BirdGuard – Protecting Birds from Window Collisions

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Collisions with windows are one of the major causes of death for birds [1], among which are endangered species. In Switzerland alone, more than a million birds are estimated to die from such collisions every year – events that could be avoided. The BirdGuard project develops a solar-powered and computer vision-based patch that is placed on the window to monitor birds and warn them if they are on a collision trajectory with the window, saving their lives. First results from a laboratory demonstrator have shown promising results, successfully detecting and tracking birds, proving the concept.

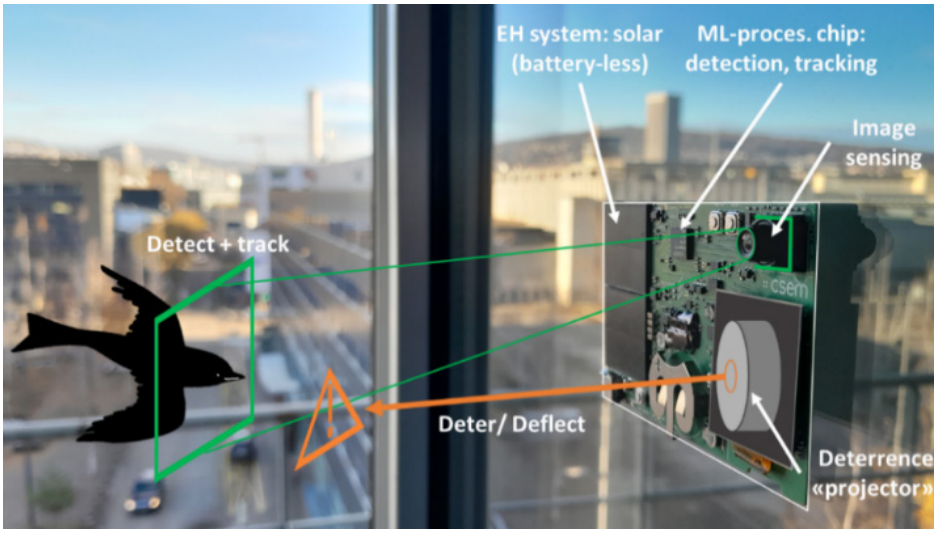

Figure 1: Illustration of the system detecting and deterring an approaching bird.

BirdGuard is an applied research project at CSEM, employing state-of-the-art machine learning (ML) technologies to make houses more bird-friendly and enable a respectful human cohabitation with nature. To cover all bird-specific aspects of the problem, CSEM collaborates with Swiss research institutes that are at the forefront of researching birds and their habitat around humans. This aims to complement existing installations that require pattern stickers covering the entire window, making them unpopular and thus limiting their deployment. BirdGuard provides a small and easy-to-use alternative that enables laymen to retrofit existing windows while being completely self-sustaining through solar power and barely visible due to its small size on the window. The patch is placed on the window and autonomously monitors birds to warn them if they are on a collision trajectory with the window. Aesthetically, this solution does not compromise the window design (as opposed to stickers), providing designers and architects with new opportunities for bird-friendly constructions.

Figure 1 illustrates the business card-sized prototype patch, consisting of a solar energy harvesting subsystem to enable battery-less operation, a CSEM low-power image sensor, and CSEM's ML system-on-chip for processing acquired images and controlling the steerable deterrence mechanism. The high efficiency of the ML chip allows to run complex state-of-the-art detection algorithms onboard the patch while being solely powered by sunlight.

Detecting birds

Robust detection and tracking are essential for monitoring the trajectory of the birds and estimating the collision probability in real time. Machine learning-based detection algorithms, like YOLO, have revolutionized the field and have thus been adopted for this project. Our successfully demonstrated implementation is trained on a diverse dataset that enables to accurately detect birds of different species (e.g., Figure 2) while avoiding detections of other animals and objects (false positives) to save power and avoid disturbing the environment with false warnings.

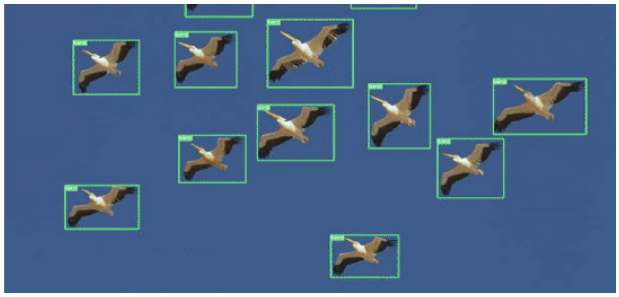

Figure 2: Output of the bird detection algorithm on a validation image.

Warning birds

An effective and timely warning of the birds on collision trajectories is essential to make sure the birds understand the obstacle and still have sufficient time to change their course. The warning is directed within a small spatial angle to the bird, reducing power consumption and interference with the environment. For the laboratory demonstration, a servo-driven eye-safe laser has been used, that is being replaced by a miniaturized deterrence subsystem in an ongoing project.

Miniaturized edgeML deployment

In the next phase, the system will be deployed to a miniaturized prototype, based on CSEM's latest machine learning chip Fibonacci SoC [2]. This will enable increased frame rates beyond the currently achieved 10 frames per second and allow to showcase self-sustaining operation using the solar panel.

[1] M. Rössler, *et al.*, "Vogelfreundliches bauen mit glas und licht", Schweizerische Vogelwarte Sempach (2022).

[2] CSEM technical factsheet "Fibonacci ML SoC", https://hdl.handle.net/20.500.12839/1369 (2023).