جامعة الملك فهد للبترول والمعادن
King Fahd University of Petroleum & Minerals

The Spinning Drone

TEAM Design | Term 231

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Problem statement:

Developing a power-efficient spinning drone with a built-in AI model for military and agricultural applications to promote environmental sustainability and extends flight duration.

Constraints

- Weight :Limitations Restrictions affecting components selections and payload.
- Weather Conditions: Operation only in dry and fine weather conditions.
- Commutation Range: Not more than 6 km due to limitation of commutation links.
- Environmental Impact: Employing recyclable materials with minimal ecological footprint.

Target Specifications

- Flying time>30 min
- Communication range < 6 km
- MTOW < 2.5 Kg
- Camera frames ~ 5 fps
- Diagonal diameter between 1250-1700 mm.
- Thrust > 750 N
- Image processing accuracy > 90%

Essential Parts

Motors

Servo motor

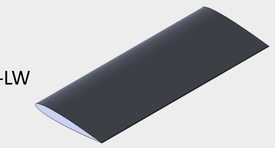
Manufacturer: TowerPro
Model: MG995
Stall Torque: 9.4Kg/Cm
Speed: 0.16s/60degree
Voltage: 4.80 v - 6.00 v

Brushless motor

Manufacturer: Tarot
Model: 4006
Thrust: 850 g – 2050 g
Full-Load amp: 15A

Wing

Airfoil: NACA0012
Material: Esun PLA-LW
Length: 600mm
Weight: 150g



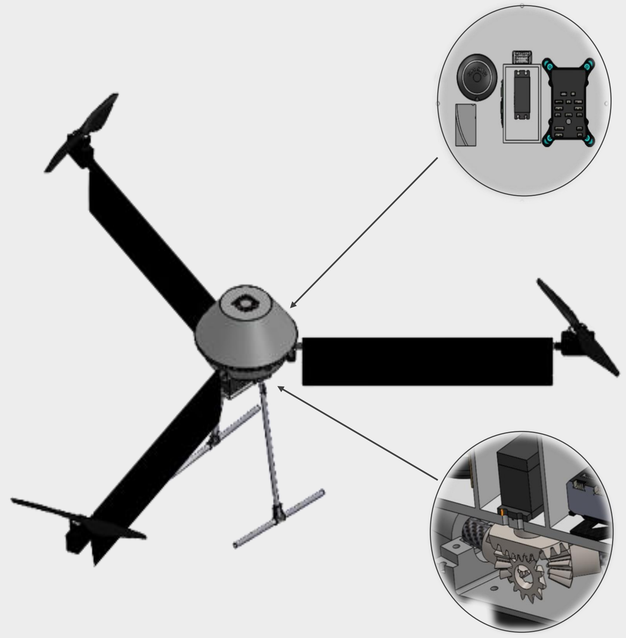
Flight controller

Manufacturer: Readytosky
Model: Pixhawk 2.4.8
Main sensors:
- MPU6000 as main accel and gyro
- ST Micro 16-bit gyroscope
- ST Micro 14-bit accelerometer/compass
- MEAS barometer

Computer

Manufacturer: Raspberry
Model: Raspberry Pi 4 Model B
software : Linux
Main features:
- Video Core VI 3D Graphics
- Bluetooth 5.0 with BLE
- H.265 (HEVC) hardware decode (up to 4Kp60)

Final Assembly



System Process

Computer Vision

Using a Raspberry Pi, the YOLOv8 model was implemented for real-time object tracking. The system uses a custom model, providing frame-by-frame information including detected objects and their coordinates.

class_count.txt_predict6.txt | combined_results_predict6.txt

File Edit View

class	coords1	coords2	coords3	coords4	confidence_value	objectID
0	0.185315	0.708304	0.368265	0.581437	0.955273	1
0	0.441876	0.891691	0.164741	0.215311	0.874761	2
0	0.185329	0.708572	0.367952	0.580919	0.953827	1
0	0.441322	0.891467	0.165112	0.215793	0.877395	2
0	0.1843	0.708734	0.367656	0.580532	0.953371	1
0	0.444384	0.893551	0.16304	0.21147	0.878468	2

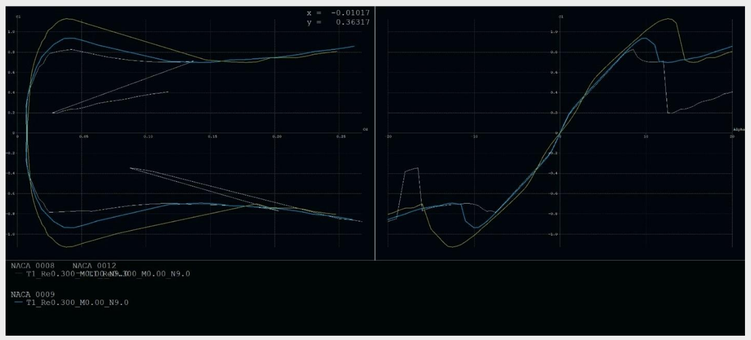
The system groups and crops images of the detected objects, along with the number of objects detected from each class, with the capability to replay sessions with segmentation.

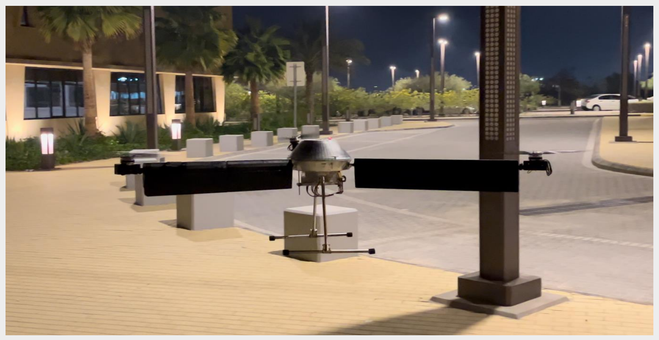
Live streaming of the camera is through LAN for real-time monitoring. To facilitate manual upload and identification of images, a dedicated website was created.

While the drone spins, we adjust the FPS of the camera to a multiple of the drone's revolutions such that the feed appears still and not spinning.

Testing and Validations

Airfoil simulation





Battery consumption improvements