Payload Delivery System

Atılım UAV Team · Atılım University — Payload Subteam Technical Documentation · SUAS 2026

ABSTRACT

The Atılım UAV payload system was developed for the 2026 Student Unmanned Aerial Systems (SUAS) competition to deliver a strobing beacon to the tent target and a water bottle to the mannequin target during one autonomous flight. Two independent DC-motor-driven winches lower the payloads at a controlled speed instead of releasing them in free-fall. Each payload is held by a dedicated servo-actuated slider-crank spool lock until the aircraft reaches the designated release location. Both winches are controlled through one HW-231 dual-channel H-bridge, and the complete module uses a rail-guided detachable mounting system for tool-free installation and servicing.

1 DESIGN CHOICES

The payload subsystem must carry both competition objects simultaneously and deploy them at different stages of the same mission. The design therefore prioritizes independent operation, controlled descent, secure in-flight retention, low mechanical complexity, and rapid serviceability.

Each delivery channel combines a servo-actuated slider-crank lock with a dedicated 800 RPM DC motor and winch spool. While the lock is engaged, the payload remains fixed at the bottom of the UAV regardless of motor state. Once the UAV reaches the stored target coordinate and positions itself over the designated drop location, the servo first opens the spool lock. Only then does the DC motor begin lowering the payload at a controlled, constant descent speed. The motor stops when the delivery is complete.

The full release sequence is executed at the 50 m (164 ft) mission altitude, which keeps the aircraft above the 150 ft AGL minimum altitude fence. A single HW-231 dual-channel H-bridge provides independent bidirectional control of the two winch motors, allowing the beacon and water bottle to be deployed separately without one delivery mechanism affecting the other.

2 DETACHABLE MODULE MOUNTING

The airdrop mechanism is built as a detachable module so it can be reloaded, serviced, or replaced without disassembling the main airframe. Grooved channels guide the module into position, and locking sliders secure it during flight. Releasing the sliders allows the complete unit to be removed without tools or permanent fasteners.

This arrangement reduces turnaround time between flights and keeps payload-system maintenance independent from the avionics and structural subsystems.

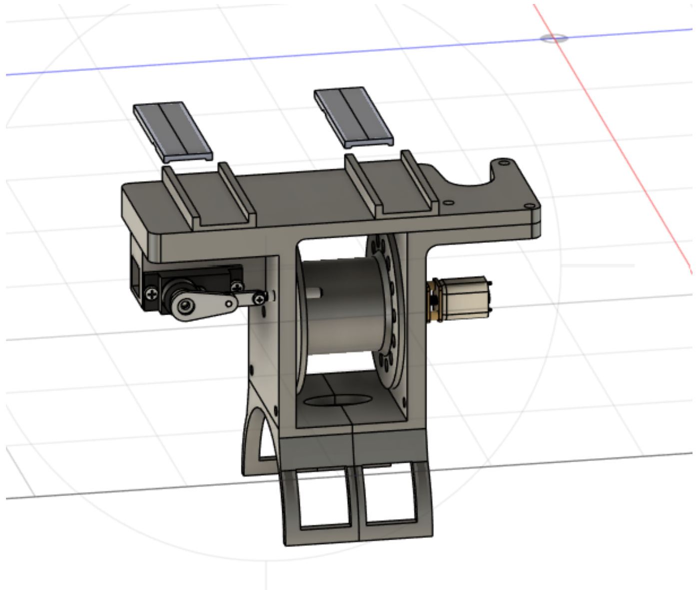

Figure 1. The detachable winch module assembly. The servo-actuated lock secures the payload, the motor-driven spool controls the descent, and the rail-guided sliders support tool-free installation.

3 WINCH SPOOL AND LOCKING MECHANISM

The winch spool is a cylindrical drum driven by the dedicated 800 RPM DC motor. Its flanges retain the wound line as the payload is lowered and recovered. The mounting-hole pattern connects the spool to the drive interface of the winch assembly, while the centered geometry keeps the line payout stable.

The servo-actuated slider-crank mechanism functions as a separate spool lock. This separation is important: the lock carries the payload during flight, while the DC motor is used only after the lock has opened. As a result, motor state alone cannot cause an accidental release.

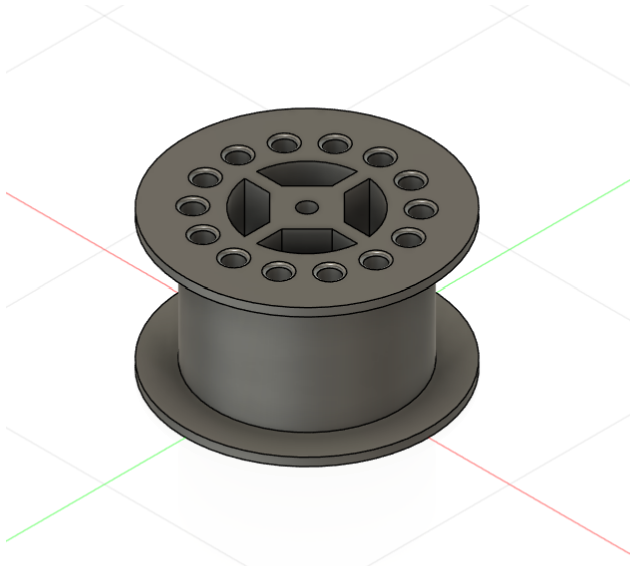

Figure 2. The motor-driven winch spool. The cylindrical drum stores the line, the flanges retain the winding, and the mounting-hole pattern connects the spool to the winch drive interface.

4 TESTING, IMPLEMENTATION, AND INTEGRATION

Component-level tests first verified the servo-actuated locks and motor-driven winches independently. For both delivery channels, the team confirmed lock engagement, lock release, controlled payload descent, motor stop behavior, and independent bidirectional motor control. Repeated trials produced consistent deployment.

The complete Search–Detect–Deliver chain was then exercised in flight. The first end-to-end test was conducted at approximately 20 m AGL to keep the release within visual range while the guidance chain was flown for the first time. Both targets were detected, their positions were transferred to the guidance system, and the aircraft navigated to the stored release coordinates. The strobing beacon landed on the tent target, while the water bottle landed approximately 5 m from the mannequin.

The same sequence was repeated at the 50 m mission altitude. Detection confidence and delivery offset remained of the same order, and both payloads landed inside the 50 ft (15.2 m) scoring radius. The releases in these tests were commanded from the stored geolocation; closing the terminal-guidance loop on the live image remains a software refinement rather than a change to the mechanical release system.