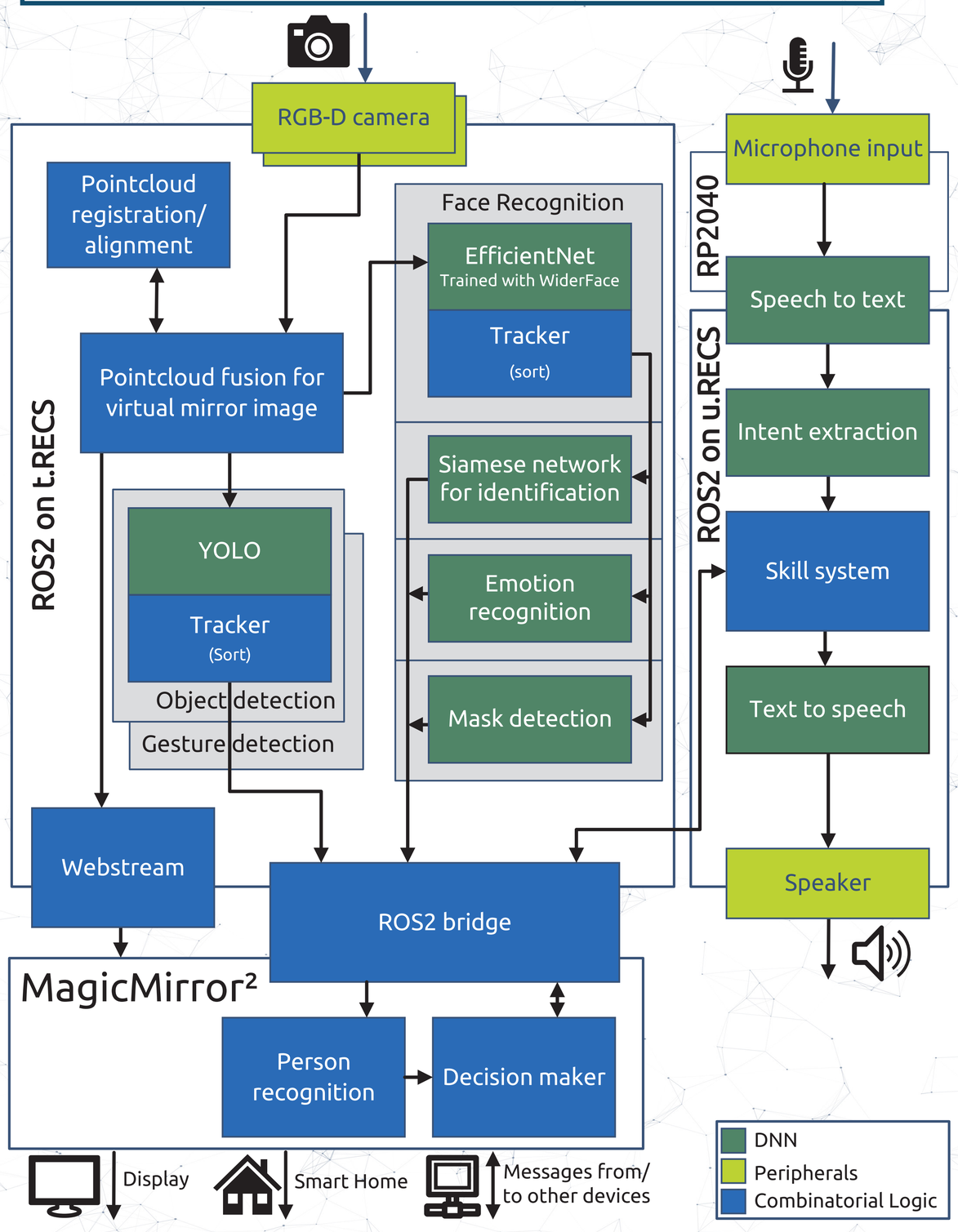
SMART MIRROR

VEDLIoT
Very Efficient Deep Learning in IoT

AN INTUITIVE INTERACTION INTERFACE

OVERVIEW

The smart mirror was developed as an intuitive interface to assist the interaction in smart home environments with a strong focus on local processing for data privacy.
It shows a mirror image of the user and displays personalized information and the status of the smart home. Based on the reconstructed virtual mirror image generated from depth imaging cameras, the user's face is recognized, and simple hand gestures are used for intuitive control. In addition, a voice recognition system, supported by natural language processing (NLP), enables an interaction via a voice assistant. In principle, all computations are performed locally on the device using open-source software, ensuring maximum privacy as no data is transferred to the cloud and to third-party service providers.
A significant challenge in this project is combining multiple machine learning techniques. The methodology developed within the VEDLIoT project helps to keep up with high performance while also maintaining a low energy consumption. Newest security techniques ensure meeting the high privacy requirements.



Smart Mirror running on the heterogeneous near edge computing platform t.RECS

ACCELERATED MACHINE LEARNING

In order to achieve the different needed detections, multiple neural networks are combined via the common middleware ROS2. This facilitates effortless interchangeability and varying the distribution of computation tasks. Every subsystem (e.g., for object or gesture detection) can be calculated in parallel on the used heterogeneous hardware platform t.RECS, utilizing different hardware accelerators available. In this example, the smart mirror software architecture is distributed on two NVIDIA Jetson AGX Xavier microservers to share the load of computing YOLOv4 for object detection, YOLOv4-tiny for gesture recognition, a feature extractor and a Siamese network for face recognition. The current setup achieves a performance of 16 FPS with a power consumption of about 150 Watts, which is to be further improved within the project's scope. A local voice assistant is implemented on the far edge computing platform u.RECS, which also utilizes the ROS2 middleware. The voice input of a microphone is pre-processed by a RP2040 microprocessor. This smart microphone sensor can recognize simple keywords extracted by a hot word detection or send a compressed audio-stream to a local edge-server. This approach ensures the highest level of privacy for the user.

t.RECS near edge computing platform with one x86-based COM-HPC server and two NVIDIA Jetson Xavier AGX accelerators

CONTACT

Nils Kucza, nkucza@techfak.uni-bielefeld.de
Bielefeld University, Germany
Cognitronics & Sensor Systems
https://cit-ec.de/en/

@VEDLIoT
VEDLIoT Project
VEDLIoT EU Project

PARTNERS

Universität Bielefeld, Christmann Informationstechnik + Medien, veoneer, antmicro, Siemens, embedl, Ciências ULisboa, FCiências.ID, Universität Osnabrück, RISE Research Institutes of Sweden, unine Université de Neuchâtel, University of Gothenburg, Chalmers University of Technology

Funded by the European Union
Grant No 957197

www.vedliot.eu