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Oxcart Hybrid Multicopter: Preliminary Specifications



The Oxcart is a hybrid electric multirotor UAV capable of autonomous flight. The main body is machined out of a single piece of high strength aircraft aluminum and serves as the fuel tank for the vehicle. It also provides protection to the autopilot and electronics from the elements and rough handling. The Oxcart is capable of flying in almost any weather, the electronics are protected from dust and rain.

The eight 30 inch propellers allow for extended flight times while carrying heavy payloads, as well as providing redundancy in case of a motor or prop failure. The Oxcart is capable of flying even after losing a motor or prop. The payload is attached to the vehicle using a MIL-STD m1913 Picatinny rail, which allows for integration of custom payloads to suit a variety of applications. Sprayer tanks, pan-tilt-zoom pods, LIDAR sensors and cinema grade gimbals can all be carried by the Oxcart.



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The Oxcart can be easily broken down for storage or transport. Each folding arm features a custom designed over-center clamp with safety lock (**Figure 1**). To fold the arm, the operator releases the safety lock and rotates the clamp vertically away from the body. Once the clamp is released, the arm can be folded down and stowed for transport (**Figure 2**). Unfolding the arm before flight is just as painless: the operator merely rotates the arm horizontal and pushes down on the clamp lever until the arm is secure. The safety lock will automatically engage when the arm is in the correct position, ready for flight.

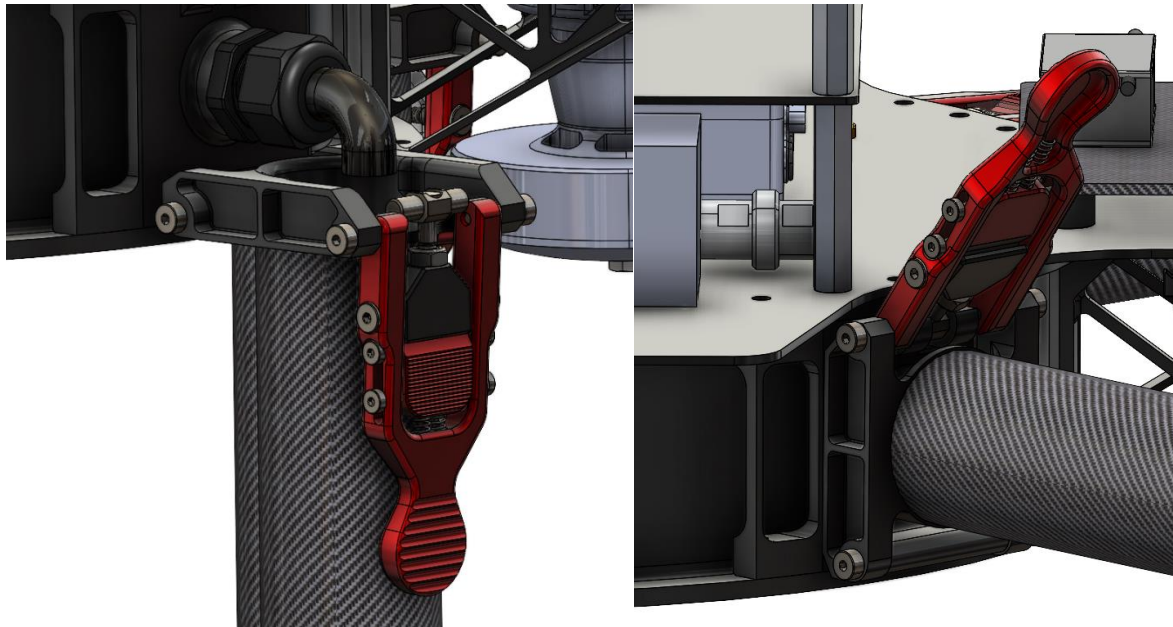


Figure 1: *Folding arm mechanism on the Oxcart. The system is designed to be able to rapidly deploy the arms, while providing high strength and stiffness for flight*



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Figure 2: Oxcart with arms stowed. The Oxcart is designed to be easily transportable in a wide range of vehicles. The Oxcart when stowed can fit in the front seat of a normal sized passenger car.

The onboard generator system features a 2-stroke, liquid-cooled, fuel-injected internal combustion engine controlled by CANBus. The fuel mixture and spark timing is controlled by the Generator Control Unit (GCU) based on the atmospheric conditions and power output of the generator. If the generator begins to overheat, the GCU will throttle the power output of the unit to prevent a failure in mid air. The generator runs off of 91 octane gasoline with 50:1 2 stroke oil mixed with the fuel.

The Oxcart is controlled by an Radio Controller with an integrated android tablet (**Figure 3**). The controller is open and can load virtually any 3rd party software for android. The controller also features a high definition real time video downlink that can be displayed on the controller.



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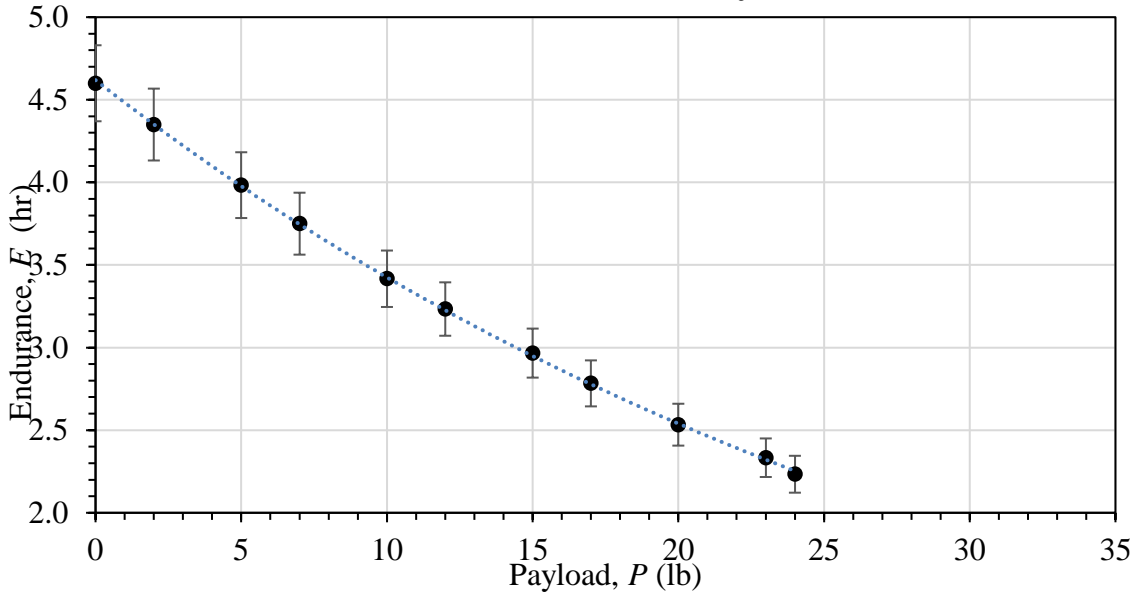
Figure 3: The handheld ground station controller for the Oxcart. This system provides the operator with multiple ways to interface to the vehicle. The operator can control the drone via the joysticks in manual and assisted modes, or the vehicle can operate fully autonomously via a waypoint mission uploaded from the controller. A real time HD video feed is present on the controller's screen. Multiple auxillary switches allow for controlling various payloads without the need for a separate controller or laptop computer.



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Oxcart - Endurance vs Payload



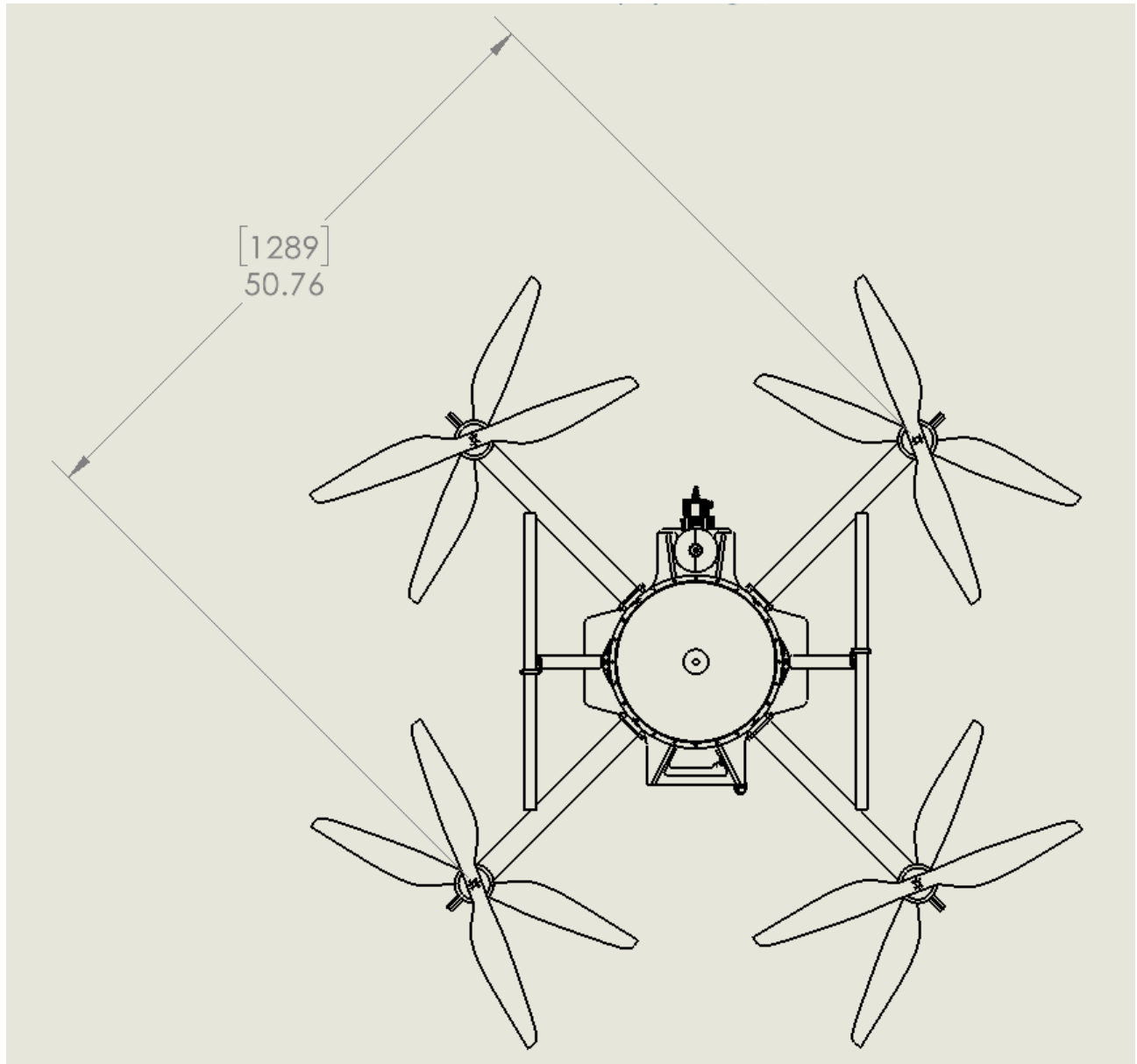
Oxcart - Endurance vs Payload						
Fuel mass (gal)	Endurance (mins)	Endurance (hr)	Power Range (W)	AUW (lb)	Airframe Weight (lb)	Payload (lb)
1.75	276	4.6	2253-1996	44	5	0
1.75	261	4.4	2372-1809	46	5	2
1.75	239	4.0	2559-1951	49	5	5
1.75	225	3.8	2688-1957	51	5	7
1.75	205	3.4	2889-2217	54	5	10
1.75	194	3.2	3029-2320	56	5	12
1.75	178	3.0	3246-2511	59	5	15
1.75	167	2.8	3396-2644	61	5	17
1.75	152	2.5	3628-2855	64	5	20
1.75	140	2.3	3869-3082	67	5	23
1.75	134	2.2	3952-3118	68	5	24

Flight time may vary depending on atmospheric conditions, size of payload and flight speed. The chart above is intended to give the operator a general idea of the endurance of Oxcart with varying payloads.



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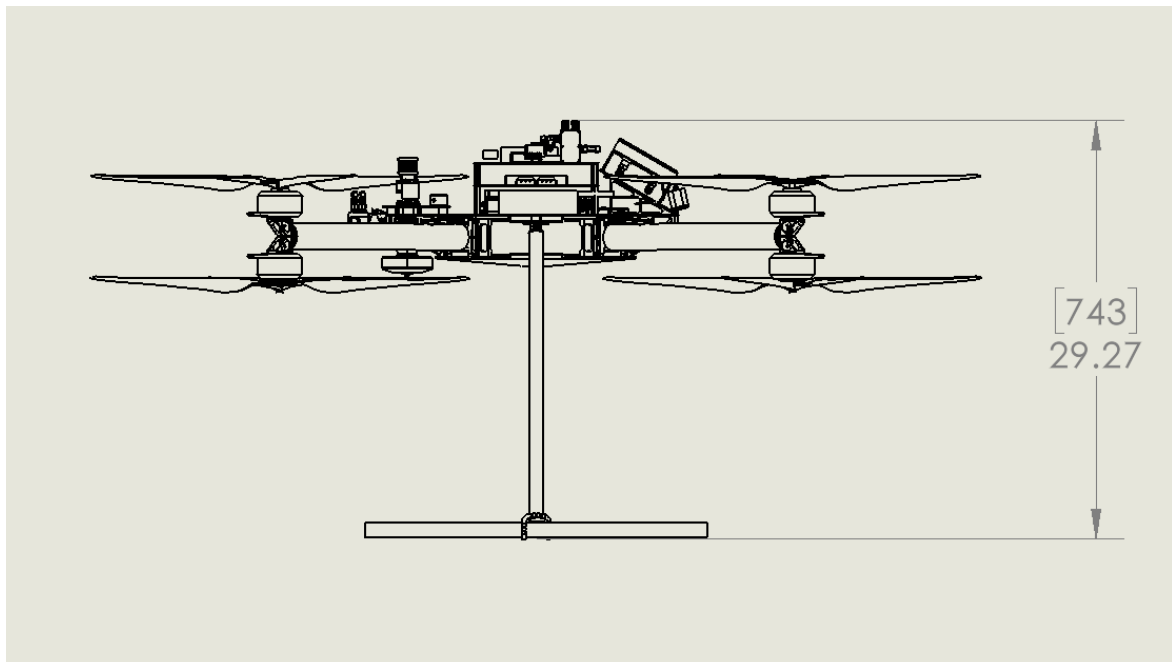
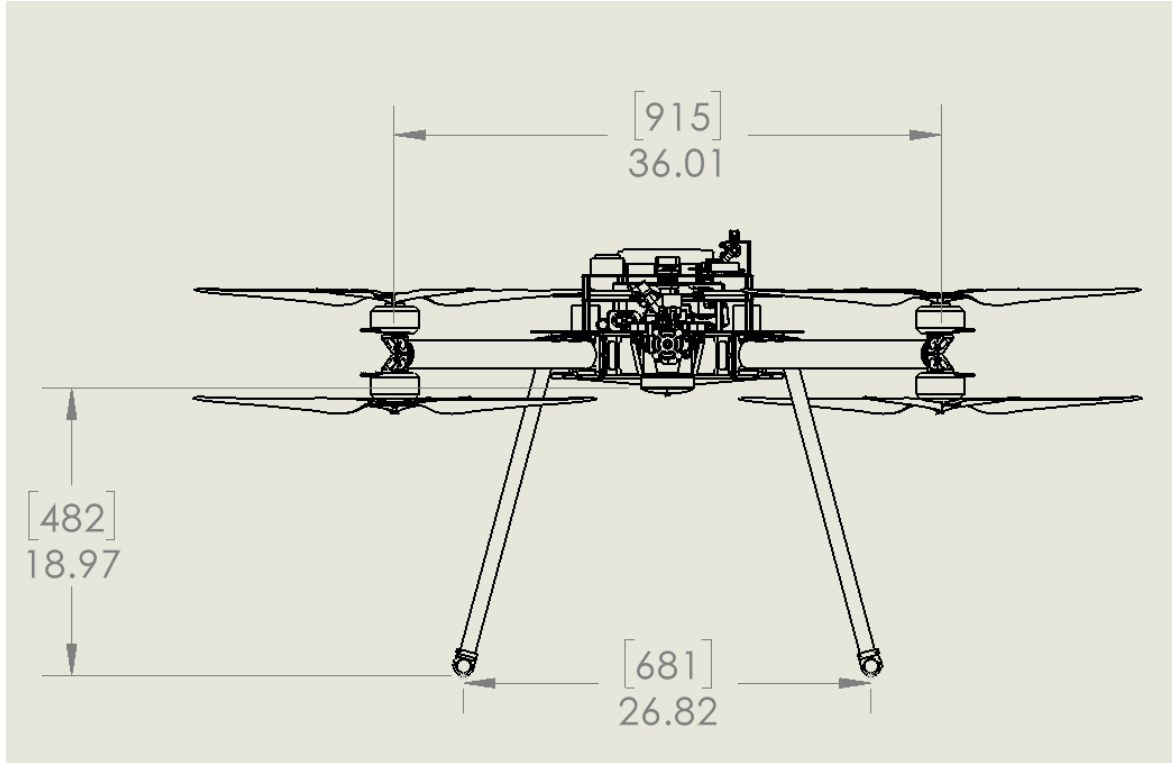
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Vehicle Type	multirotor helicopter
VTOL Capable	Yes
Endurance (no payload)	240 minutes*
engine type	brushless electric x8 (KDE 7215XF-135)
speed controller	KDE EXF-UAS95HVC x8
Rotor diameter	30 in (x8)
Motor to Motor Diagonal Length	50.76 in (1289mm)
Width (Motor to Motor)	36 in (915mm)
Height	29.27 in (743mm)
Empty weight	35lbs (15.9kg)
Fuel Capacity	1.75 Gallons
Max Take off weight	75 lbs** (34kg)
Maximum Payload	25 lbs** (13.36kg)
Energy source	91 octane gasoline with 50:1 oil premix
Operating distance	6 miles (10Km)***
Operating cost (\$/hr)	\$12.00/hr****
Manual controller	RC Radio with Android OS and real time video downlink
Groundstation telemetry link	Integrated to handheld controller; RFD 900x optional
GPS	Dual redundant uBlox F9P RTK
Wind Speed (max tolerance)	30 MPH (16 m/s)
Navigation Lighting	FAA compliant (Red , Green, white)
Operating temperature	20-120 degree F (5-50C)
Enviornmental tolerance	IP54 (dust tight, capable of operation in heavy rain)
Failsafes	Return to Launch (RTL) in case of loss of radio, loss of groundstation. Land on low battery. Dual GPS, IMU, Compass. Redundant motor configuration (can fly on 7 motors/props)

*Endurance depends on atmospheric conditions.

**Max takeoff weight may be restricted by the FAA or other governing bodies. Please check your local laws before flight

*** Range limited by 2.4GHz signal. Range dependent on obstacles and atmospheric conditions

****Operating costs based off of 200 hour maintenance cycle (replace motor bearings and ESCs) and 500 hour engine overhaul