UMEP (UAV Mission Extension Platform)

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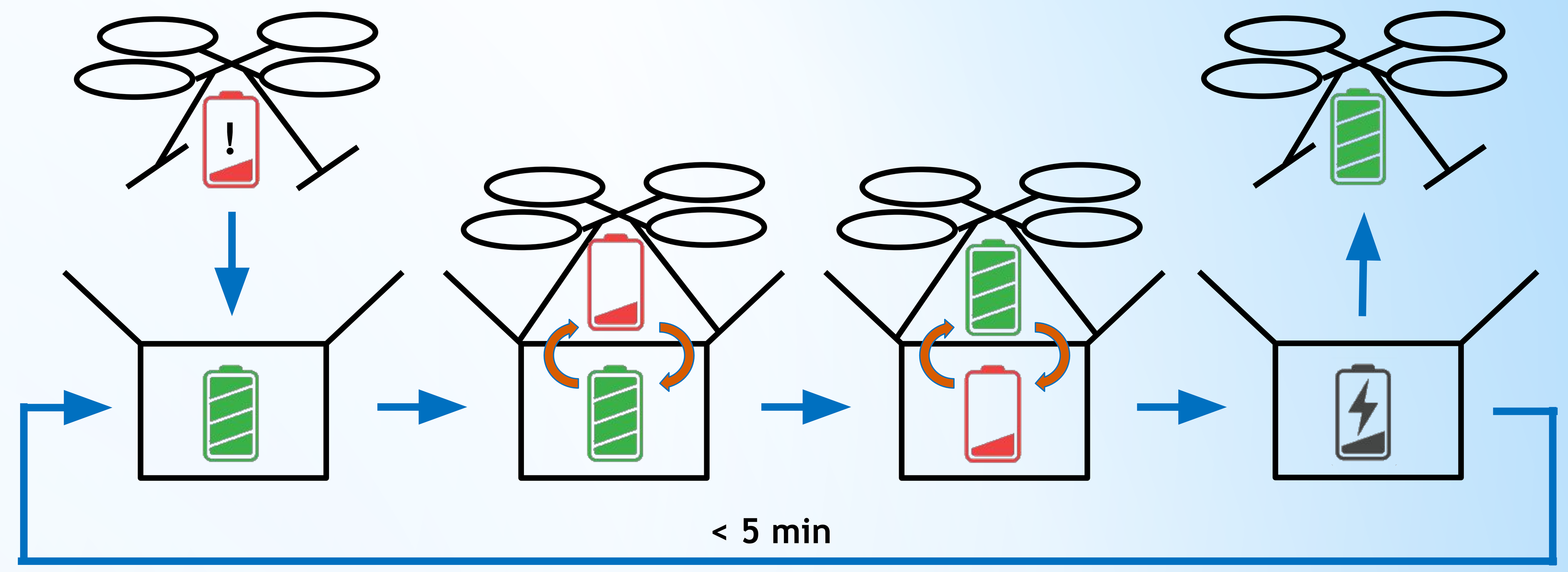
The Expanding Industry: Drone

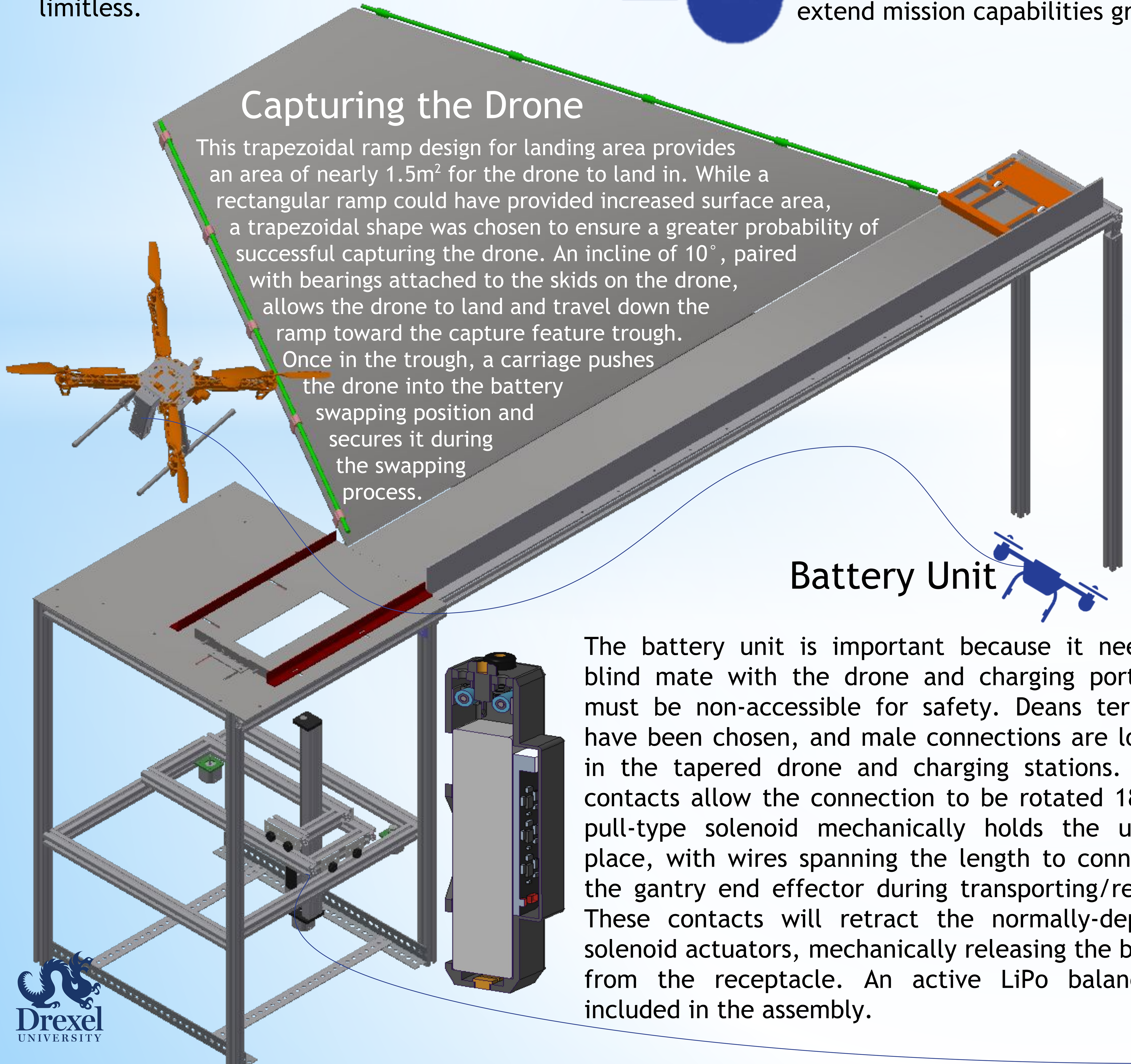
Unmanned Arial Vehicles (UAV) are developed for a large range of commercial applications such as search and rescue, non-destructive structure evaluation, agriculture monitoring, and transportation. Their small profile and ability to maneuver makes their possible applications seem limitless.

Problem: Energy Density of Batteries

As commercial UAV usage becomes more popular, the energy density of batteries is the limiting factor on how much work can be done during a single mission. If designed properly, a system capable of automatically supporting the power requirements of aerial drones indefinitely would help extend mission capabilities greatly.

Solution





Capturing the Drone

This trapezoidal ramp design for landing area provides an area of nearly $1.5m^2$ for the drone to land in. While a rectangular ramp could have provided increased surface area, a trapezoidal shape was chosen to ensure a greater probability of successful capturing the drone. An incline of 10°, paired with bearings attached to the skids on the drone, allows the drone to land and travel down the ramp toward the capture feature trough. Once in the trough, a carriage pushes the drone into the battery swapping position and secures it during the swapping process.

Electronics

Algorithm for all functionalities resides in and is carried out by Arduino Mega, which commands relays to control charging process of batteries individually and stepper motors. Limit switches help home the battery positioning system and monitor the battery swapping process. Buck converters are used where needed. Power will be provided externally.

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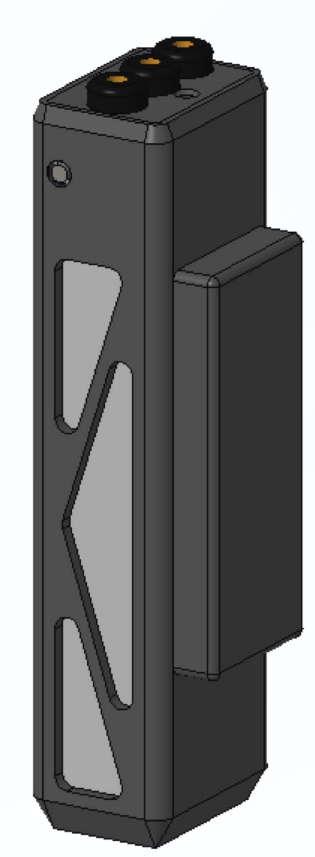
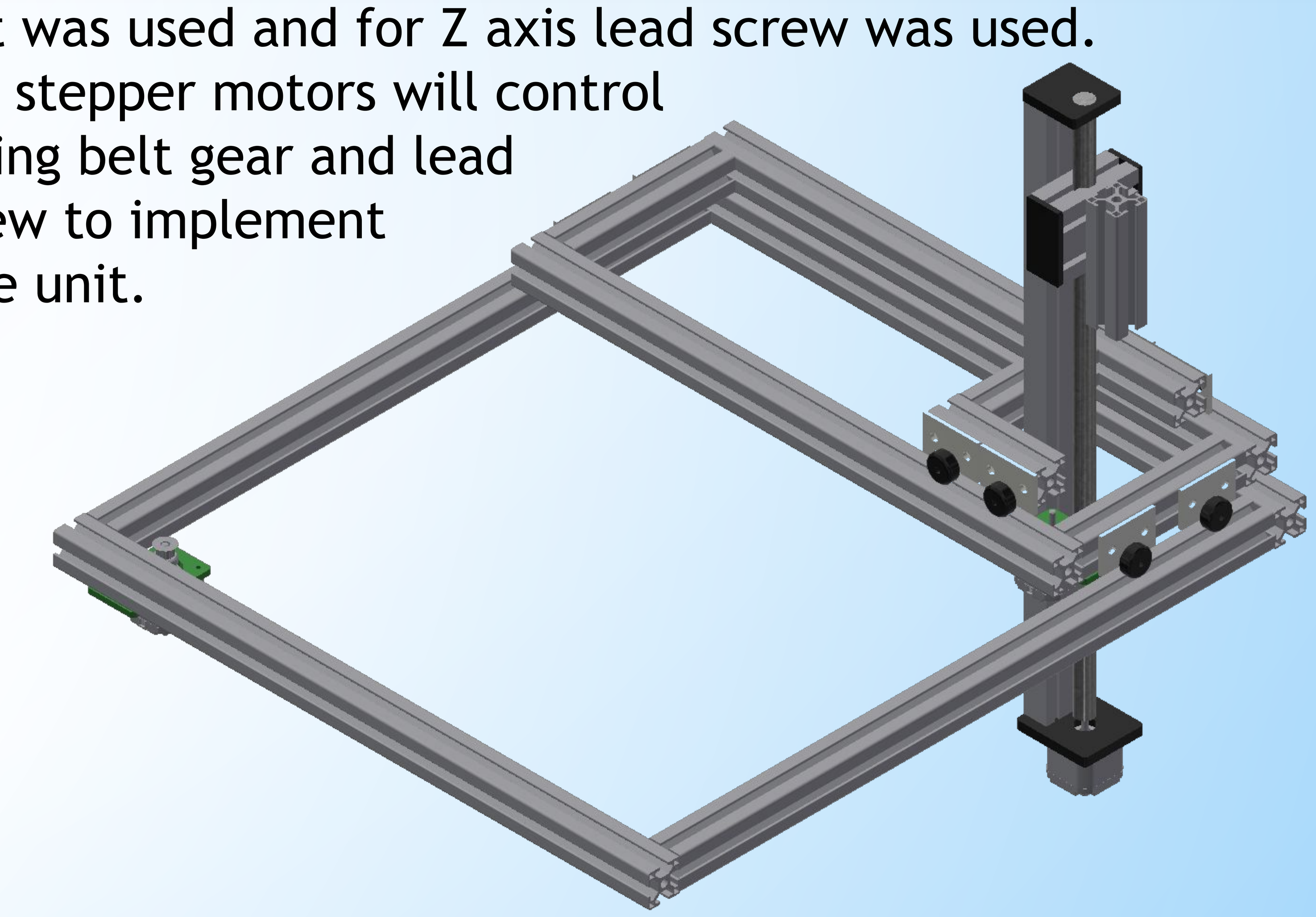
Battery Unit

The battery unit is important because it needs to blind mate with the drone and charging ports and must be non-accessible for safety. Deans terminals have been chosen, and male connections are located in the tapered drone and charging stations. Three contacts allow the connection to be rotated 180°. A pull-type solenoid mechanically holds the unit in place, with wires spanning the length to connect to the gantry end effector during transporting/release. These contacts will retract the normally-deployed solenoid actuators, mechanically releasing the battery from the receptacle. An active LiPo balancer is included in the assembly.



Positioning the Battery Unit

The battery positioning system requires at least 3 degrees of freedom (DOF). For X and Y axis movement, timing belt was used and for Z axis lead screw was used. The stepper motors will control timing belt gear and lead screw to implement base unit.



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