Remote monitoring of disease vector mosquitoes with a new optical sensor system for automatic classification

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1. Introduction

- Mosquitoes represent a major threat to public health given their ability to transmit several pathogens. Some species of *Aedes* can transmit viruses such as dengue, Zika, or chikungunya.
- Prevention of vector-borne diseases largely depends on effective and sustainable vector surveillance.

2. Objectives

- Help to develop a novel bioacustic sensor that is able to identify the mosquitoes' species in real time
- Deploy the sensor in the field in Madeira and Algarve

3. Methods

Mosquitoes collected both in the field and reared in insectary conditions were used to develop classification models for the automatic identification of mosquito species using a novel optical sensor system coupled to a standard mosquito suction trap (Figure 1). Field sensors were also deployed, first in INSA/CEVDI to assess the sensor capability to work in non-urban environment and then in Madeira and Algarve regions for real pilot trials.

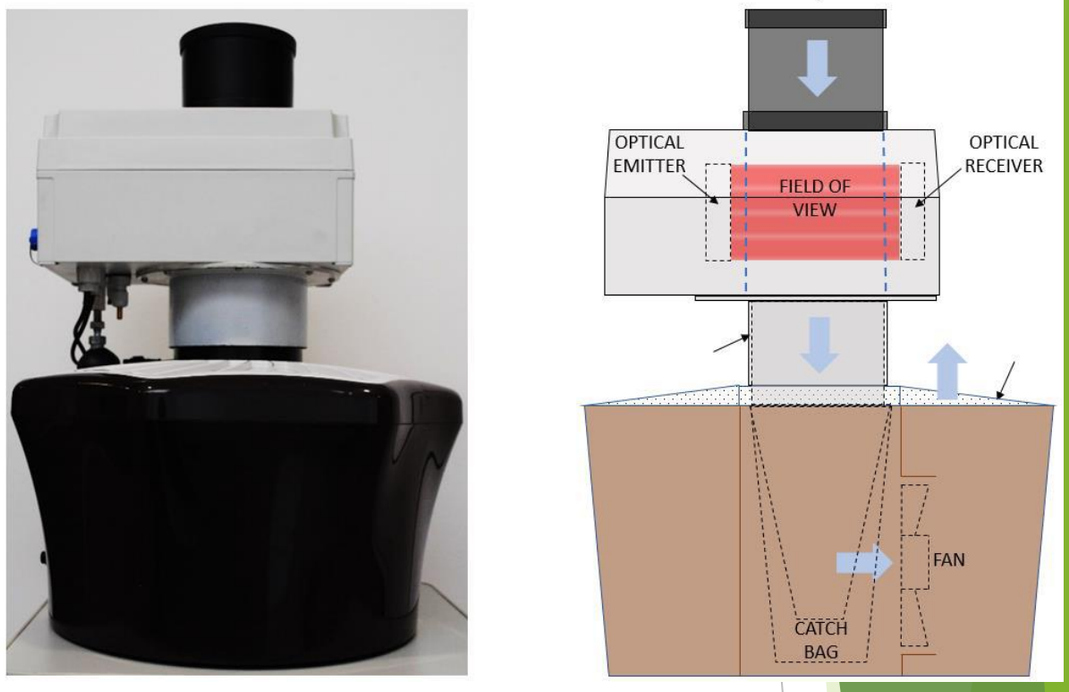

Figure 1 – Photo and schematic of the bioacustic sensor created by Iridion

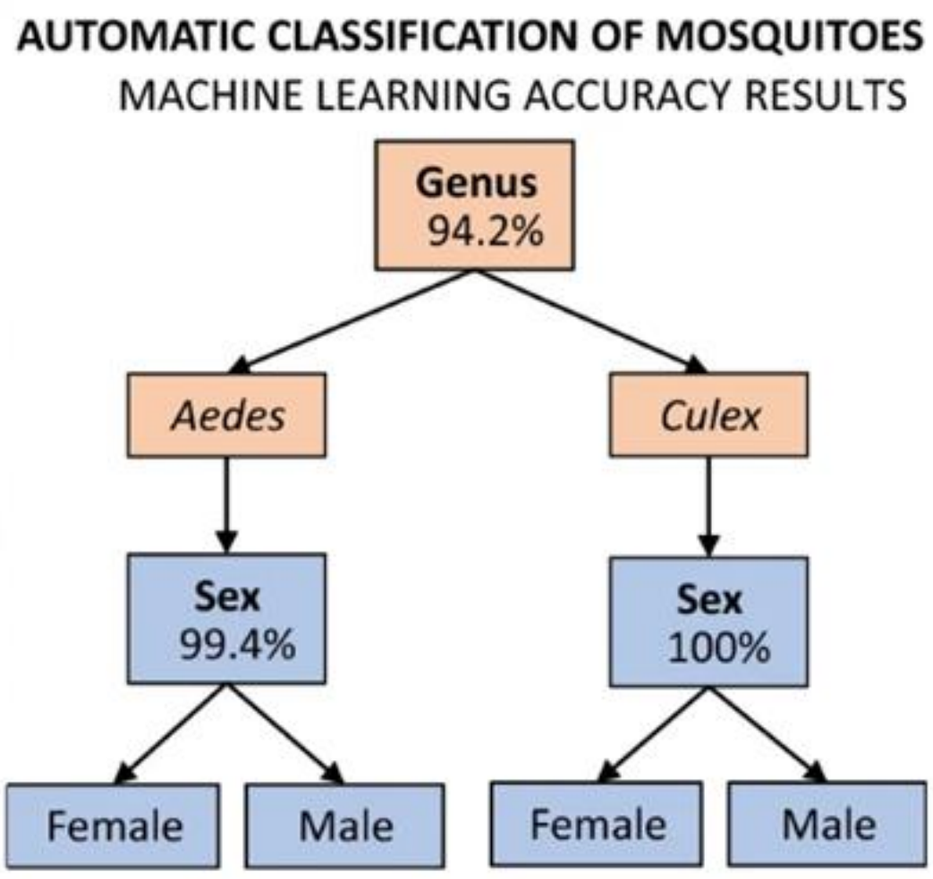

Figure 2 – Early results of how the machine learning algorithm is classifying laboratory reared mosquitoes

4. Results

Lab results

- More than 10 000 mosquitoes were tested at INSA, being the majority *Aedes albopictus* and *Aedes aegypti* easiest species to rear in laboratory
- Preliminary data confirms that the sensor is able to reliably separate between *Culex* and *Aedes* species and to identify the mosquito gender
- The sensor is able to distinguish *Aedes aegypti* from *Aedes albopictus*
- It was shown that the sensor enables the identification of the mosquito age, something that even for entomologists is not easy to determine

Field results

- Results were obtained in real time from over 1 000 Km away
- The sensor was able to reliably separate between mosquitoes and non mosquitoes' species
- The sensor proved to be capable to properly count and identify *Aedes* mosquitoes in real time
- These results demonstrate how the sensor can be used to greatly increase the timely response of the health authorities to *Aedes* activity disease outbreaks

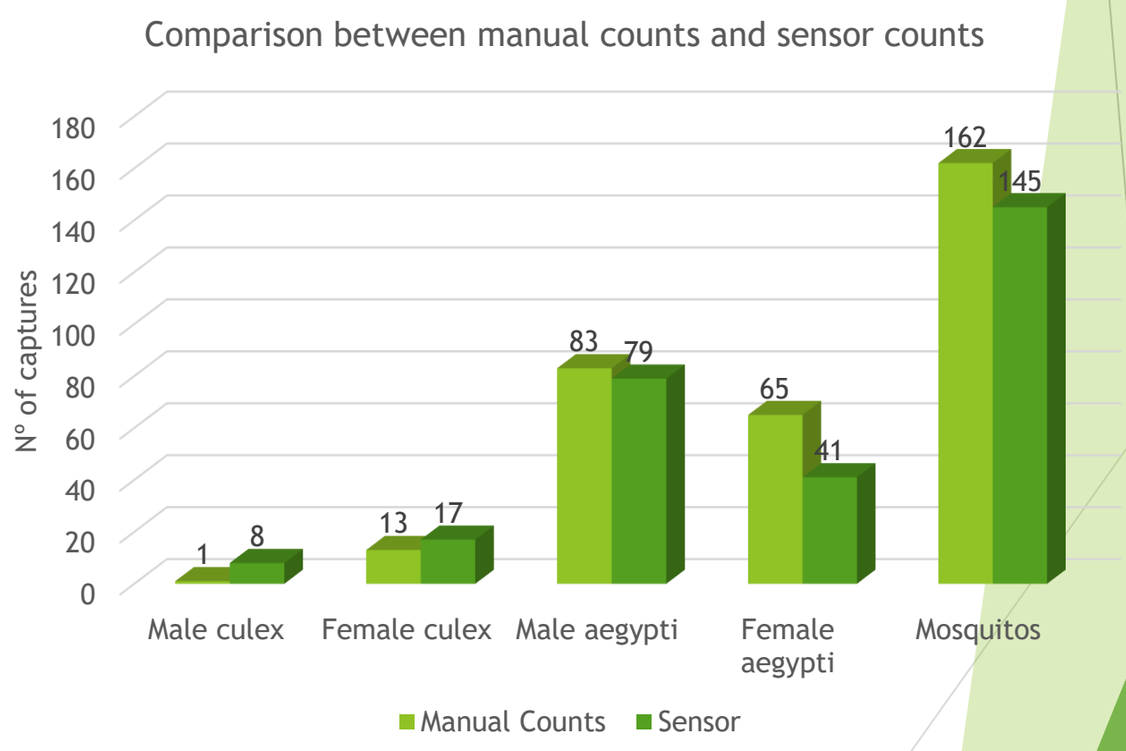

Figure 3 – Comparison between manual counts versus sensor identification of the trap in Madeira Island

6. Conclusions

- The lab results showed that the most important categories in mosquito classification can be determined above 90% fidelity
- The field tests in CEVDI demonstrated the ability of the sensor to perform on a non-urban environment, although the machine learning needs further samples of non-target species
- The field tests in Madeira showed the sensor's ability in real field assays to improve the timely response of health authorities to control invasive mosquito activity/populations and prevent mosquito-borne disease outbreaks.

References

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- Osório, H. C., Zé-Zé, L., Neto, M., Silva, S., Marques, F., Silva, A. S., & Alves, M. J. (2018). Detection of the invasive mosquito species aedes (Stegomyia) albopictus (diptera: Culicidae) in Portugal. International Journal of Environmental Research and Public Health, 15(4), 1–9. https://doi.org/10.3390/ijerph15040820