

Project Specification Sheet

Project: Professional Gimbal for Phones

Client: Mechanical Design 1 Class, Prof. Reuven Katz

Version: v1.0

1. Purpose

Although many gimbals exist for smartphones, most are not specifically optimized for cinematic video stabilization. This project addresses that gap by developing a two-handed gimbal designed to record both vertical and horizontal footage with high precision and professional-quality stabilization.

2. Scope of the Design

This project focuses on the mechanical and functional design of the gimbal. Primary concerns include:

- Ensuring the motors have full freedom of motion.
- Designing the structure to meet all functional requirements.
- Achieving compliance with environmental and durability specifications.

Electronics and firmware are outside the scope of this initial project.

3. Functional Requirements

- Payload capacity: Support a phone weighing up to 400 g (as a benchmark, the iPhone 16 Pro Max, one of the heaviest on the market, weighs 227 g, which yields a safety factor of 1.76).
- Rotational freedom:
 - Yaw ($\pm 360^\circ$)
 - Roll ($\pm 90^\circ$)
 - Pitch ($\pm 120^\circ$)
- Environmental resistance: IP67 (dust-tight and immersion resistant).
- Response time: 2.5–5 ms (gyroscope input to corrective torque application).

4. Technical Specifications

4.1 Dimensions & Weight

- Total device weight: ≤ 1.2 kg (ergonomic two-handed operation).
- Maximum overall length: 400 mm.

- Handle grips: 35 mm diameter, rubberized for comfort.

4.2 Phone Mount Compatibility

- Supported width: 55–100 mm.
- Supported thickness: 6–15 mm.
- Mounting: Quick-lock clamp for secure, tool-free mounting in < 5 seconds.
- Lens support: Compatible with external lens rigs (e.g., Moment, Sandmarc).

4.3 3-Axis Stabilization System

- Motors: Precision brushless with accuracy $\pm 0.01^\circ$.
- Shooting modes: POV, Lock, Follow, Inception (360° roll), Dolly Zoom.
- Controls: Joysticks (to control pan/tilt)
- Horizon lock: Maintains level horizon on uneven terrain.

4.4 Power & Battery System

- Battery type: Dual swappable Li-ion packs.
- Runtime: ≥ 5 hours continuous operation.
- Charging: USB-C PD, fast-charge at 30 W.
- Power output: Phone charging via USB-C (5 V, 2 A).

4.5 Durability & Environmental Resistance

- Structure: 6061 Aluminum Alloy
- Environmental protection: IP67 (dust-tight, 1 m immersion for 30 min).
- Drop resistance: Withstands 1.5 m drop on concrete without functional loss.
- Operating temperature: -10°C to $+45^\circ\text{C}$.

5. Safety & Compliance

- Electrical protection: Overcurrent, undervoltage, and thermal cutoff.
- Mechanical safety: Locking system prevents phone slippage.
- Materials: RoHS-compliant, recyclable, and non-toxic.
- Standards: Designed to comply with CE and FCC certification.

6. Testing & Validation Plan

- Drop test: 3× drops from 1.5 m on all faces.
- Vibration test: Continuous 3–5 Hz shaking for 1 hour with stabilization maintained.
- Thermal cycling: 100 cycles between -10°C and $+45^\circ\text{C}$.
- Battery test: ≥ 500 charge–discharge cycles before $< 80\%$ capacity.
- Field trials: ≥ 10 hrs continuous outdoor operation under dust and humidity.

7. Future Development Opportunities

- AI-assisted predictive stabilization.
- Magnetic mounting system for faster phone attachment.
- Modular add-ons: lights, microphones, cold-shoe mounts, dual handles.
- Foldable arms for improved portability.