EMPOWERING | **AUTONOMOUS MACHINES**

Connect Tech

Wind Turbine Inspection Drone

NVIDIA ELITE PARTNER

CASE STUDY

Designing an AI Driven Inspection Drone for Wind Farms

ALERION

Inspecting a single wind turbine manually is a long and dangerous operation. Utilizing early drone technology has cut down on time, but produces inaccurate imaging, resulting in costly re-inspections. Alerion designed a fully autonomous drone (WEGOOI) to perform inspections of wind turbines, relaying real-time damage identification, and drastically reducing the time and cost involved. Using both an auto-pilot program and AI damage detection, WEGOOI can navigate and orient itself to each turbine, generating a 3D image to detect even microns of damage.

Connect Tech

Advanced AI technology performs fully autonomous inspections in a fraction of time

Damaged wind turbine blades can have catastrophic effects on performance. A fully autonomous drone ensures accurate and quick inspections.

Bringing Efficiency to Renewable Energy

ALERION

Harnessing wind energy has gained popularity over the past two decades due to its much smaller impact on the environment compared to fossil fuels — and the fact that it's a sustainable and renewable energy source. The aerodynamics of the turbine's blades are determined by the performance required to efficiently extract energy from the wind, and any defect in the blades themselves can have devastating consequences to the turbine's performance. As the popularity of installed wind turbines climbs, regular maintenance and inspections of the equipment is critical to ensure optimization — inspections traditionally done through manual inspection. By utilizing drone technology, wind farms can inspect a field of turbines in a fraction of the time it would traditionally take to do manually.

Evolution of Inspections

A manual inspection of a single wind turbine took an operator anywhere from 2-3 hours to complete. Initial drone technology cut that inspection time down to 1-1.5 hours per turbine, but limitation in camera technology caused between 20-30% of the assessment to be repeated to ensure accurate results. Add to that, early drones typically needed to be flown and controlled by an operator on the ground, making this task a labored and expensive way of performing inspections.

The team at Alerion envisioned a system powered by Artificial Intelligence that would be able to autonomously inspect turbines without manual intervention and at a fraction of the time traditionally required.

> Early drone technology was a big leap forward in reducing costs and danger during turbine inspection - but the inaccuracy didn't allow for the full technology benefits to be realized. We designed the WEGOOI drone to be fully autonomous while providing high-resolution and precision damage detection. For a task that would at one time take 2-3 hours, the WEGOOI drone will complete the full inspection in about 10 minutes.
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> - Oier Peñagaricano, CEO, Alerion

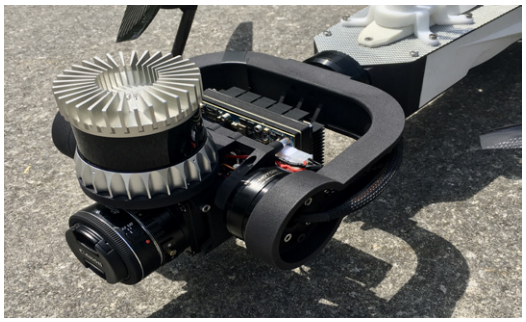
Limitation of UAVs

The Alerion team knew the industry required a fully autonomous solution, which would necessitate significant computing requirements — a task best suited for edge devices. The added size and weight of an edge device on the drone made any model readily available on the market unsuitable. This led the Alerion team to design their own drone from the ground up: the WEGOOI inspector drone.

System Design

While most drones typically housed camera technology on the underside of the drone, this mounting location posed significant challenges to the field of view required for turbine inspection. Alerion designed the WEGOOI drone to include its cameras and edge device on the front – with the inspection module mounted using a gimble harness.

In order to inspect the turbines with the accuracy Alerion wanted to achieve, a computing device that locally runs the inspection and AI algorithms includes:



XIMEA 50MP Camera
For high-resolution images

SwiftPilot Autopilot
Autonomous navigation and orientation to turbine

NVIDIA Jetson AGX Xavier
To power the locally run inspection programs

Ouster OS1 3D LiDAR Laser
To create a 3D image of the wind turbine

FastVideo
High performance raw image processing software on GPU

Flying Solo

Alerion utilizes both an auto-pilot program and AI damage detection for the drone to correctly orient itself and identify any damage to the turbine. The first step in detecting damage is for the system to generate a 3D image of the turbine.

Autonomous navigation software paired with the 3D LiDAR laser determines distance between the drone and turbine and provides depth to ensure the drone is consistently centered and in line with the turbine – critical for inspection accuracy. The local edge devices run deep neural networks that calibrate the information provided by the 3D LiDAR and combine it with the high-resolution images. The end result is a high-resolution, full color, 3D image of every turbine.

AI damage detection software inspects each 3D image generated and automatically detects even a micron of damage to the turbine, all without requiring any re-inspection.

Empowering Deployment

In order for Alerion's detection programs to achieve the accuracy within a fully autonomous system, the drone required significant computing power within the inspection module. Alerion selected the NVIDIA® Jetson AGX Xavier™, as it provides 32 TOPs of performance with 512 CUDA® core Volta GPU with 64 Tensor cores.

Early within project development Alerion selected the high-end XIMEA camera for its ability to capture detail, and required a hardware platform that would support both the GPU and camera.

Alerion partnered with Connect Tech to provide the carrier board that would house the NVIDIA module and bring out connectors for the XIMEA cameras. Connect Tech's Rogue-X Carrier Board was an off-the-shelf carrier board designed specifically for the Jetson AGX Xavier, which had already passed verification testing with XIMEA equipment. In order to bring this project to market, Connect Tech developed a customized board support package for Alerion that provided software to support the cameras on the Jetson platform. The ability to utilize readily available hardware allowed Alerion to quickly pass through prototyping and rapidly deploy the fully autonomous drone to market.