Westdrone Inc.

Aerospace Research and Development

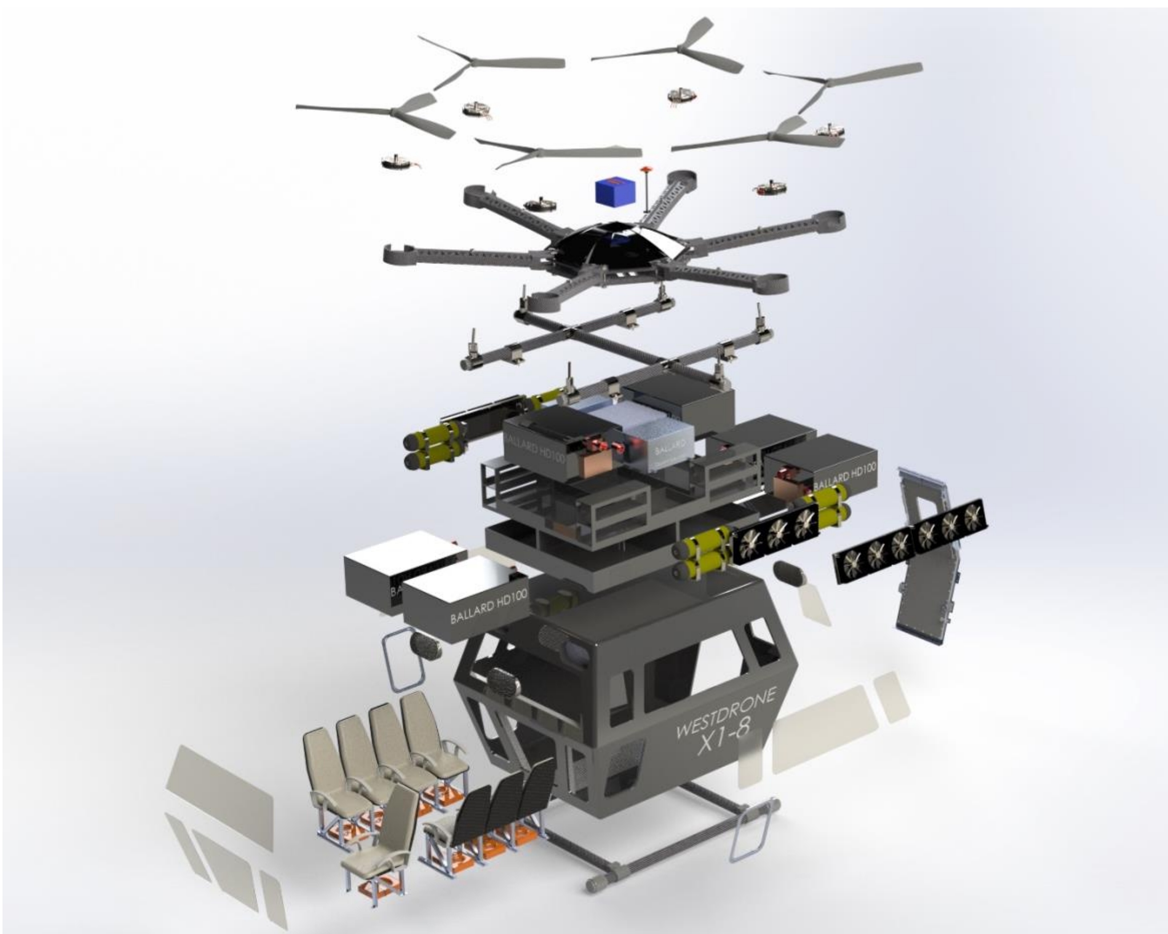
45X Capstone

Date: September 1st, 2020.

Title: Design Airframe and Propulsion System for Passenger Drone

Introduction

Westdrone Inc. is dedicated to changing the way people and goods travel - with electric large-scale drones. Fly within minutes to a remote mountain lake from downtown on a Friday night to flying medical equipment and personnel from a ship into a remote area. The scope of possibilities is unlimited. The environmental footprint is minimal. Low operating costs mean low air fares and freight charges. The X1-8 is essentially an eight-passenger or 2,000lb payload flying van. The X1 -8 is currently at research and development stage with a 1:6 scale working model built and tested.



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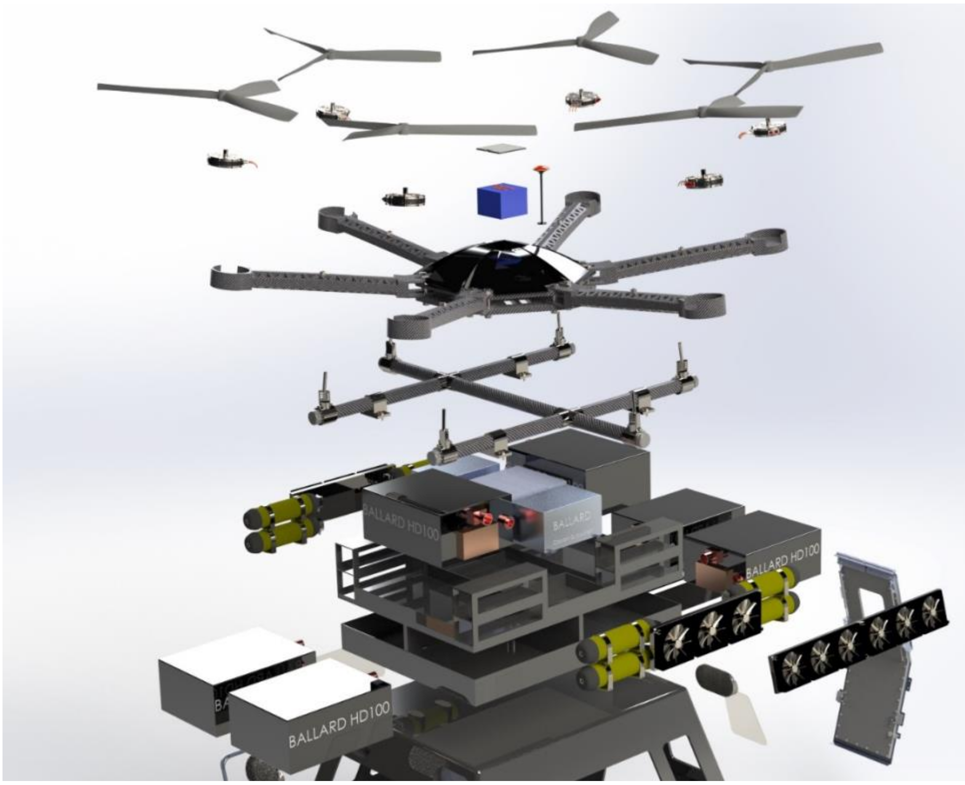

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<u>**Project Description**</u>

Project Two – Propulsion System

Design and test the X1-8 propulsion system. Determine performance and fuel usage. The X1-8 is powered by 100kW fuel cells to 100kW 400v electric motors. The motors attach directly to 7 ft propellers. The six fuel cells are Ballard HD100 s each with a coolant and an air subsystem. These are heavy duty and have thousands of hours of real-world experience. The motors are Yasa P400 R series E-motors built for aerospace in collaboration with Oxford University.

<u>**Expected Outcomes**</u>

Project Two – Propulsion System

Virtual design(simulation) fuel cell propulsion system with air and coolant sub-systems, controllers, and electric motors. Validate performance.

<u>**Major Deliverables**</u>

Project Two – Propulsion System

Fabrication ready design of the propulsion system. The base deliverable would be designing fuel cells, coolant and air sub-systems, controllers, and motors with hoses and wiring diagrams. A next level of deliverables would add performance data. The optimum deliverable would add comparison to component alternatives.

<u>**Special Considerations**</u>

A list of specifications and components as well as the layout and weight distribution will help narrow the scope and focus of the project. A list of components will be submitted as recommended. All components need to be evaluated.

<u>**Additional funding beyond Capstone $650, available for two projects combined on preapproval and justification basis.**</u>

Required:
Capstone Undergraduate Project NDA Agreement
Capstone Undergraduate Project IP Agreement

Specifications

Components and Structure

Fuel cell

Ballard HD 100
Proton-Exchange Membrane (PEM) fuel cell
Maximum output 100kW (134DIN hp)
Weight 280 kg (564lb)
Size approx. 1200X869X487mm high (47”X34”X19” high)

Coolant subsystem
Weight approx. 44 kg (97lb)
Size approx. 737X529X379mm high (29”X21”X15” high)

Air subsystem
Weight approx. 61 kg (134lb)
Size approx. 676X418X352mm high (27”X17”X14” high)

Air Frame
Diameter (propeller tip to tip) 7m (23 ft)
Top main center frame - carbon fiber 2.6mX1.9m (8.5ftX6.25ft)
Frame arms - carbon fiber 1.6764m (5.5ft)

Yasa P400 RHC Series Electric Aerospace Motor – six required
(Yasa has a collaboration with Oxford University)
Power continuous 100 kW (134HP)
Propeller RPM 2,850 @ 100kW (134HP)
Torque continuous 200Nm @ 100kW (134HP)
Voltage 300-400V
Weight 24kg(57lb)

Yasa Si400 Motor controller – six required
Dielectric oil cooling
Voltage 50-400V
Weight 5.75kg

Propellers – six required
Propeller diameter – 2.1336m (84”)
Carbon fiber
Pitch – 10”
Propeller Type – APC W
CF – 1.09
Number of blades – 3
Maximum RPM 2,850
Air temperature – 68F
Air density – 1.2045 Kg/m3
Static thrust 1,682.84 lbs.
Perimeter speed (speed at blade tip) 318.22ms (320ms is maximum = the speed of sound)
Required engine power 87.881kW (119.489HP)

*as temperature falls – static thrust increases and air density increases

Hydrogen Fuel Tanks
Hydrogen tanks – 8 required
Dimensions 254mmX 870mm (10”X34”)
Pressure 70 MPa (10,000psi level 4)
Volume 40 L
Hydrogen storage 1.3 kg
Weight 32 kg (70lb)

Carbon fiber is used to build high pressure hydrogen fuel tanks making them light and strong. Toyota and Quantum are two major manufacturers but there are others. Manufacturer to be determined.

Ballistic Parachute
BRS Aerospace
Weight (approx.) – 38.5kg (85lbs)
Due to 8,000lb weight of X1-8, BRS would need to custom design parachute

Power Management Unit (PMU)
Power Management Unit regulates voltage for the 5-8V system required by the Main Controller, the GPS/compass, and the Inertial Measurement Units (IMU) 3-axis accelerometer, 3-axis gyroscope, and barometer. Second system is 12V for navigation, electronics, heating, ventilation, defrost, and windshield wipers.