

LAND & AIR DRONE SYSTEM

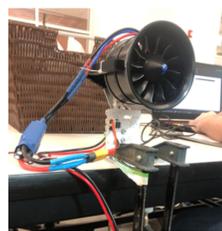
PROJECT DESCRIPTION

Neff Aeronautics wants to investigate the feasibility of a drone/car hybrid for commercial transportation use. The goal of the LADS Team project is to deliver a proof of concept of the vehicle. The vehicle must meet the following requirements:

- Fly and drive successfully
- Quickly transition between the two modes
- Use in-wheel propulsion to power flight
- Scale up to carry 1-2 passengers

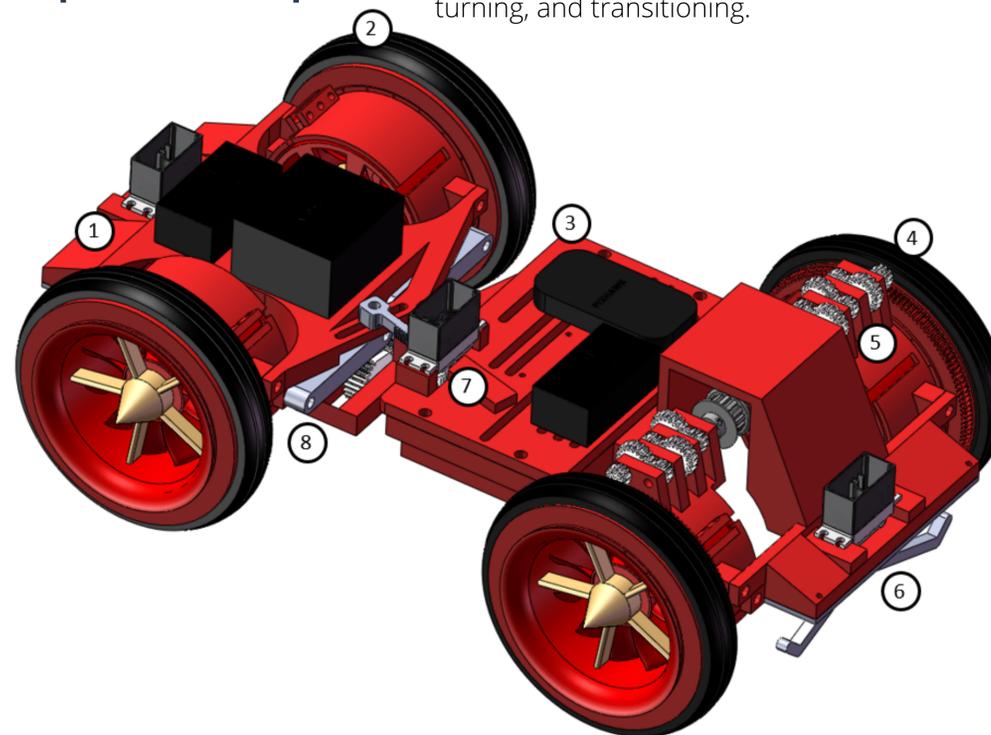
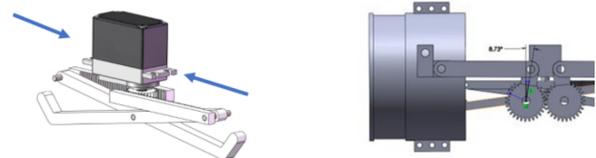
PERFORMANCE REVIEW

The vehicle was evaluated based on four engineering specifications. The team performed analysis to validate the vehicle's ability to meet each specification.



1) Thrust to Weight Ratio (Target: 1.5)
A thrust test was performed on the EDF and compared to the overall weight of the vehicle based on the CAD model and known weights of electronic components.
The Thrust to Weight ratio was estimated to be 1.8.

2) Transition Time Between Driving and Flying modes (Target: 10 s)
Using geometry information from the CAD model, the rotations required to turn the servos for lifting and transitioning were estimated. Comparing this to the manufacturer specs for servo speed, and adding time for the user, allowed for the calculation of 5 s transition time.



The design was inspired by commercial quadcopters and RC cars, as well as front loaders. The vehicle is made up of four sub assemblies - two frame sections and two types of wheels. There are also four systems - transmission, lifting, turning, and transitioning.

Subassemblies

- ① Front Frame
- ② Front Wheel
- ③ Rear Frame
- ④ Rear Wheel

Systems

- ⑤ Transmission
- ⑥ Lift Mechanism
- ⑦ Turn Mechanism
- ⑧ Transition Mechanism

Electronic Components

- 12S 480A High Current Power Distribution Board (PDB)
- Pixhawk Flight Controller
- 6S 2000mAh 120C LiPo Battery
- 2.4GHz RC Transmitter Controller + Receiver
- 100A RC Brushless Motor Electronic Speed Controller (ESC) + 5.5V 4A UBEC (x4)
- 6V 16kg-Torque Servo Motor (x6)
- 90 mm 6S 12-Blade Electric Ducted Fan (x4)

CONCLUSION

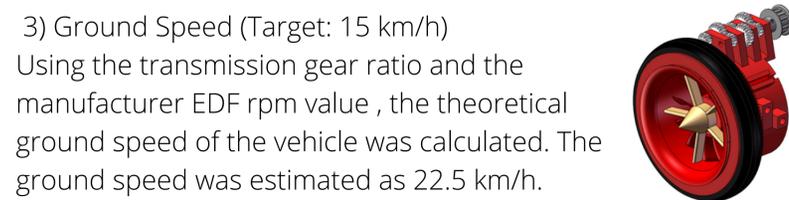
The vehicle is a successful proof of concept for a car/drone hybrid. It produces more than sufficient thrust and ground speed and can turn and transition quickly.

Lessons Learned:

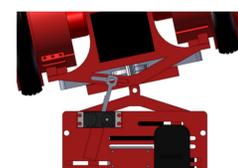
- Accommodate for design drawbacks and shipping delays in schedule
- Design for assembly - create parts to facilitate integration
- Account for thermal expansion in 3D printed parts

Future Work:

- Redesign simpler and more robust lifting mechanism
- Strengthen turning mechanism
- Rebuild prototype at 1/2 scale and replace servos with industrial size servos



3) Ground Speed (Target: 15 km/h)
Using the transmission gear ratio and the manufacturer EDF rpm value, the theoretical ground speed of the vehicle was calculated. The ground speed was estimated as 22.5 km/h.



4) Turn Radius (Target: 2 m)
Verifying the turning space in the CAD model and the throw of the servo and turning arm, the team estimated the turn radius to be 0.6 m.