Institute for Automation and Applied Informatics (IAI)
Karlsruhe Institute of Technology (KIT)
✉ lorenz.wuehrl@kit.edu

DiversityScanner 4K: A High Resolution Extended Focus Camera Setup as Extension for the DiversityScanner

Lorenz Wührl, Christian Pylatiuk, Matthias Giersch, Rudolf Meier

Motivation

Imaging thousands of specimens in many biodiversity samples is time-consuming and requires experienced personnel.

Efficient tools for assessing invertebrate samples are urgently needed. Ideally they should yield image training sets for convolutional neural networks.

DiversityScanner: First Generation

Video

DiversityScanner with 1, 2, 3: Linear axes; 4: Petri dish; 5: Microplate; 6: Overview camera, 7: Detail camera [1].

- Sorting, imaging, measuring, and classification robot for small invertebrates (< 3 mm)
- Detail camera (1.3 MP) for specimen images
  - Small amount of data and fast processing
  - Possible loss of image information for classification and taxonomic work due to low resolution

DiversityScanner: Workflow

Taking overview image → Taking detail image

Position detection

Insect classification

Transfer specimen to microplate for DNA barcoding

Positioning pipette over identified specimen

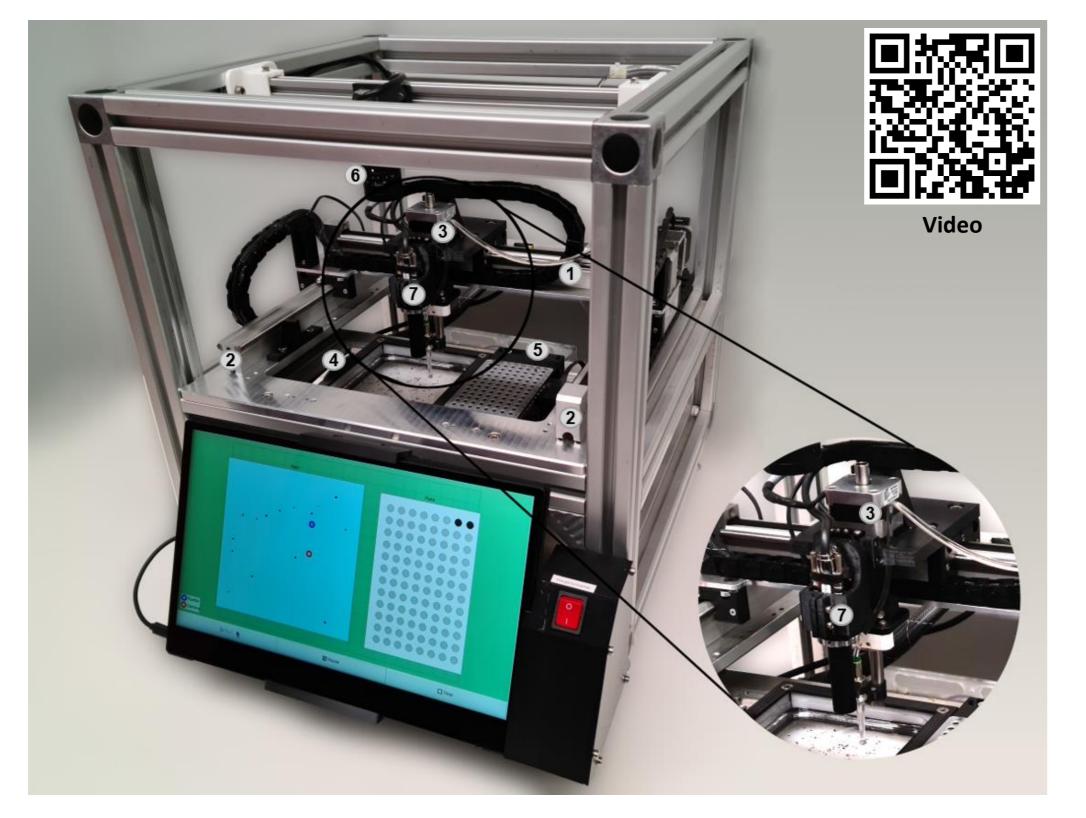Dispersing the specimen

Picking up the specimen

DiversityScanner 4K: Camera Setup

Identification to species level requires more detailed images.

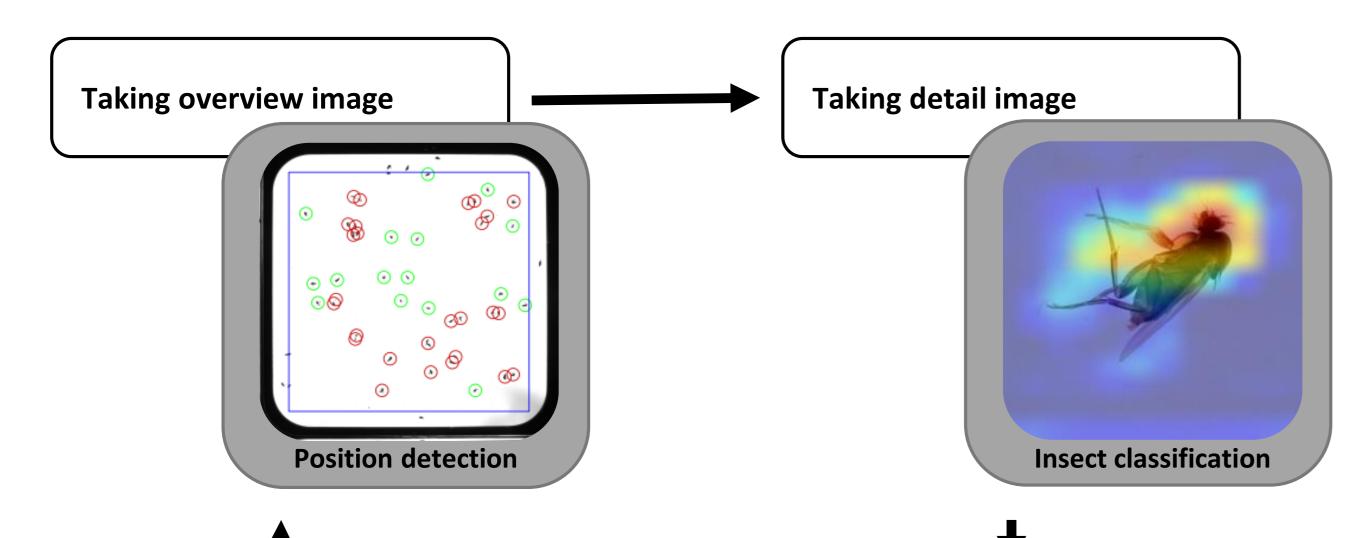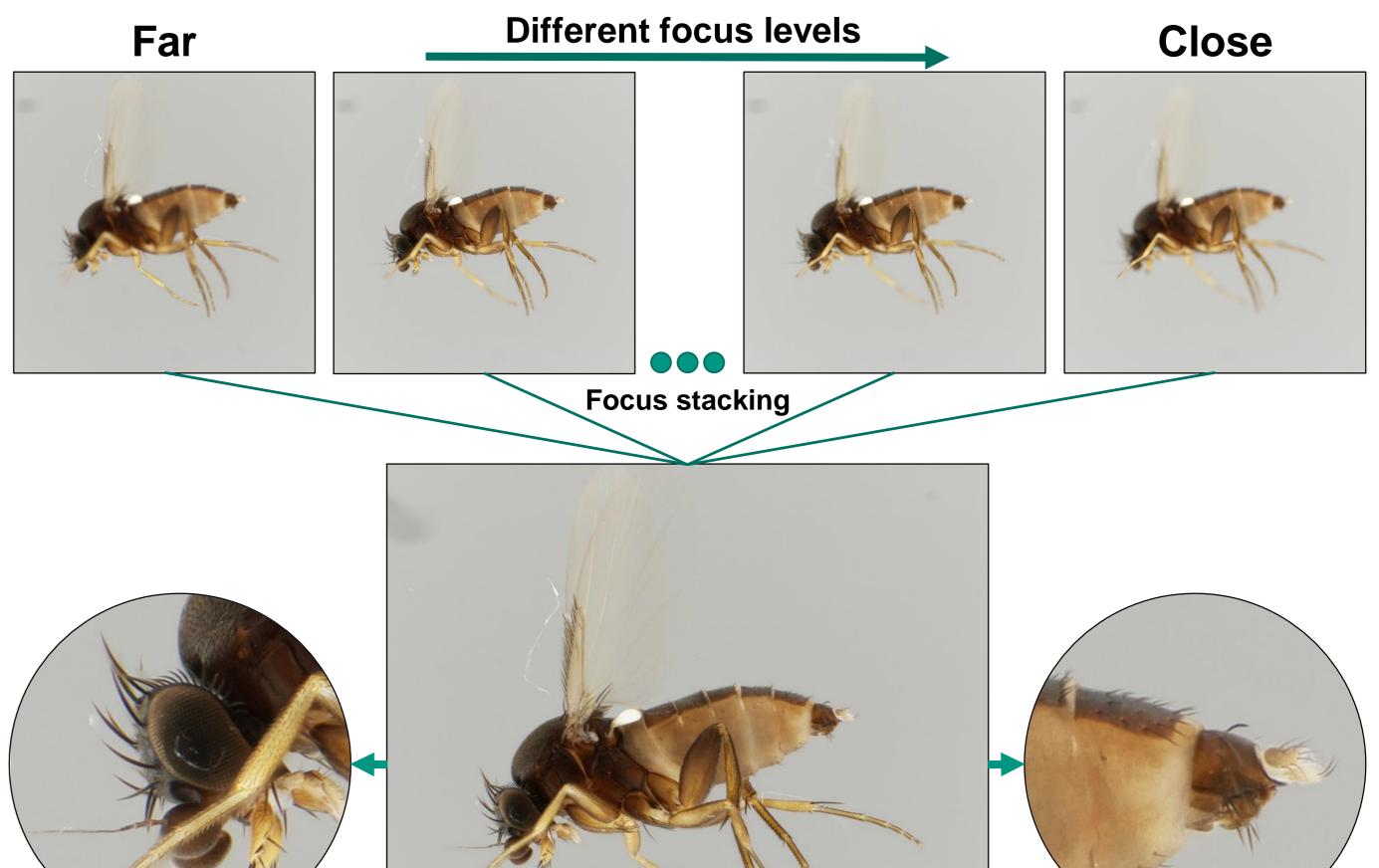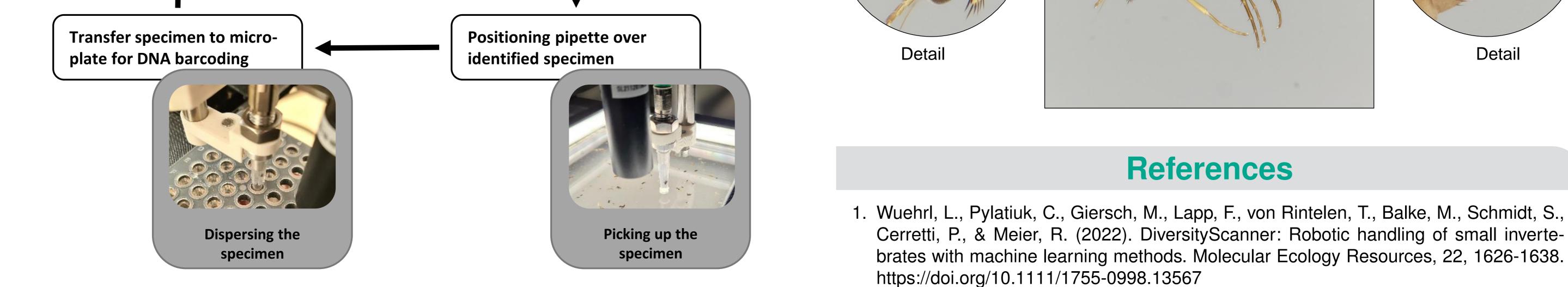Therefore we equipped the **DiversityScanner 4K** with a new camera setup:

- HDMI camera cable
- Camera 12 megapixel
- Focus tunable lens
- Telecentric lens with 1x magnification

DiversityScanner — 1.3 MP

DiversityScanner 4K — 12 MP

- High resolution (12 MP) camera with a small pixel size (1.55 µm x 1.55 µm) for very sharp images and focus tunable lens (Optotune, Switzerland) for focus stacking
- Enables high quality fully automated imaging of invertebrates in ethanol

DiversityScanner 4K: Focus Stacking

Far — Different focus levels → Close

Focus stacking

Detail — Detail

References

1. Wuehrl, L., Pylatiuk, C., Giersch, M., Lapp, F., von Rintelen, T., Balke, M., Schmidt, S., Cerretti, P., & Meier, R. (2022). DiversityScanner: Robotic handling of small invertebrates with machine learning methods. Molecular Ecology Resources, 22, 1626-1638. https://doi.org/10.1111/1755-0998.13567