Single Actuated SWaP-Optimized Monocopter Drone

A bladeless, single-motor aerial system for agile flight

■ Prototype Snapshot:

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1. Introduction

This document outlines the concept, design, and working principles of a single actuated, bladeless monocopter drone. This unique aerial system operates using only one rotating motor and no traditional propeller blades. The drone is built to demonstrate minimal Size, Weight, and Power (SWaP) for micro aerial vehicle (MAV) applications, suitable for indoor and constrained environments.

■ Objective:
- To demonstrate a flight-capable drone using one actuator.
- Minimize mechanical complexity and moving parts.
- Use onboard sensors and embedded controllers for navigation and stability.

Key Features:
- One rotating propulsion unit
- Compact 3D-printed frame with modular electronics stack
- Raspberry Pi or microcontroller-based control logic
- Real-time onboard processing for vision or stabilization

2. Hardware Components & Architecture

■ Core Components:
- T-Motor MN3110-17 (KV700): Main actuator
- Custom PCB stack or Raspberry Pi: Onboard processor
- ESC (Electronic Speed Controller): Motor control
- Inertial Measurement Unit (MPU6050 or similar)
- Camera module: Navigation or visual feedback
- Power system: LiPo battery (3S/4S) + BEC

■ Mechanical Build:
- Lightweight carbon/PLA frame with stacked mounting plates
- Central shaft with balanced mass distribution
- Vibration dampening supports for sensor stability

■ Communication Interface (Optional):
- WiFi/Bluetooth for telemetry
- Optional RC receiver or mission planner support

3. Working Principle & Control Logic

■■ Operating Concept:
- The single motor creates lift and torque.
- A counterweight or rotating fuselage produces thrust vectoring.
- Control is achieved by adjusting the thrust or by deflecting fins (if equipped).

■ Control System:
- Sensor fusion from the IMU is used to estimate orientation.
- PID controller processes sensor data to stabilize yaw/spin.
- Optional camera processing using OpenCV for feature tracking.

■ Testing and Performance:
- Successfully demonstrated vertical lift and hovering motion.
- Highly responsive to PWM-based motor control inputs.

■ Future Improvements:
- Add autonomous flight control using SLAM or Aruco markers.
- Enhance stability via onboard AI for corrective motion.
- Replace manual counterweights with servo-based adjusters.