

Camera System Design for Automated Monitoring

SpeciesMothCam and SpeciesSiteCam

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Organization:

WP 2: Automatized visual monitoring and image analyses (Radig, TUM)

- *WP 2.1: Acquisition and processing of visual data (Radig, TUM)*
- WP 2.2: Moth scanner (Bodesheim, Jena)
- WP 2.3: Processing and interpreting depth data (Steinhage, Bonn)
- WP 2.4: Novelty detection, life-long learning and classification (Bodesheim, Jena)

Construction of a ready-to-use operative Visual Monitoring System, which provides classification and counting with an acceptable error rate for a non-trivial number of species even under real conditions and is capable of learning for further species.

The main focus of the AMMOD visual system (WP 2) is the image acquisition of wildlife in the observation area of an AMMOD station and the light trapping of moths.

Special hardware elements for visual observation have to be designed, implemented, integrated into the AMMOD stations, tested and improved for the detection of different species.

An operational system consisting of tailor-made hardware and software (**SpeciesSiteCam**) is being developed, which is capable of observing a representative subset of wildlife on site.

A special visual observation system (**SpeciesMothCam**) will be developed and built to detect nocturnal moths.

- The moth scanner consists of an illuminated screen. Light source is LED mixed light, UV and white separately switchable (LepiLED). A camera with 20 MegaPixel image in 5472x3648 pixel format and in synchronization with an LED flash takes pictures at regular, programmable intervals.
- A subsequent evaluation splits the image into dark areas which may contain moths. These are forwarded to WP 2.2. Too large areas are examined whether they exist permanently or only for a limited time. Appropriate actions will taken.
- Normally only image areas are transmitted that represent newly arrived moths. It is also planned to switch off the light source at programmable intervals for a programmable time to allow moths to leave the screen.
- At Melbgarten the SpeciesMothCam is connected to the AMMOD base station with two cables, mounted freely suspended on wooden poles, one for power supply and the other for data communication. An important design goal is to **minimize power consumption** by intelligent operation.

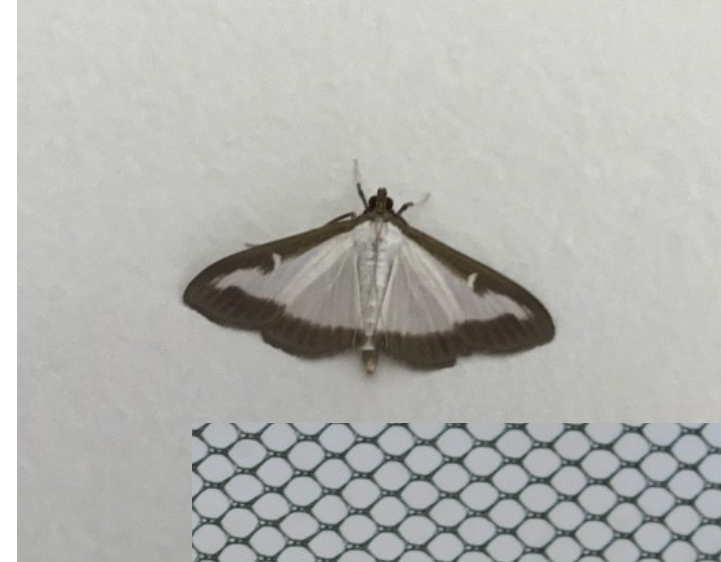


© Gunnar Brehm, Phyletisches Museum Jena

Tests with a 10 W LepiLED in a light trap by G. Brehm

(A new LED lamp for the collection of nocturnal Lepidoptera and a spectral comparison of light-trapping lamps, *Nota Lepidopterologica* 40: 86-108, 2017)

A new lamp with an intrinsic mirror to focus light directly on a screen is under construction and will be tested next spring



- A flexible high-end stereo imaging system is constructed to capture terrestrial (mainly mammal-like) species with sufficient magnification, high resolution and large depth of field.
- Videos with adjustable length (e.g. 20 seconds) are recorded after the cameras are triggered by animals passing their field of view.
- At night infrared (920 nm) flashes are illuminating the scene.
- A low-energy special processor calculates depth images. It sends the left stereo image, the right one, a disparity image and the depth image to the downstream computer. Meta information is added. This data stream is further processed by WP 2.3 and WP 2.4.
- SpeciesSiteCam requires the development of software with high complexity and an extensive testing of the interaction of the components - also under the aspect the economy of energy consumption - and the automatic setting of system parameters to adapt to all conditions depending on the weather, ambient light, plant growth in the area, speed of passing animals, etc.

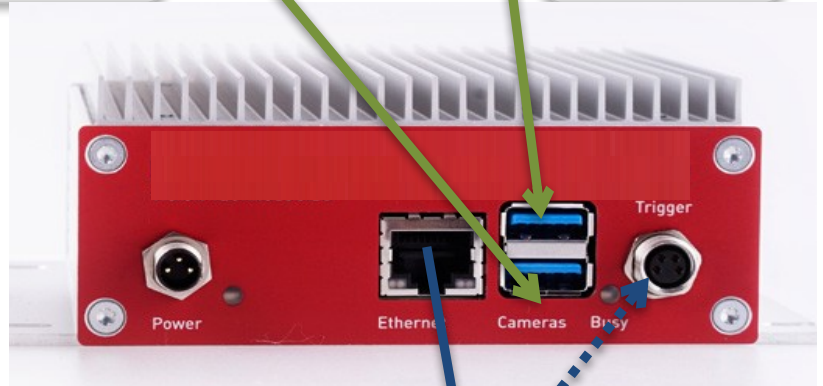
The goal is to provide optimal image quality for WP 2.3 and WP 2.4 for optimal results.

SpeciesSiteCam



Camera right

Camera left



Stereo Processor

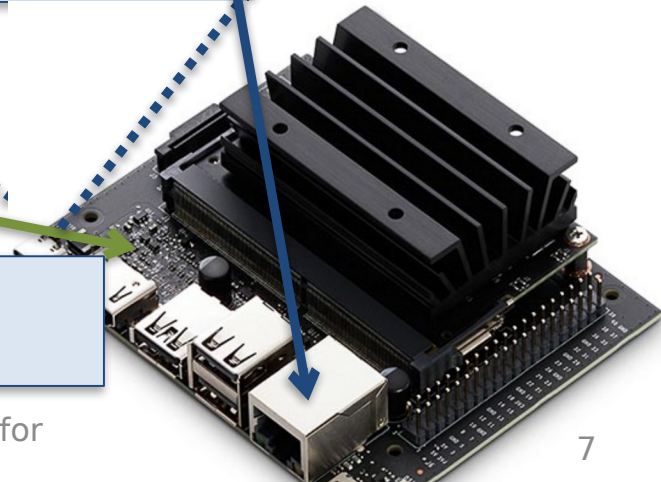


PIR Motion Detector

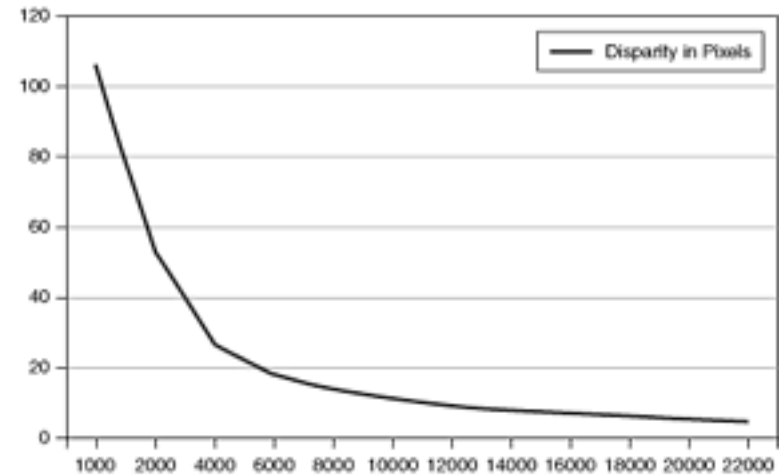
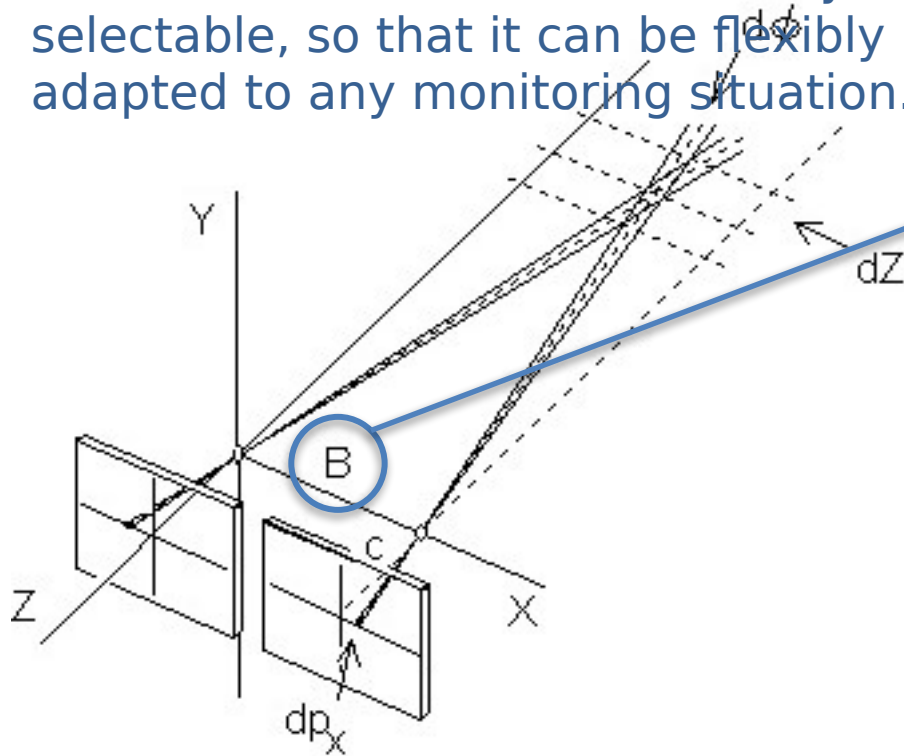


IR Flash Control

small, power-efficient AI computer



Almost all commercial makes of stereo image processing systems are equipped with fixed camera distances (baseline B). In our system the baseline distance, the cameras and the lenses are freely selectable, so that it can be flexibly adapted to any monitoring situation.



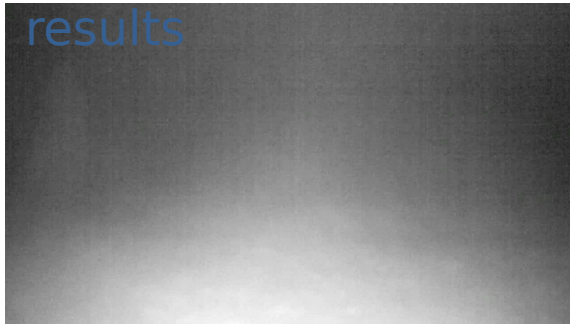
https://www.researchgate.net/publication/253059674_Stereoscopy_application_of_spherical_imaging/

https://zone.ni.com/reference/en-XX/help/372916T-01/nivisionconcepts/Stereo_what_to_expect_from_a_stereo_vision_system

Visual motion detector by anomaly detection.

learned background \longleftrightarrow

results



Detected anomalies

Results

θ : 'ok'

Anomaly score: 0.27

Thresholds

Classification: 0.29

Segmentation: 0.27

- A cooperation between WP 2.1 and Gunnar Brehm (Phyletisches Museum Jena) for testing a development version of a SpeciesMothCam has been agreed. WP 2.1 supplies the camera technology, Brehm contributes with his new LepiLED and the screen.
- Ordered components are delivered in December, technically assembled and tested in January, delivered to Brehm in February and tested there.
- A prototype will be installed in the Melbgarten with the help of students from the University of Bonn (supervised by WP 2.3).
- Between WP 2.1, WP 2.2, WP 6, and WP 7 will be agreed upon
 - power supply and management,
 - communication equipment and bandwidth management,
 - data networks and storage management,
 - provision of metadata and
 - administration and communication of results.

- The design of the SpeciesSiteCam is finished - hardware and parts of software.
- Ordered components are delivered in December, at TUM assembled and tested in January and modified according to the test results.
- A twin unit will be built at TUM and delivered to WP 2.3.
- As soon as the technical equipment of the base station is completed, it will be installed in the Melbgarten with the help of students from the University of Bonn (supervised by WP 2.3).
- Between WP 2.1, WP 2.3, 2.4, WP 6, and WP 7 will be agreed upon
 - power supply and management,
 - communication equipment and bandwidth management,
 - data networks, storage management, archiving,
 - provision of metadata, and
 - administration and communication of results.



