Drone Dynamometer

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The Drone Dynamometer introduces a cost-effective real-time drone dynamometer aiming to provide reliable flight performance data while significantly reducing risks and expenses, since current methods require in-depth prior knowledge and a large area. The concept involves the use of load cells to measure thrust and rotational velocities and torque, onboard gyroscopes and accelerometers for black-box data logging, mapping thrust force distribution, and turning angles under tethered conditions This works in combination with a universal coupler joint that ensures multi-axial freedom which in turn allow s the drone to perform a full-armed test scenario while still on a tabletop. This system employs five 10kg load cells, with four tracking yaw, pitch, and roll forces and one devoted to thrust measurement. The data is processed through an ESP 32 microcontroller providing real-time force mapping stored as a CSV. file. Iterative testing was carried out to correlate the actual force values to the inputs received by the controller, the difference was compensated with the PID tuning, providing stability and accurate control to the drone, improving safety. Experimental results demonstrate high accuracy with pitch, roll, and yaw recorded at 4.20 rad/sec, 3.90 rad/sec, and 1.59 rad/sec accordingly, compared to 4.00 rad/sec, 3.87 rad/sec and 1.40 rad/sec of real-time drone flight results, demonstrating a 2-5% of error rate. 80% of testing costs are slashed due to the addition of 3D printing and off-the-shelf components and fasteners compared to traditional manufacturing methods. This platform offers a safe, accurate, accessible, and affordable multirotor testing solution, enabling developers to optimize stability and performance without the risk of crashes or hardware damage.

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