



nvisionist

in cooperation with



# 9th HAEE Energy Transition Symposium

22/05/2024

nvisionist – Innovative Solutions for ICT  
and Green Energy Market

by  
Lampros Argyris  
Business Development Manager



nvisionist

in cooperation with



- **nvisionist was established in 2021**
- An innovative Greek I.T. start-up company focusing on applied digital solutions which are based on **Artificial Intelligence** and **Machine Learning** adding value to the renewable energy sector.
- The company's expertise and know-how also cover the areas of **ICT** including development & maintenance of IT and Communications projects.
- Its **management team** has a long history of successful projects, mainly in IT and renewable sources industry in Greece and abroad.
- It has an experienced **R&D team** consisting of AI, Machine Learning and vision expert scientists.
- **The PPC Group (ΔΕΗ)** has invested in nvisionist. (+βραβεία)



Future Unicorn Award

an award by DIGITALEUROPE



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# nvisionist advanced technological solutions for protecting the environment and supporting sustainability with AI and computer vision



Bird detection & monitoring solution for protecting bird and bats from colliding with Wind Turbine Generators blades

## nvFirePro

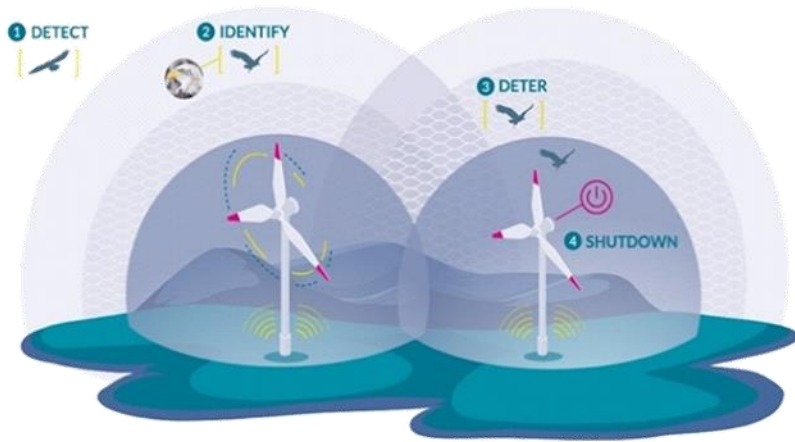
Autonomous fire detection system which can detect and locate wildfires during the first minutes of their breakout and broadcast the event to the appropriate Agency in order to extinguish it before it spreads.

## nv3Dmap

Creation of highly detailed 3D maps for environmental projects utilizing Lidar, HD cameras and advanced GIS systems.



# nvbird<sup>®</sup> bird detection & monitoring system



## THE PROBLEM

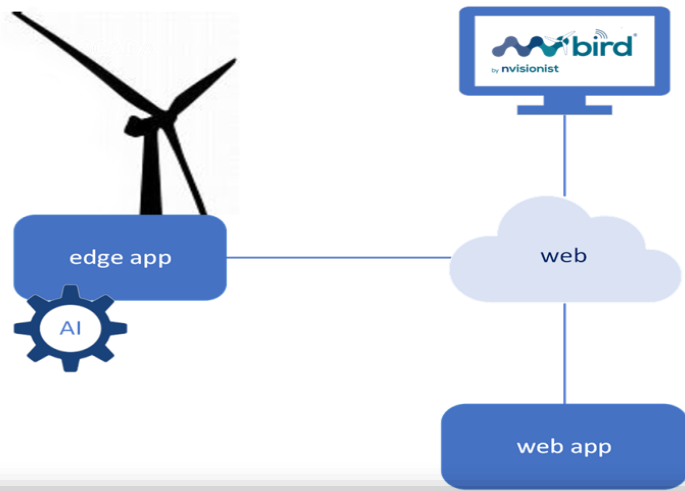
- The rapid expansion of renewable energy sources, more specifically wind power, has led to increased concerns about their impact on wildlife, particularly birds and bats.

## THE SOLUTION

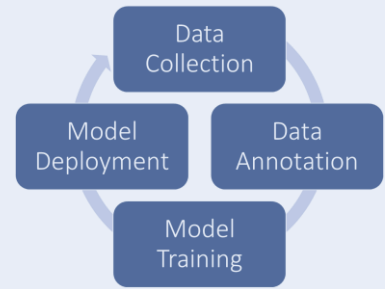
- **nvbird<sup>®</sup>** an innovative, state-of-the-art bird & bat detection and monitoring system which prevents collisions of birds & bats with wind turbine blades.
- Its core is based on **advanced AI and machine learning algorithms** which in collaboration with the latest HD cameras, 3D radar and powerful servers can:
  - ✓ detect birds
  - ✓ analyze their flight path
  - ✓ deter them with special sounds to make them change their flight direction or even slow down or shut the wind generator, if necessary, until the birds fly away.
- The nvbird<sup>®</sup> Bird Detection & Monitoring System is a game-changer in environmental protection and biodiversity. Utilizing AI and Machine Learning, nvbird<sup>®</sup> safeguards rare bird species while optimizing turbine productivity.
- nvbird<sup>®</sup> with its innovation and efficiency serves the protection of birds and the development of wind energy leading the way towards decarbonization and net zero emissions.



# nvbird<sup>®</sup>: system architecture



- Our solution is based on the **Edge AI** paradigm: computations are performed at the point of data collection, i.e. the wind turbines
- We deploy powerful servers as **edge devices** with dedicated GPUs for 4 up to 12 cameras
- **SCADA** integration (we have developed our own OPC UA client/server for two-way communication with the Wind Turbine)
- **nvNOC** (network operations center) for monitoring & maintaining the entire system health. Processes over 100.000 data point every 5"
- **DARP** (Data Analysis Reporting Platform) for integrating, analysing and visualising data.
  - Two-way authentication
  - Various access levels depending on authorisation.
- Continuous system improvement through training of the AI algorithm with a **Multiclass Detector** (blades, insects, airplanes, clouds etc.)



- System Modules: **Detection** - localizing birds in the video frames  
**Tracking** – estimate bird trajectory  
**Recognition** – identify birds of interest



# nybird®: rapid development

PO.025



Advanced bird detection and monitoring system: Innovative approach for distance estimation with a monocular camera

D. Driolou, L. Miliou, A. Sakellios, C. Constantopoulos  
nvisionist

\*Historically, we created instead, a side of the art system for the protection of birds, its core functionality is based on AI models for the detection of approaching birds. A protection system, in order to be effective needs to estimate the distance of the birds, and decide the appropriate protection measures. In the following, we present preliminary results of the novel solution for distance estimation that we are developing.

\*The classical solution for distance estimation, is based on the principles of stereo vision. It uses two cameras with fixed position and known distance. The computations are using the distance between corresponding pixels of the two images. Our innovative approach uses a single camera, and the algorithm is based on the location and size of the bird inside the frame.

Herein we present preliminary results from our work on distance estimation, that is part of our solution for bird protection. Our method is exploiting information from a single frame that is recorded by a high-resolution camera. Using principles of computer vision, the developed algorithm is able to produce distance estimations in real time.



\*In the figure above, we can see a comparison between the actual distance and our estimation. The dark blue line is the distance reported by the RTK system, and the light blue line is the average distance estimated by the neural system. We were able to average estimations because during flight the drone passes from multiple points with the same distance from the base, we get very good estimations inside the reference area. This is a time consuming as we move further away. In any case, the relative error is less than 20%.



Wind TECHNOLOGY WORKSHOP EUROPE 2022 | windurope.org/tech2022

PO.002

Use of Artificial Intelligence and Machine Learning algorithms to accurately detect, classify and deter birds maximizing wind turbines operating time and saving bird lives



Tassos Alefantos  
nvisionist

In this abstract we describe an innovative solution that helps save birds' lives and at the same time helps Energy Provider companies maximize their profits by securing more running time for their wind turbines. The system is built using state of the art cameras and innovative developed Artificial Intelligence and Machine Learning Algorithms and can manage not only to detect and deter birds but also to recognize and classify them in order to take accurate decisions.

Thousands of birds, domestic and migratory, fly through the wind parks and face risk of a collision with the wind turbines blades. Some of the birds are endangered and the life of each one of them is valuable to the ecosystem. EU legislation has enacted environmental protection rules and energy providers are often required to install bird deterrent systems especially on "sensitive" areas. Existing Bird Deterrent Systems are based on sophisticated motion detection algorithms, that trigger the system to stop the turbines too often, since in many cases they simply distinguish classic, yellow birds, even insects flying close to the cameras. Another challenge is that Motion detection technology needs to cover (deterrence) certain areas to improve its detection results, creating blind spots. As more and more wind parks are built around the world, new conflict areas for wind turbines become scarce, the global need for bird protection is rising and there is also a clear need for more accurate systems.

Using state of the art ICT and software development technologies, we manage to deter the birds from the wind turbines, while at the same time maximizing the operating time, almost eliminating shut-downs and minimizing noise pollution. The development of this innovative system, unique in functionality by using artificial intelligence and machine learning technologies, adds value to the global wind energy market. The hardware of the system consists of a powerful server, capable of processing and rendering high-resolution images quickly. Ultra-high definition cameras with special lenses capture high resolution color video and images at up to 1000 meters. Additional thermal cameras help the system detect birds even at complete darkness. Powerful acoustic modules emitting a special directional sound that targets the acoustic reflexes of the birds without harassing them. The solution has been built around a unique machine learning algorithm designed and developed in-house. It uses advanced classifiers and large datasets to achieve its performance. It has been deployed in a few wind parks and has been working with outstanding results in terms of recognizing birds' geometry and successfully deterring them, eliminating false positives and shutting down the turbines only when it is absolutely necessary. The bird detection system is continuously self-improving its detection capabilities using the Machine Learning video content analysis algorithms and is adapted the most continuously better with the support of a team of ornithologists that classify birds understood by the algorithm.

References:



Results

Metric	Value	Target
Detection Accuracy	95%	90%
Classification Accuracy	85%	80%
False Positive Rate	5%	10%
Response Time	200ms	300ms

Conclusions: The system has made use of Artificial Intelligence and Machine Learning current technological advances in a real-world application in the area of birds biodiversity conservation. It manages to protect the birds, stopping the WTG only when it is necessary. It is very accurate and has the ability to continuously improve its performance, offering variable data to companies and researchers that can be accessed in real time from the cloud.

References:

PO.007

Preventing Bird Collisions using Artificial Intelligence, Machine Learning, radars and cameras while maximizing wind turbine availability



Tassos Alefantos  
nvisionist

Abstract: As more and more wind parks are built around the world, low conflict areas for wind turbines are becoming scarce, the global need for bird protection is rising and there is also a clear need for more accurate and reliable solutions. For the first time an innovative system combines radars and cameras to achieve the required accuracy and reliability and at the same time to maximize wind turbine availability. The system can be installed to offshore wind parks and to large flat areas where offshore wind parks are located.

Objectives: To combine data from radars and cameras to successfully detect critical flights and identify bird species in offshore wind park environments.

Methods: nvisionist solution uses radars and Ultra High Definition cameras of 12 megapixels in combination with Thermal vision technology to achieve 24 hours, all weather detection and operation. The detection range of the radars is up to 10km. These cameras are enabled to classify the targeted birds when the distance is less than 1km. The classification of the birds depends on the quality of the dataset the system has been fed. The more data available on a specific bird of interest, the better. When the birds are flying in a collision route (direction and height towards the rotor swept area) with the wind turbines the system sends an automatic command via the GPS, screen to slow down the rotor speed in order to further analyze the flight data. Such systems should be able to monitor the operation of the wind turbine by receiving input data from the SCADA system in order to improve their functionality. Furthermore, based on the previous detection and classification, data of the air currents, drone releases with ultralight vehicles are used to avoid collisions with birds entering the wind turbine risk zone, marking their charge route. In the extreme scenario that a bird enters the critical zone, the turbine (or group of WTGs) can receive automatic signals in various forms, in order to stop or trigger operation and prevent the collision. The system is a big data application that communicates directly with the wind turbines. Access to all this data is crucial both for the park owner and the environmental authorities. Thus a report generator is allowed to produce a user friendly dashboard that can be further adapted to the needs with graphs that are required in various formats. Furthermore, all the information get uploaded to the cloud and are accessible to the ornithologists to correctly classify the birds that have not been classified automatically. Then, the system algorithms get "retrained" and the quality of detections and recognition improves.

Results: After extensive R&D studies the best performance achieved when the following criteria were met:

- 95% maximum accuracy, with maximum false positive or false negative rates.
- Able to estimate distance and height of the detected birds in different background context, especially in offshore environments via use of radars.
- Classification of bird species according to Environmental impact. However:
- robust and able to withstand harsh weather conditions (snow). It should withstand ice falling from the nacelle or from sliding on the tower.
- Avoid multiple error or operators.
- Advance covering capabilities to meet customer demands.

References: 1. nvisionist Website, Name of author 2. nvisionist Website, Name of author



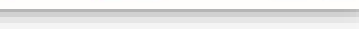
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MEET US AT (INSERT BOOTH NUMBER)

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✓ In-house R&D team with AI and Machine Vision experts. (for our system innovations we have obtained 5 patents 3 of which are form the International PCT)

✓ We work closely with WindEurope – actively participate in the WEDS project (Wind Energy Data Standard) which includes:

- cyber security
- data exchange
- universal metrics & knowledge sharing platforms
- universal wind data standard

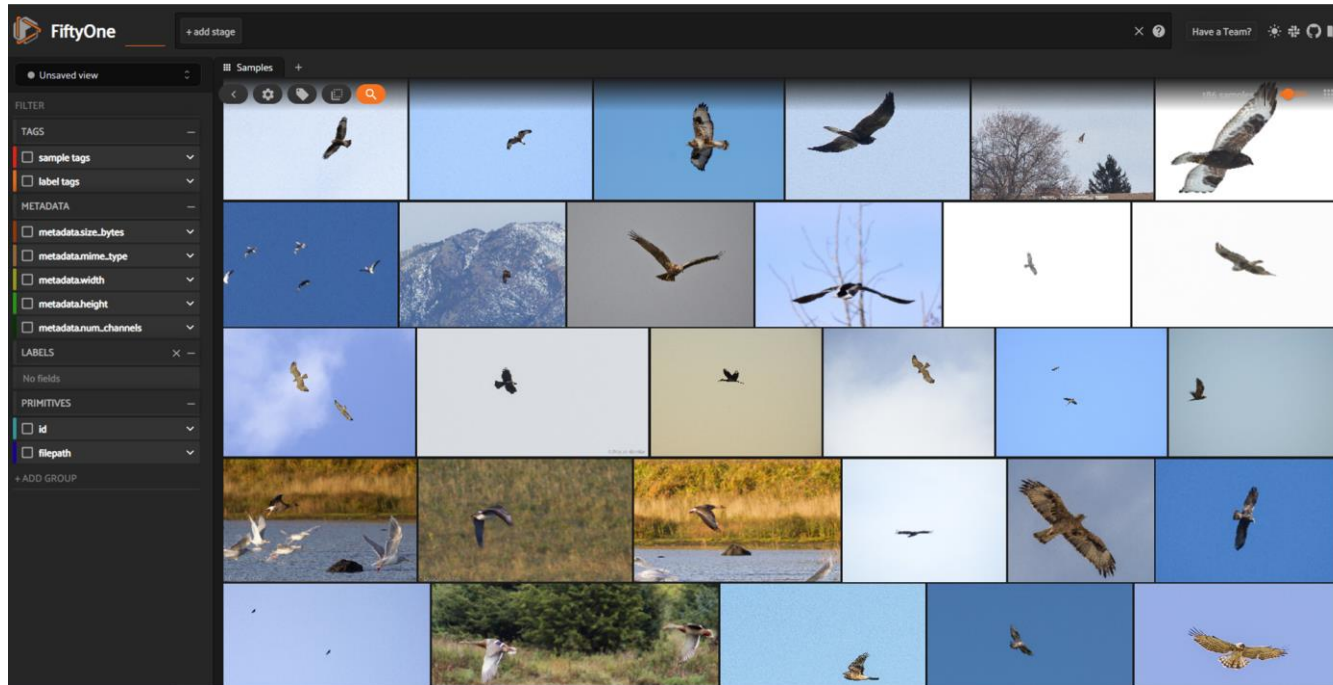
✓ Work with the PPC (ΔEH) Innovation Hub in areas of research and quality assurance.

✓ Collaborate with various Universities in Greece and abroad on research projects to develop new innovative solutions.

✓ Work with Environmentalist and Ornithologist Institutes for understanding bird & bat behavior in order to advance our solution.



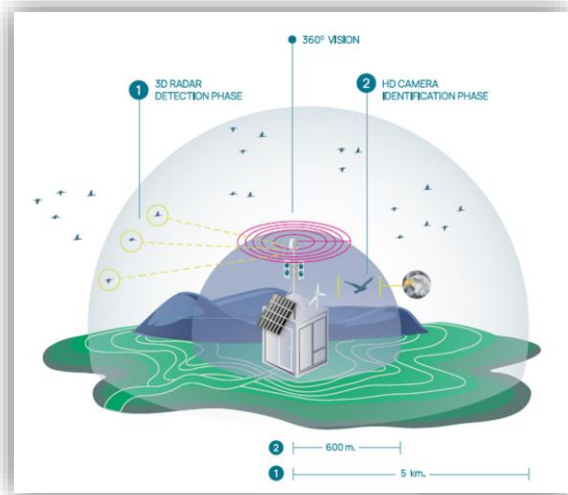
# nvbird<sup>®</sup>: recognition module (next step)



18 protected species,  
250K high resolution  
images

- This module has dual purpose:
  - Filter-out false detections by the detector
  - Identify the birds of interest, that should trigger some action by the system
- Trained with a private dataset, that we obtained through our collaboration with a renowned research institute.

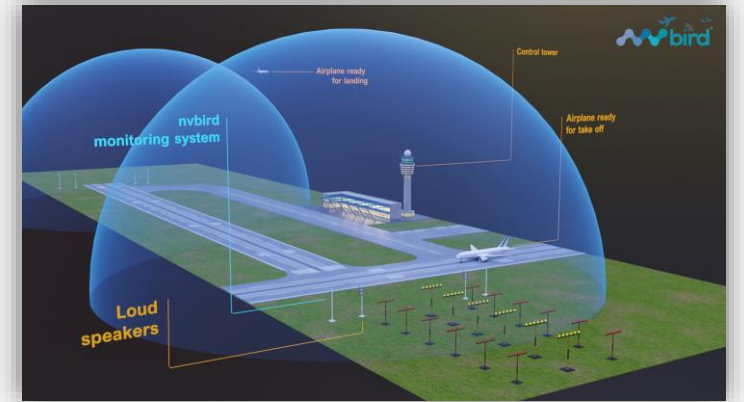
# nvbird<sup>®</sup>: applications



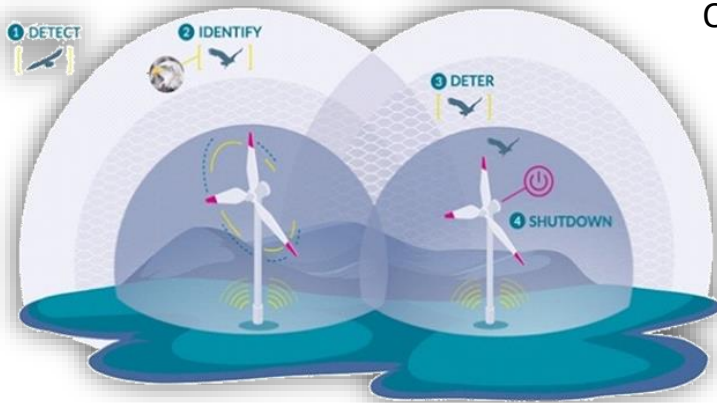
## Pre-Construction

Autonomous system integrated 3D Radar with HD cameras

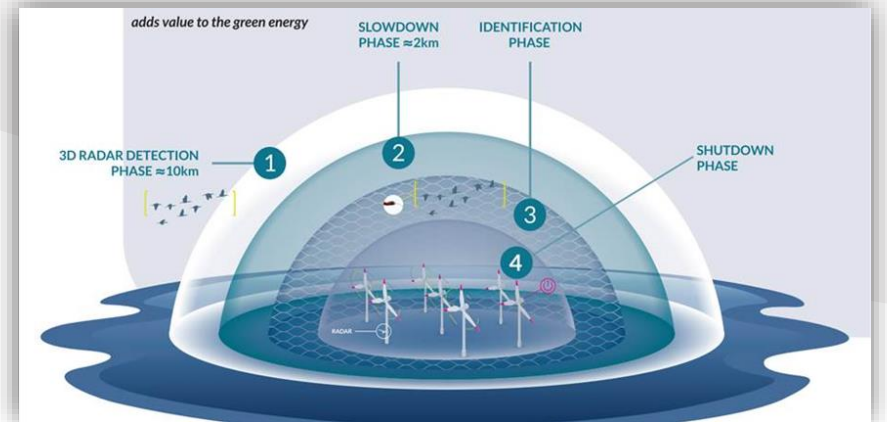
## Airport System



## On-Shore System



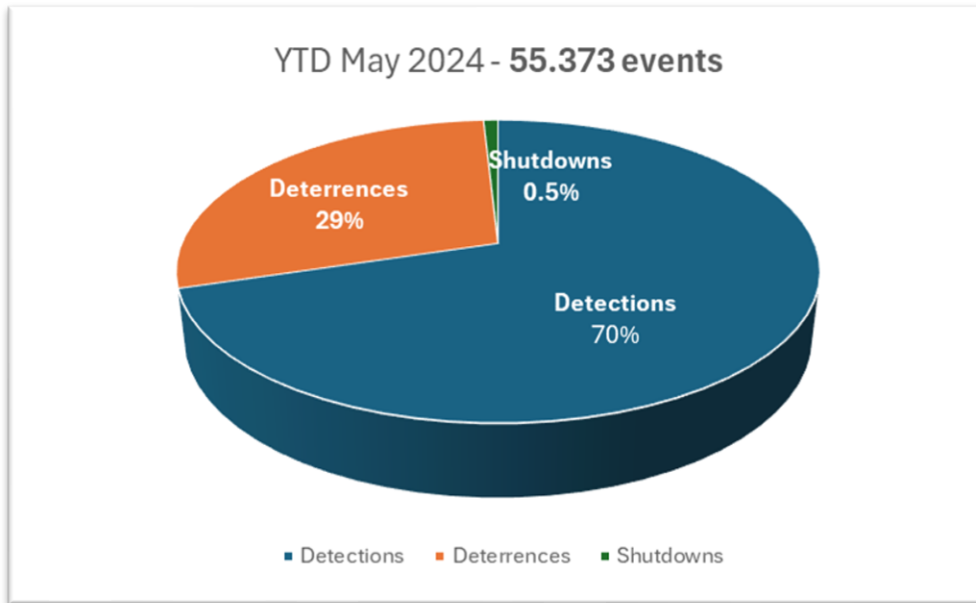
## Off-Shore System





# nvbird®: results

- 158 deployed nvbird® systems
- 26 Wind Parks
- System installations throughout Europe
- Installed on various WTG manufacturers (Enercon, GE, Goldwind, Nordex, SG, Vestas etc.)



Generator	Camera	Timestamp	Event Type	Duration	Bounding Box
WTG1	D2	2023-02-23 14:17:56	deterrence	5	<input checked="" type="checkbox"/>

20-02-2023 14:17:54

Generator	Camera	Timestamp	Event Type	Duration	Bounding Box
WTG	ELD-2	2023-02-19 11:54:29	shutdown	3	<input checked="" type="checkbox"/>

19-02-2023 11:54:28

ELD-2



thank you