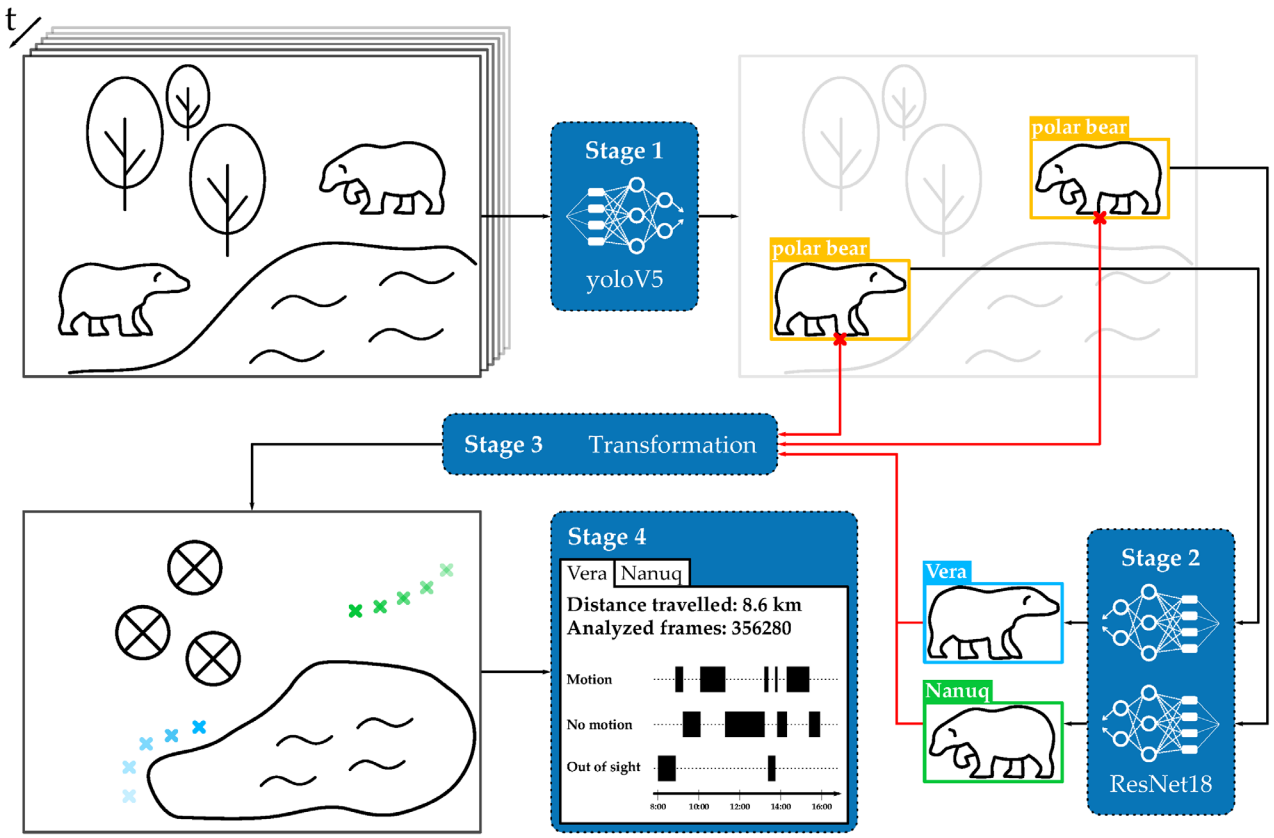
21 POLAR BEA(I)R

A BEAR LIKE ANY OTHER? ABSOLUTELY NOT!

At this box, you learnt a lot about how AI systems can be used to recognize objects or animals in images and videos and even reliably distinguish individual animals. Here you can find out more about the 'VERA' research project and the great benefits of AI systems in nature research.

In order to monitor the behavior of polar bears in zoos more effectively, a research group from FAU Erlangen-Nuremberg observed the polar bears at the Nuremberg Zoo. The aim of the research group was to develop a a system that records and analyses the behavior of animals in order to be able to take countermeasures more quickly in the event of atypical behavior. DTherefore, cameras were set up in front of the enclosure to film the polar bears for three years. A lot of video material had to be analyzed in order to obtain results on the behavior of the polar bears from the data. To do this, the scientists used an AI system based on a neural network, which searched the video footage frame by frame for the polar bears, determined their position in the enclosure and worked out which polar bear it was. . This process is illustrated again in the diagram. To identify the polar bears, the AI system assesses the physique and body size, but also the fur color or clear discoloration in the fur. For a better analysis, into a two-dimensional coordinate system, as you know it from your math's lessons. This requires a complicated mathematical calculation method.

Using these recordings, another team of scientists has now been able to analyze the behavior of the polar bears. Among other things, they were interested in whether the polar bears exhibited atypical behavior in their travel paths across their enclosure and whether this occurred more frequently during the mating season, for example. In a further step, AI systems can also be used to determine the current behavior of a polar bear on a specific image or video. That is what you have already seen at the box.



Here you can see the exact process of polar bear recognition again: First find the bears in the pictures (1), then identify the individuals (2) and finally draw their paths on a map (3) and analyze them (4).

The use of an AI system in this project enables observations and analyses that would not be possible without the support of machine learning algorithms: No human can review the multitude of images from three years of video recordings and also determine how and when which polar bear moves through the enclosure. Although human researchers can sit down at the enclosure on one or more days and observe what the polar bears are doing at that time, it is, however, not possible to observe the bears permanently and comprehensively. At the same time, the use of video recordings is the most comfortable observation method for the animal: if the animals are fitted with a transmitter that could also record their movements, they have to be anesthetized to attach it. In addition, the animal may find the transmitter disturbing and therefore exhibit aversive behavior. Repair or replacement is also only possible if the animal is anesthetized again. If you want to observe animals not only in the zoo but also in the wild, they must also be captured in order to attach observation transmitters to the animals.

The scientists have already shown that the observation method does not only work with polar bears: they also work with other animal species such as bats, foxes, wolves and lynxes, which are observed not only in zoos but also in the wild.

AI systems offer great potential for supporting nature research. They make it possible to observe animal behavior more accurately than before and with research tools that are more comfortable for the animals. The analysis of plants and other data from nature will also be improved by AI applications. We have collected a number of example projects in which AI systems are used for nature and the environment:

'Flora Incognita' research project:
You can use the Flora Capture app to photograph plants and have them identified. Your observations are sent directly to the project researchers and used to document which plants occur where, to assess their condition and also to find rare species. The image recognition in the app uses machine learning algorithms. Similar apps are also available for identifying and protecting insects, fungi, plant diseases, etc.

Deciphering the language of whales:
In this project, researchers are using machine learning to analyze sound recordings of whale songs and compare them with the animals' behavior. The aim is to identify sound sequences that are repeatedly used by whales in similar situations and therefore represent the same messages. From this, an attempt is then made to develop an 'orca vocabulary'.

Use of AI systems to protect biodiversity:
Data analyses using AI systems can help us to better understand the interrelationships in our ecosystems and thus improve nature and species conservation. A large number of projects are analyzing the diversity of species in different habitats.

Protecting birds from wind turbines:
Using a camera system and AI methods, the flight of birds in the vicinity of wind turbines can be tracked and, if the birds are in danger, the wind turbine can be stopped automatically until the airspace is clear again.

Remote monitoring of bee colonies using AI image recognition:
Camera images are used, for example, to analyze the behavior of bees during pollination or to search for signs of disease and threats to the bee colony, such as the Varroa mite.

Glacier observation:
With the help of neural networks, this project aims to recognize the break-off edges of glaciers on radar images in order to improve observation and evaluation of the effects of climate change on glaciers.

The idea and realization of this learning box was developed in cooperation with the students of the Inno lab project of the Machine Learning and Data Analytics (MaD) Lab at FAU. Many thanks for the cooperation!

SOURCES

Graphic polar bear recognition taken from the paper:

Zürl, Matthias, Stoll, Philip, Brehm, Ingrid, Raab, René, Zanca, Dario, Kabri, Samira, Happold, Johanna, Nille, Heiko, Prechtel, Katharina, Wünsch, Sophie, Krause, Marie, Seegerer, Stefan, von Fersen, Lorenzo und Eskofier, Björn (2022): Automated Video-Based Analysis Framework for Behavior Monitoring of Individual Animals in Zoos Using Deep Learning—A Study on Polar Bears, Animals 2022, 12(6), 692; https://doi.org/10.3390/ani12060692. CC BY 4.0.

Information on the research project VERA (Video-based Re-Identification and Behavior Analysis for Animals):

https://team-vera.github.io/

Dataset PolarBearVidID: //team-vera.github.io/PolarBearVidID.html

Information pages on the other research projects:

https://www.tu-ilmenau.de/en/news/forschungsprojekt-flora-incognita-interaktive-pflanzenbestimmung-mit-dem-smartphone

https://www.fau.eu/2020/10/news/research/the-language-of-whales/

https://www.feda.bio/en/projects/biodivki/

https://irida-tech.ai/bird-protect/

https://www.uni-hamburg.de/en/newsroom/campus/2022/0727-coworking-startup-bienen.html

https://www.idp-mocca.forschung.fau.de/

SOURCES DIGITAL BOX

Polar bears on picture cards:

Nuremberg Polar Bear Dataset, https://zenodo.org/records/5910445

Bildnummern: 000000002231, 000000003327, 000000000018, 000000000124, 000000003877, 000000002845, 000000000053, 000000000109, 000000000047, 000000003506

All other polar bear images used:

Nuremberg Polar Bear Dataset, https://zenodo.org/records/5910445

https://team-vera.github.io/