# Title: Single Actuated SWaP-Optimized Monocopter Drone Documentation

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### 1. Introduction

The Single Actuated Monocopter Drone is an experimental aerial system designed to showcase efficient flight using only one active motor component. This architecture eliminates the need for multiple rotors or servos, reducing mechanical complexity and increasing robustness. Built under the Size, Weight, and Power (SWAP) constraints, the system is highly compact, lightweight, and power-efficient, ideal for close-quarters indoor operations and educational demonstrations.

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### 2. Objectives

- Demonstrate sustained flight using a single rotating actuator.
- Reduce total weight and footprint of drone design.
- Enable onboard processing using camera and IMU sensors.
- Test control via PWM, PID feedback loop, and visual navigation.

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### 3. Components Used

**Hardware:**

- **T-Motor MN3110-17 KV700** – Brushless DC motor used as the sole actuator.
- **ESC (Electronic Speed Controller)** – To control motor speed via PWM.
- **Raspberry Pi** – Handles image processing and sensor fusion.
- **MPU6050** – IMU sensor for gyroscope and accelerometer data.
- **Camera Module** – For visual tracking and SLAM.
- **Custom 3D Printed Frame** – Designed to balance torque and payload.
- **LiPo Battery 3S/4S** – Powers all onboard electronics.

**Software:**

- Python with OpenCV

- RPi.GPIO or pigpio for PWM
- Sensor fusion algorithms
- Optional: ROS or custom control stack

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**4. System Architecture**

- The Raspberry Pi reads data from the IMU and processes camera input.
- PID controller adjusts PWM signal to the ESC based on drift or tilt.
- The motor induces rotation and thrust using a weighted and tilted center.
- Optional fins or counterweights passively assist in stability.

**Control Flow:**

```
[ IMU + Camera ]
      |
      v
[ Raspberry Pi Controller ] --> [ PWM Logic ] --> [ ESC ] --> [ Motor ]
```

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**5. Operation Steps**

1. Connect Raspberry Pi to IMU and ESC.
2. Flash code to enable sensor reading and PID loop.
3. Connect LiPo and initialize ESC with correct PWM throttle range.
4. Start motor spin and read live telemetry.
5. Tune PID for balance during hover or controlled drift.

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**6. Testing & Results**

- **Initial Lift:** Achieved vertical take-off with 3S LiPo.
- **Stability:** Yaw stabilization achieved using IMU feedback.
- **Payload Test:** Up to 50g with camera and sensor stack.
- **Power Consumption:** ~11.1V @ 2.5A during hover.

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### 7. Future Work

- Add dynamic fins for roll/pitch control.
- Integrate AI for target-based visual following.
- Shift to SLAM-based navigation.
- Replace ESC with sinusoidal FOC driver for smoother control.

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### 8. Prototype Image

*A prototype of the monocopter drone featuring the single-actuator system, stacked electronics, and embedded vision module is shown below.*

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### 9. Credits

- Mechanical and Embedded Integration: Jaywing Technology
- Software and Vision System: Jaywing R&D Division
- Documentation & Testing: Project Monocopter Team

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For further queries, collaboration, or technical support, contact: **support@jaywingtech.in**