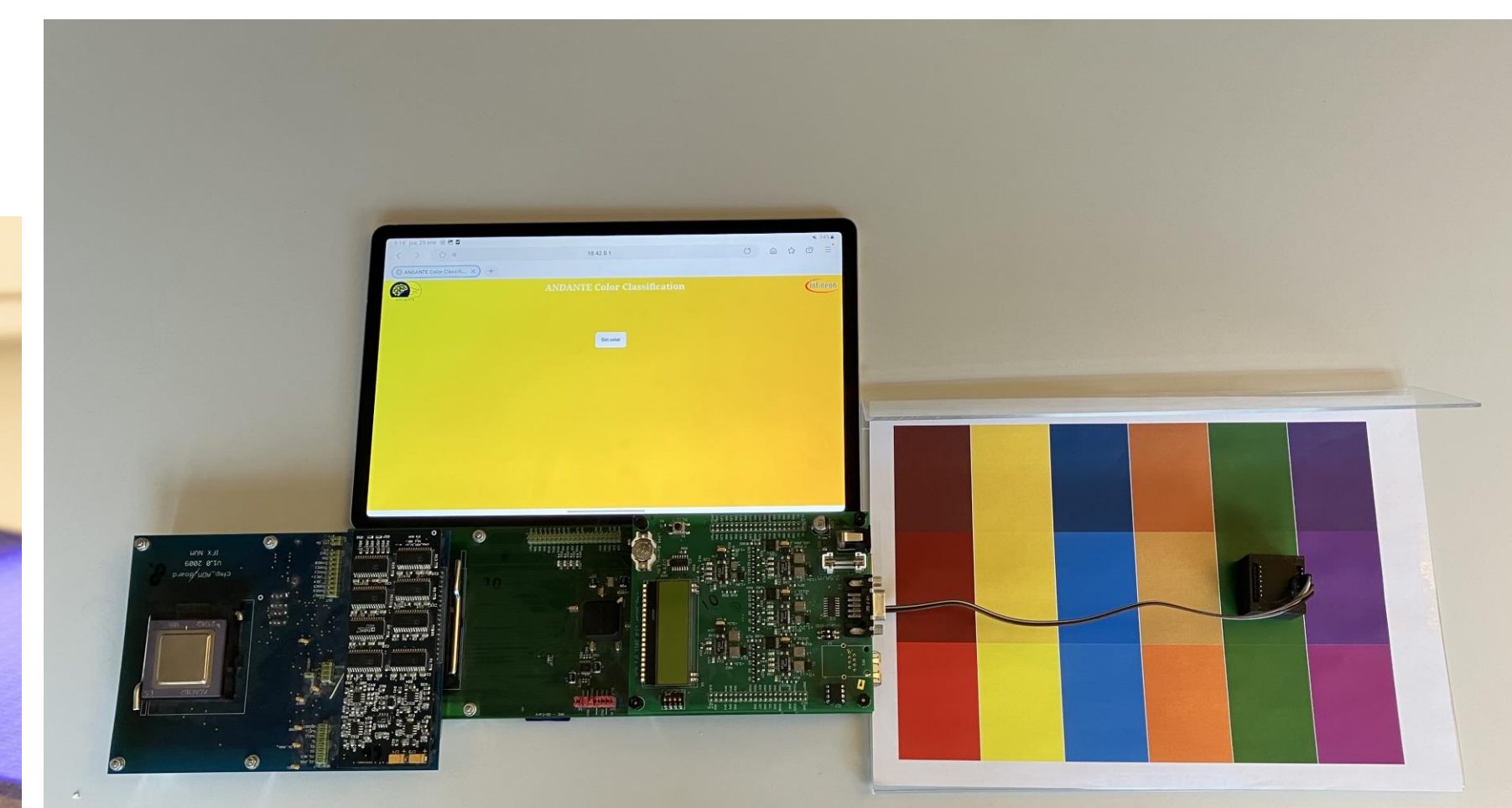
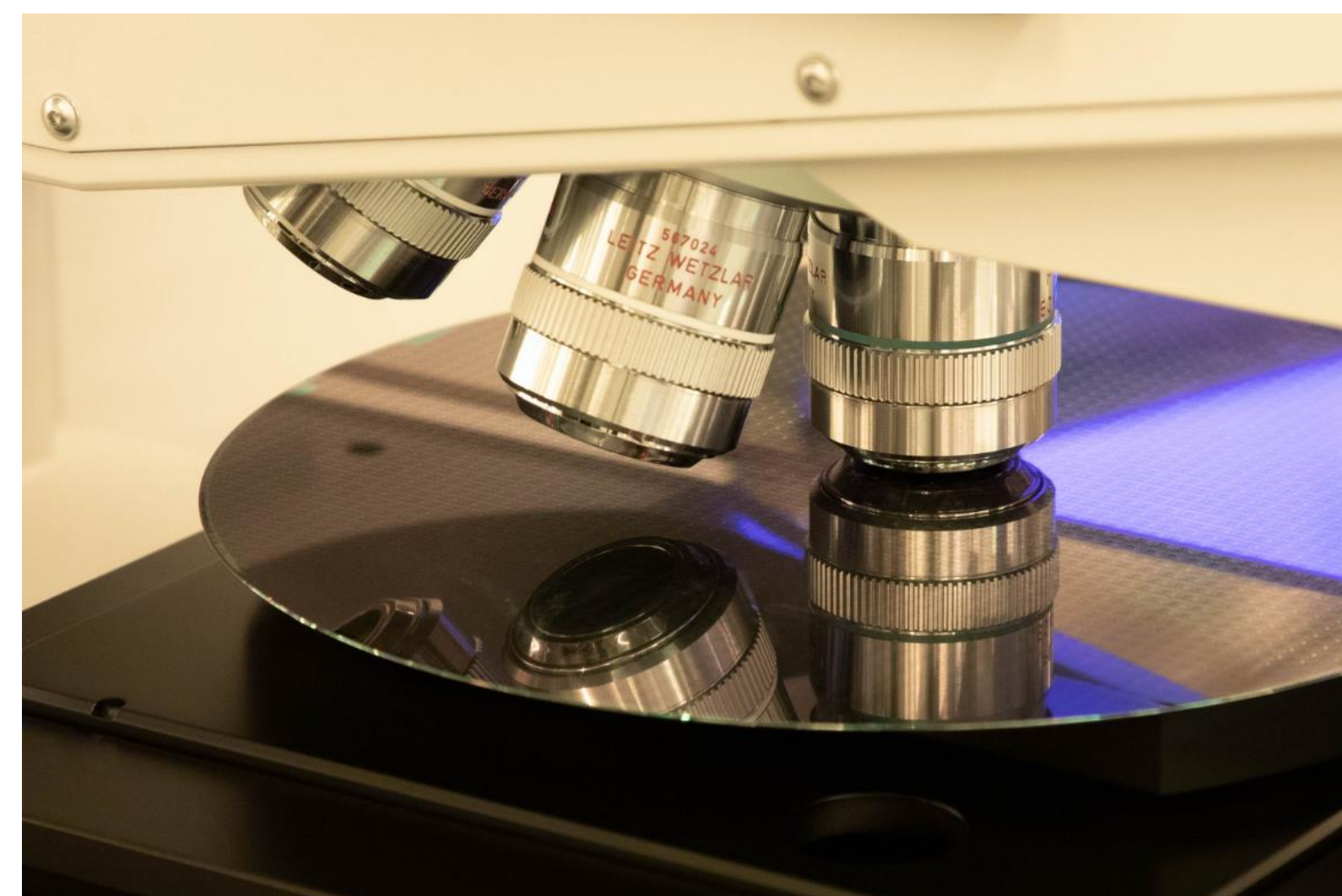


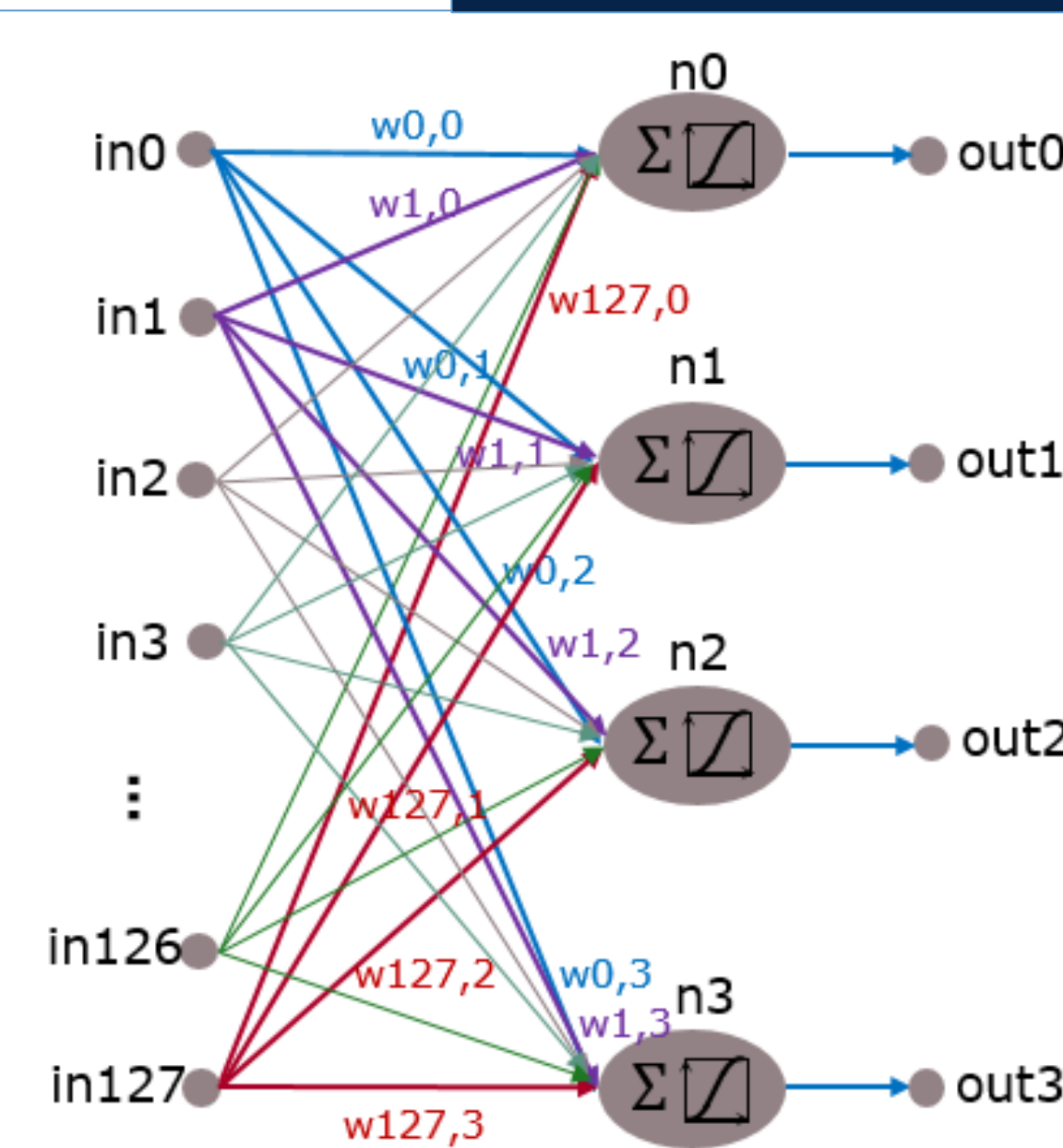
Overview & Setup

- Quality control is an important part of the production process of every kind of product
- Sensor and AI become more and more important for quality control but have latency, confidentiality and scalability issues
- IFAG and EESY explore the neuromorphic technology, analog NNs, for extreme edge application to manage these issues
- Demonstrator setup consist of:
 - Board 4.1 with ASIC3.2
 - 1 color sensor, color board, tablet and Raspberry Pi
 - Processing pipeline with small analogue NN models



Technology

- ASIC 3.2 is based on 28 HPC+ technology with a RRAM memory array at its core
- It has a static model architecture with adaptable weights
 - The architecture consists of 128 input neurons, 4 hidden and output neurons distributed over 3 layers
- Board 4.1 is based on an existing test bench from IFAG
- During ANDANTE IFAG focused on the improvement of components for evaluation e.g. the software for the programable voltage board



Results

- Two types of data sets were gathered with the color board:
 - Simple variant consist of yellow, blue, green and orange
 - Complex variant containing all color on the board
- Evaluation showed:
 - Targets could not be reached due to:
 - “Empty space” on the chip
 - Static network architecture
 - However, simple variant is not far off
 - Most likely the range of possible application is limited as the accuracy of the complex variant indicates



Impact

- Feasibility of the selected approaches for simple applications was proven
- Moving towards commercialization by:
 - Improving model approach and hardware concepts
 - Optimize ASIC implementation and transfer to smaller technology nodes
 - Focusing on optimizing algorithms and hardware for a specific set of applications e.g. key word spotting
 - Looking into efficient integration of the concepts into sensor node circuits

Progress beyond SoA

- One of the first moves towards implementing AI at the extreme edge (directly in/at the sensor)
- Researching RRAM memory in the context of analog NN and extreme edge applications
- Concepts for miniaturization of AI and compressing functionality with AI for smaller devices

Lessons learned

- Further improvements of algorithms and hardware concepts for the extreme edge required
- Trade-off between flexibility regarding possible applications and resource limitation is challenging
- Upper limits regarding possible usage of developed concepts need to be investigated

