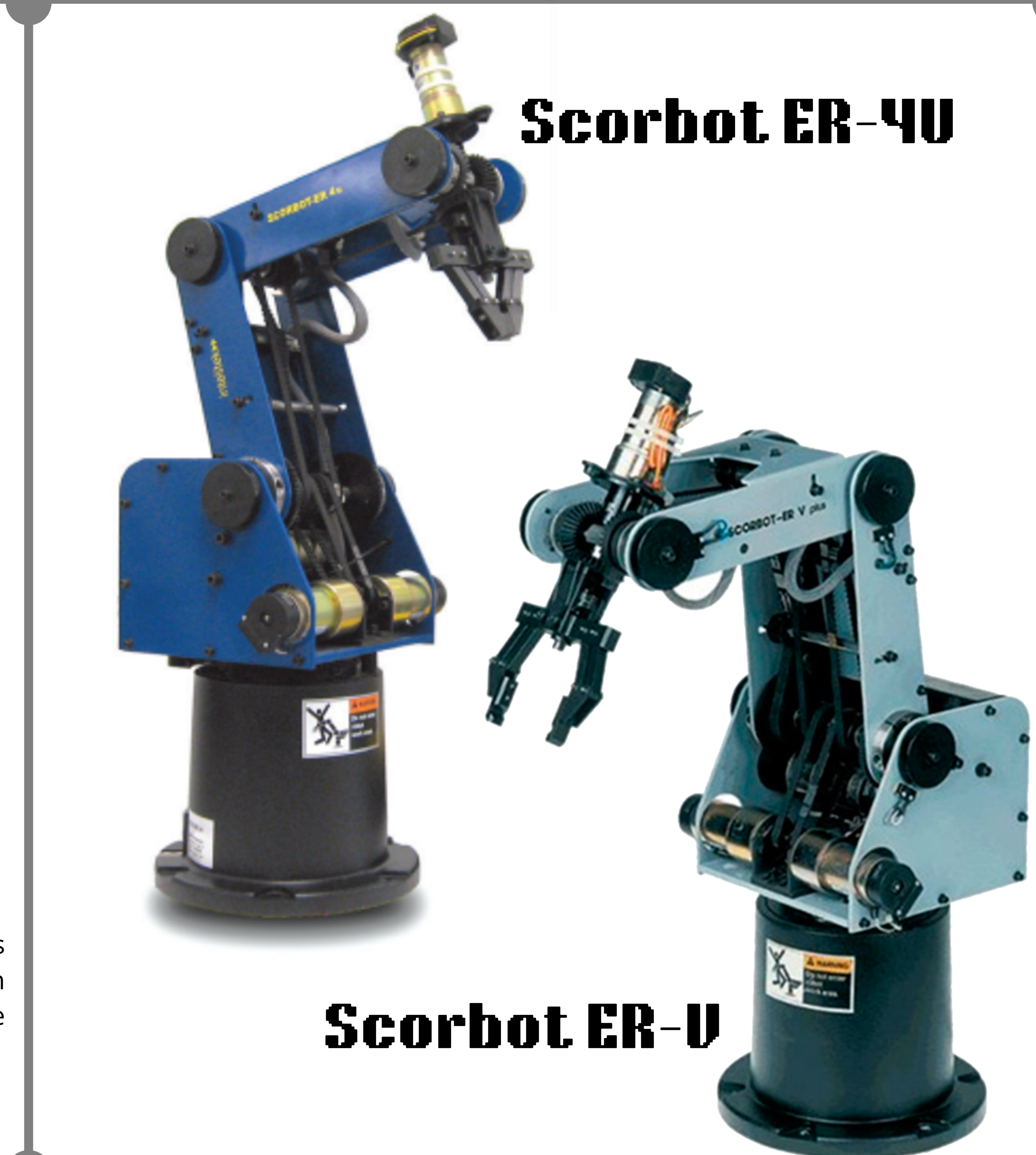
1. **Planning**
   - New features to research
   - Features to continue work
   - Features/research to drop
   - Team split into sub-teams based on current features

2. **Research & Risk Analysis**
   - sub-teams met to research features
   - sub-teams analyzed research-cost risk



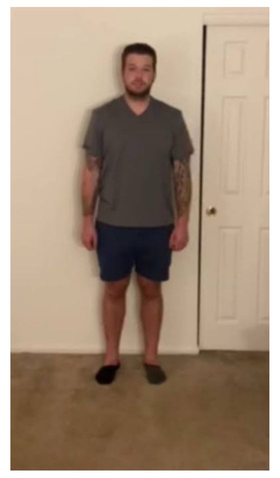
3. **Engineering & Testing**
   - sub-teams met to work on features
   - Team-wide integration testing of new features

4. **Demonstration & Evaluation**
   - Demonstrate working prototype to sponsor & additional professors
   - Collect metrics & feedback

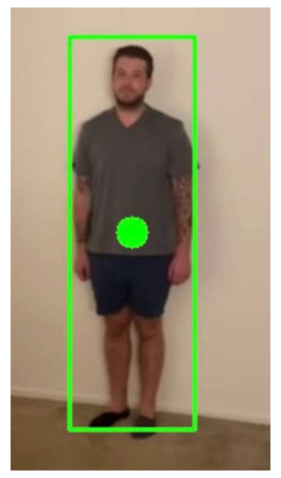


Technologies

Core Features



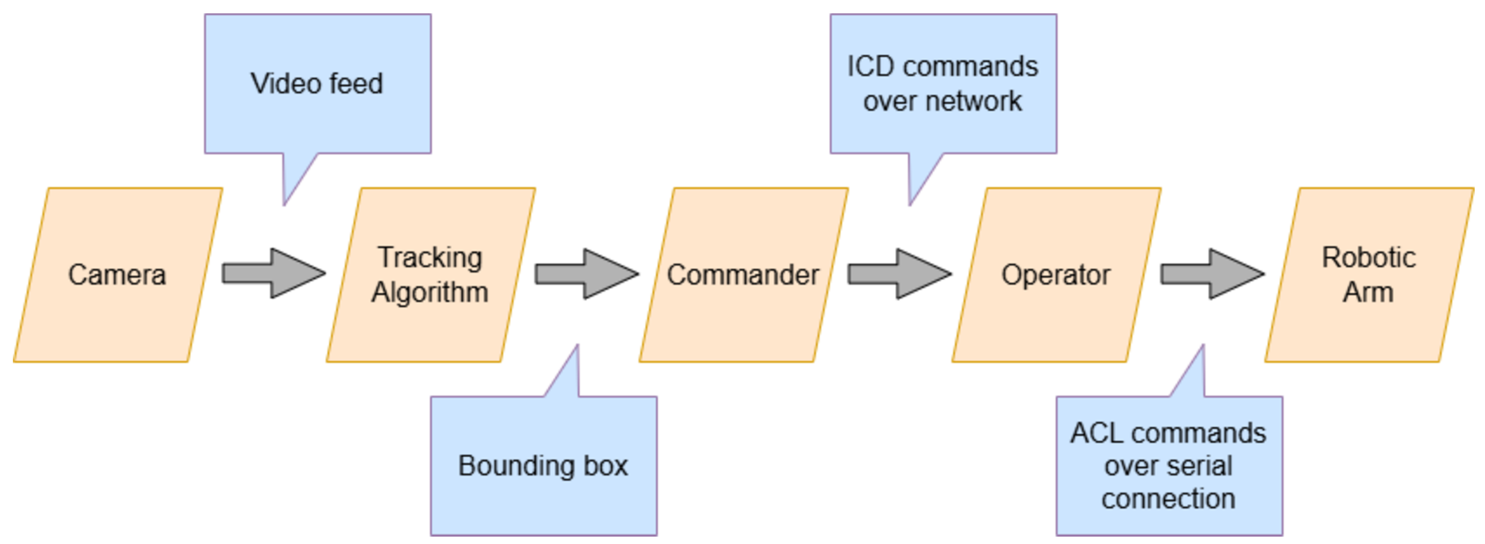
Video feed frame



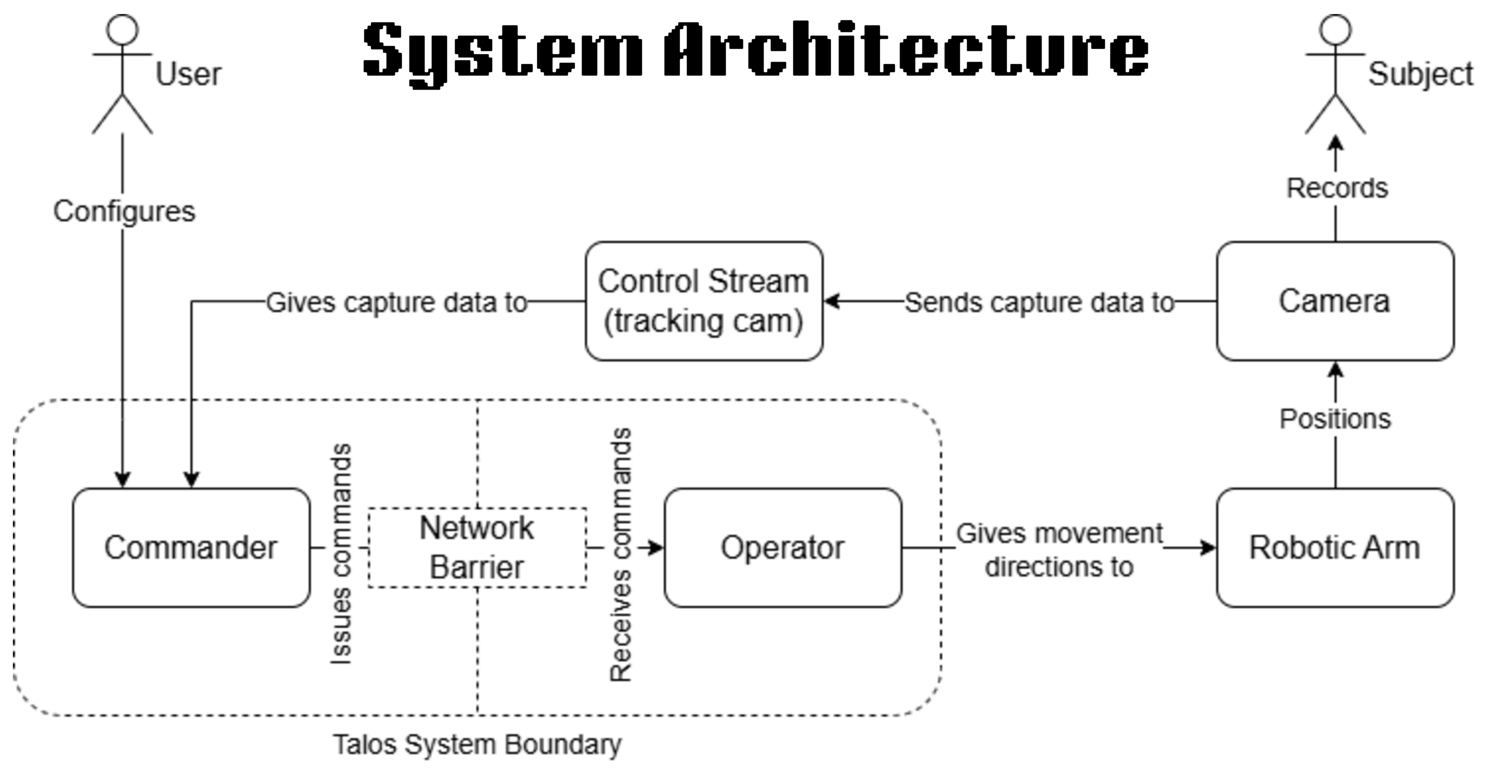
Frame with bounding box

- Subject tracking with arm following
- Single subject recognition
- Pose estimation
- Manual arm control
- Low-latency direct arm interfacing
- Idle movement
- Desk-level observing

High-level Data flow



System Architecture



Learning Outcomes

The team learned modular architecture design when working with potentially unknown changes, low-level near-electrical embedded software, networking across machines, and implementing live computer vision models.

Future Work

Modular design of the system enabled a second, untested arm to move by adding only a custom interface to send commands. Though no feature work was done with both arms, future team can experiment with them in tandem. There is also space to explore other vision models and develop novel features on top of existing APIs.