



Fellow	Dr. Subodh Sangamesh Ingaleshwar
--------	----------------------------------

Host Organisation	Fraunhofer IIS, Erlangen, Germany
-------------------	-----------------------------------

Scientific coordinator	Dr. Dr. Theresa Götz Chief Scientist Theresa.goetz@iis.fraunhofer.de Am Wolfsmantel 33 91058 ErlangenGermany
------------------------	--



I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

Accurate and timely recognition of wild animal species is very important for various management processes in nature conservation. Here, we address this challenge by proposing an embedded AI device, which is fixed on a vulture. The difficulty and cost of developing electronic devices in this kind of environment suggest that these devices must be robust and have low power consumption to increase their battery life as much as possible. Designing a smart device that can detect different behaviors of a vulture, recognize different species of wild animals, and meet the above-mentioned restrictions presents a major challenge that is addressed in this work.

We present a low power Edge-AI device, which embeds a ML model in a microcontroller that collects data from an acceleration sensor to detect three different behavioral states of vulture and a deep neural network (DNN) in another microcontroller that accurately recognizes different animal species. Multiple models were implemented and deployed in respective microcontrollers to find the best balance between energy consumption and computing performance.

The performance of the proposed system is evaluated using a real-world dataset collected via a small handheld camera from remote conservation regions of Africa. The experimental results show that the proposed animal species classification system can obtain a remarkable accuracy of 84.30% with an energy efficiency of 0.885 *mJ* on an edge device. This work provides a new perspective toward low power, energy-efficient, fast, and accurate edge-AI technology to help in inhibiting wildlife-human conflicts.

II – PUBLICATION(S) DURING YOUR FELLOWSHIP

1. Ingaleshwar, S.; Tasharofi, F.; Pava, M.; Vaishya, H.; Tabak, Y.; Ernst, J.; Portas, R.; Rast, W.; Melzheimer, J.; Aschenborn, O.; Goetz, T. and Goeb, S. (2024). Wildlife Species Classification on the Edge: A Deep Learning Perspective. In Proceedings of the 16th International Conference on Agents and Artificial Intelligence - Volume 3, ISBN 978-989-758-680-4, ISSN 2184-433X, pages 600-608.
2. Shrutika S. Sawant, J. Bauer, F. X. Erick, Subodh Ingaleshwar, N. Holzer, A. Ramming, E. W. Lang & Th. Götz, 2022. "An optimal-score-based filter pruning for deep convolutional neural networks". Applied Intelligence, 52, pages 17557–17579 (2022). (Springer) <https://doi.org/10.1007/s10489-022-03229-5>. Published.



III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

I. Training programs:

1. Business German for Beginners (A1.1 & A1.2)- (Ongoing, Fraunhofer IIS-online mode)
2. One week course on “Advanced C++” by Ralf Schneeweiss from 09.10.23 to 12.10.2023.
3. One week workshop on “Essential of Edge AI” by Doulos from 06.03.23 - 10.03.2023.
4. Workshop on “Digital Ethics in Research” from 18th Oct to 20th Oct 2023.
5. ERCIM FP Community event, 4th November 2022, and 8th November 2023.

IV – RESEARCH EXCHANGE PROGRAMME (REP)

Research transforms into a blissful experience, "when you focus on the journey, not the destination". I had one such experience in my Research Exchange Program (REP) Norwegian University of Science and Technology (NTNU), Gjøvik Campus.

I am indebted to Dr. Raghavendra Ramachandra, Professor, Department of Information Security and Communication Technology for agreeing to be my faculty mentor. The interactions were short but enough to communicate the objectives and milestones of the research on biometrics and TinyML.

Duration: Two weeks (13 Nov to 24 November 2023)

Topic of discussion: Biometrics using TinyML

My humble gratitude to my supervisor Dr. Theresa Götz, Fraunhofer IIS and ERCIM for their constant support and motivation throughout my #postdoctoral research journey since 2022 to till. Few clicks, to cherish those moments.