Acoustic-visual fusion for robust day/night detection of vectors.

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Abstract — In this article, we present an innovative framework for multimodal detection of diurnal and nocturnal mosquitoes, based on the fusion of acoustic and visual modalities. We use the frequency of wing beats, converted into audio spectrograms, for the acoustic branch, while the visual branch relies on a lightweight ResNet-18 with two channels: RGB and near-infrared. After extracting the feature vectors, a concatenation fusion step is followed by fully connected layers to perform binary classification (presence/absence) and multinomial classification (species, sex). Our experimental database includes 2,400 synchronized day/night recordings covering four mosquito species captured in various simulated environments. We train the model with 80% of the data and validate it on the remaining 20%, measuring accuracy, recall, and F1-score. Our results demonstrate an overall accuracy of 91.2%, compared to 78.5% for vision alone and 80.3% for acoustics alone, confirming an improvement of more than 12% thanks to fusion. In addition, our approach maintains 88.7% accuracy in low light conditions (< 5 lux) and has an average latency of 85 ms, which is compatible with Edge AI requirements. These results highlight the potential of acoustic-visual fusion for entomological surveillance and open up prospects for the integration of thermal imaging and 3D point clouds.

Keywords — Multimodal fusion, Acoustic analysis, Computer vision, Mosquito detection, RGB-IR imaging.

Serigne Modou Kara Samb is a Senegalese lecturer and researcher who completed his academic training at the University of Thiès, Senegal, within the Department of Science, Technology, Mathematics, and Computer Science. His educational background reflects a strong interdisciplinary orientation, combining foundations in computer science, applied mathematics, and emerging digital technologies. This academic path has shaped his current teaching, research, and pedagogical leadership activities.

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His research interests focus on natural language processing, machine learning, deep learning, anomaly detection, and data-driven intelligent systems. He is also involved in exploring the application of artificial intelligence in low-resource environments, emphasizing efficient and context-aware computational models. His work contributes to strengthening the scientific and technological ecosystem in Senegal and across Africa, promoting robust and locally adapted solutions for real-world challenges.