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AutoCam

The Future of Filmmaking

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Use Case

- Camera movements in stage productions are manual
- Process is error prone and labor intensive
- There is currently no automated system

Areas: Hardware | Software | Signals

Use Case Requirements

- Lightweight Tracking sensors (<= 1lb) to enable concealment, actor mobility, and safety
- System should be able to record for 4 hours with no issues (given sufficient battery and storage)
- Upon cue, camera pivot time + camera focus + actor centering < 100 ms
- Pivot should adjust while camera is moving → Both should happen slow enough to maintain camera focus
- Sensor Fail-safe: If sensors fail, the camera should automatically move to the center of the rail system to get a full view of the stage

Use Case Requirements

- Lockout of 1.5 s after each accepted cue to prevent overlapping motions
- Smooth single axis movement with less than 1° movement tolerance
- Easy setup (< 10 minutes) regardless of tech proficiency
- Object should stay within middle 60% of frame
- System sound output should be low enough to not annoy audience (<= 40 dB)

La Clemenza Di Tito

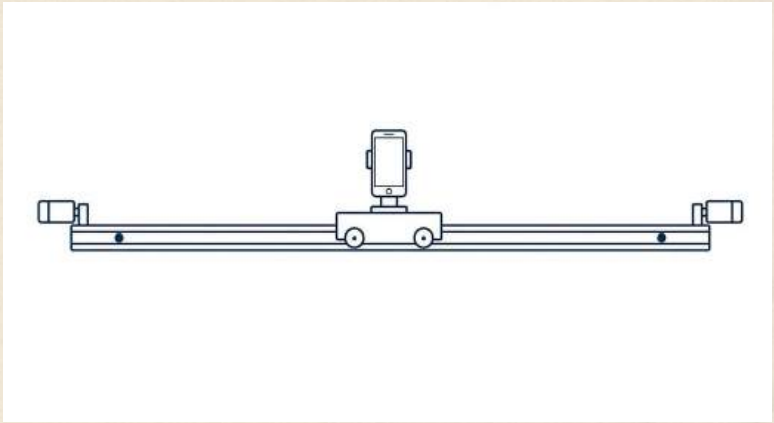
Autocam | The Future of Filmmaking

- Ideal (Automation | Through tracking and audio processing)
- Smartphone Agnostic
- Simple to set up and use
- Fully offline system
- MVP (Remote-controlled)

Hardware | Software | Signals

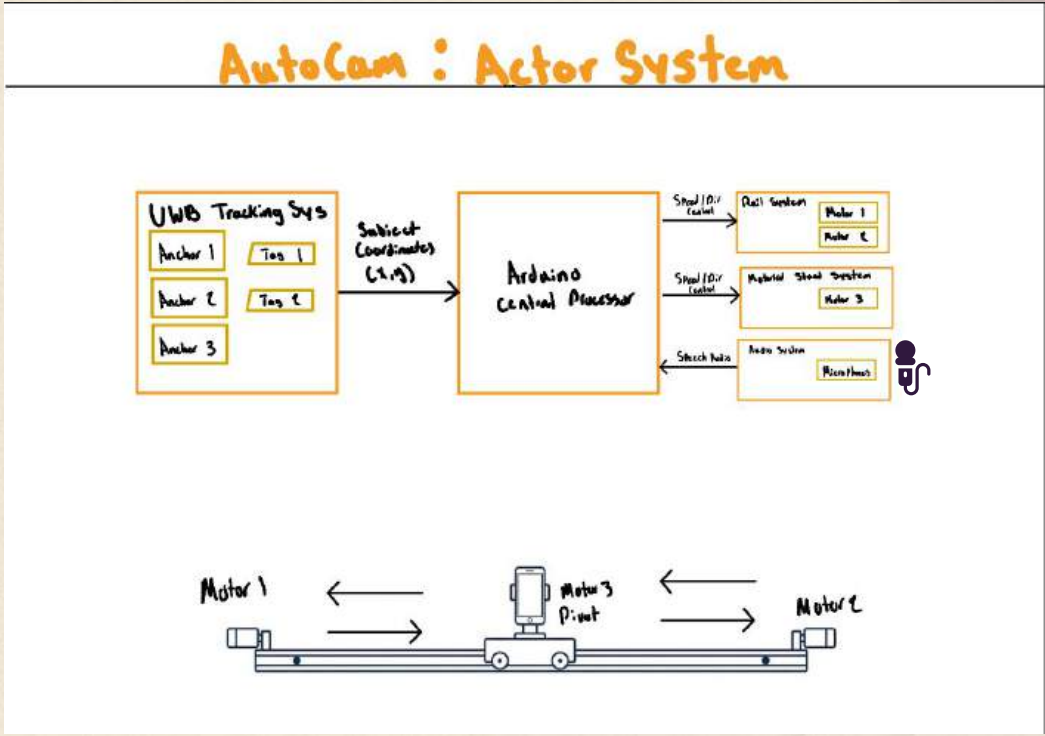
Technical Challenges

- Transition Latency (All processing → movement)
- Framing Accuracy (Tracked object stays centered)
- Smoothness (Overshooting | jitters | blurs)
- Noise (Motor noise and Stand movement)
- Reliability (Motor stability | Target Loss)
- Safety (Minimizing hazards)

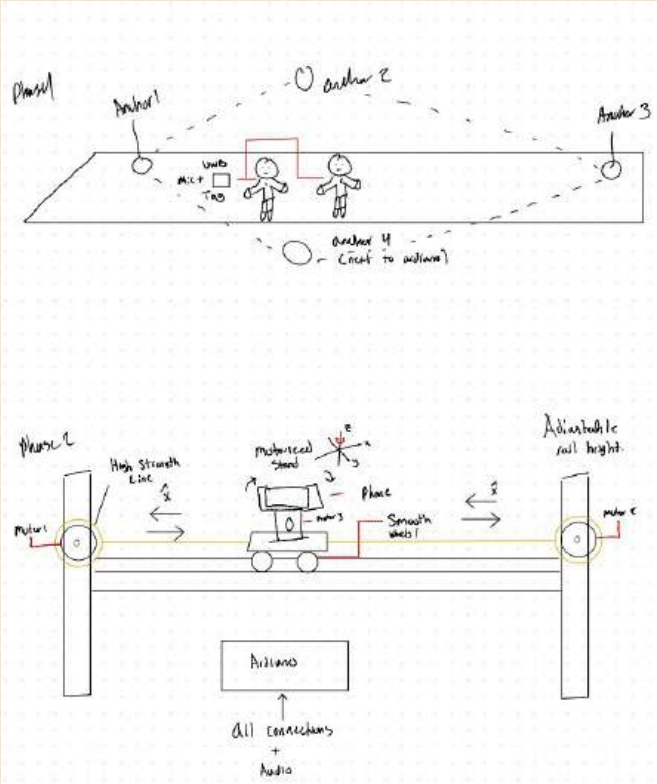


Solution Approach

Need	Device
Processing	Arduino
Movement	Brushless DC
Tracking	UWB Sensors
Audio	Wireless Microphone



Solution Approach



Ideal Product

Handle multiple actors

Reliably track and follow at least 4 actors on stage throughout the course of a scene

Speech Cues

Recognize and translate script cues into automated movement and tracking

Rapid Center + Focus

Quickly pivot to desired actor, center in frame, and move close while maintaining focus

Testing, Verification, and Metrics

Latency

- Arduino latency measurements tests to insure <100 ms

Video Quality

- Test with live actor/director to aim for good use case satisfaction (85%)
- Verify failure default case works with 100% success rate

Sensor

- Test UWB sensor tracking so that object is always in 60% center of frame.

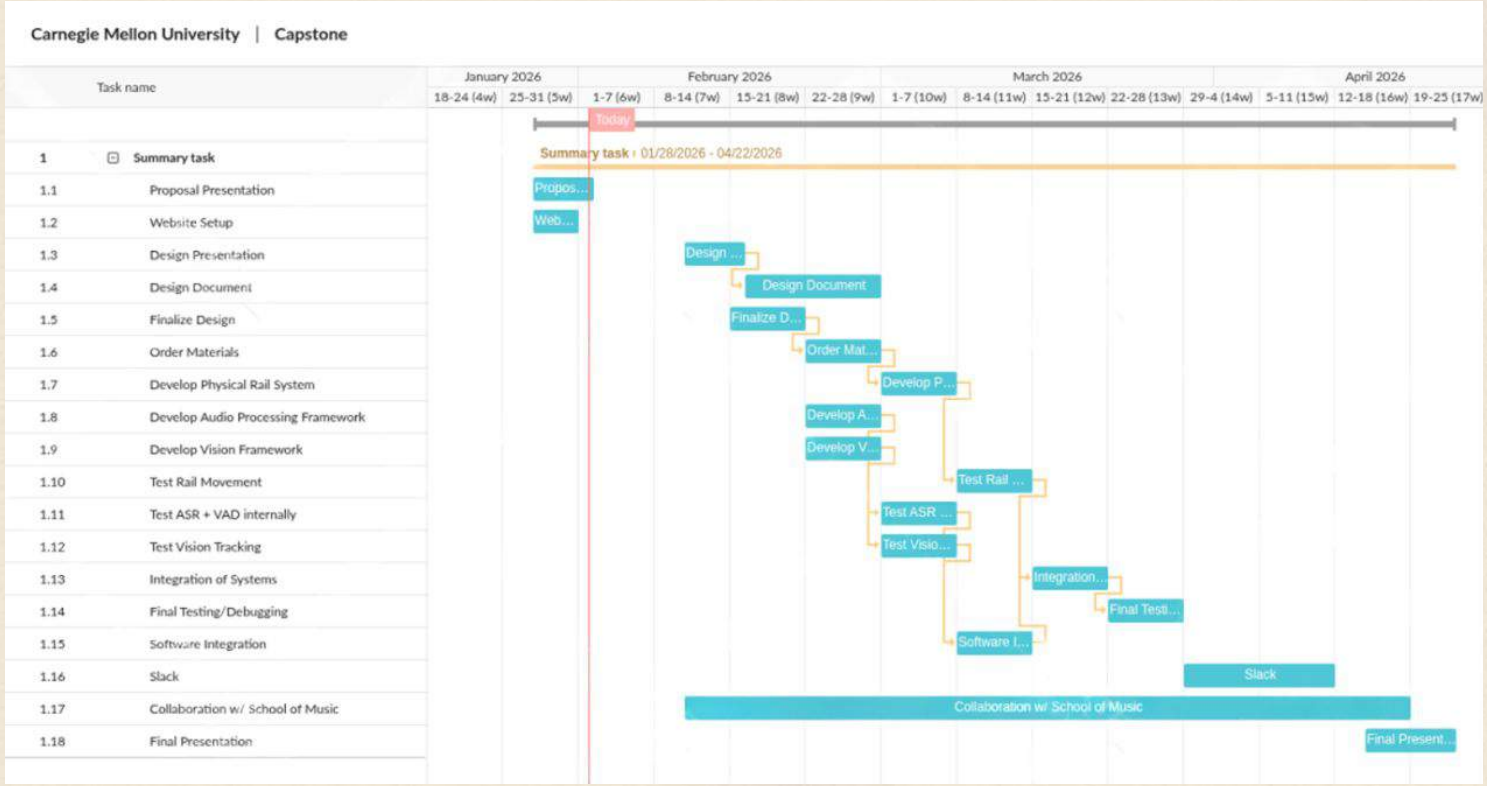
Audio

- Ensure that audio level stays <=40 dB

Tasks and Division of Labor

Tasks	In Charge
Audio processing (VAD and ASR)	Pareekshith
Vision (Tracking, Framing, Centering)	Ahmad
Hardware + Synchronization with Arduino	Ted

Schedule


Carnegie Mellon University | Capstone
Task name
January 2026
February 2026
March 2026
April 2026
18-24 (4w)
25-31 (5w)
1-7 (6w)
8-14 (7w)
15-21 (8w)
22-28 (9w)
1-7 (10w)
8-14 (11w)
15-21 (12w)
22-28 (13w)
29-4 (14w)
5-11 (15w)
12-18 (16w)
19-25 (17w)
Today
1 Summary task
Summary task : 01/28/2026 - 04/22/2026
1.1 Proposal Presentation
1.2 Website Setup
1.3 Design Presentation
1.4 Design Document
1.5 Finalize Design
1.6 Order Materials
1.7 Develop Physical Rail System
1.8 Develop Audio Processing Framework
1.9 Develop Vision Framework
1.10 Test Rail Movement
1.11 Test ASR + VAD internally
1.12 Test Vision Tracking
1.13 Integration of Systems
1.14 Final Testing/Debugging
1.15 Software Integration
1.16 Slack
1.17 Collaboration w/ School of Music
1.18 Final Presentation
Propos...
Web...
Design ...
Design Document
Finalize D...
Order Mat...
Develop P...
Develop A...
Develop V...
Test Rail ...
Test ASR ...
Test Visio...
Integration...
Final Testi...
Software I...
Slack
Collaboration w/ School of Music
Final Present...

Conclusion | The Future of Filming

- AutoCam showcases promising potential and offers a path for aspiring filmmakers
- Would be a great fit at CMU given our well-known School of Drama program
- *The School of Music Integration with Dr. Jocelyn Dueck*