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Assembly Instructions

mikado

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Contents

1 Mikado Controller Hardware **2**
- 1.1 19-inch variant . . . 2
- 1.2 Compact version . . . 2

2 Connecting the Ensenso cameras **3**
- 2.1 N-Series . . . 3
- 2.2 X-Series . . . 3

3 Fastening the calibration plate **3**
- 3.1 Stationary camera . . . 4
- 3.2 Moving camera . . . 5

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1 Mikado Controller Hardware

The Mikado Control controller is available in a compact and a larger, more powerful 19-inch version. Both controllers should be installed in a protected environment, e.g. in a control cabinet.

1.1 19-inch variant

The powerful version of the Mikado controller is supplied as a 19-inch rack with 4 U (approx. 18 cm high). The power switch and two USB ports are located on the front behind a lockable flap. All other connections are located on the rear. Power is also supplied via a 110-240 V power cable. Mouse and keyboard can be connected via USB. There are 3x DisplayPort, HDMI and DVI connections for monitors. Cameras and robots can be connected via four Gigabit network ports on a plug-in card. A further onboard Gigabit port is available for remote access or integration into the overall system. The Hilscher cifX card can also be used here for communication with the PLC etc.

1.2 Compact version

The dimensions of the controller are approx. 250 x 160 x 160 mm, but there should still be approx. 5 cm space to the front for the cables. Mounting is possible using the supplied plates with a hole pattern of 270 x 135 mm. Power is supplied via a 110-240 V power cable, keyboard, mouse and screens (DVI/HDMI) can be connected via the usual connections. Two Gigabit Ethernet ports are available for the connection to the camera and robot. The plug-in card is a Hilscher cifX card that can be used for ProfiNet integration, for example. Alternatively, a 4-port network card can also be installed.

2 Connecting the Ensenso cameras

Only a brief summary can be given here, further details can be found in the Ensenso Manual.

2.1 N-Series

The compact cameras in the N series can be connected via PoE (Power over Ethernet) as well as via a separate power supply (24 V). In both cases, data is transmitted via Gigabit Ethernet. This requires a sufficiently shielded cable, at least Cat 5e. Unfortunately, many robots are only equipped with a 100 MBit cable without sufficient shielding. With transmission times in the range of seconds, a minimum cycle time can no longer be achieved.

The mounting should be done with three M4 screws in a triangular arrangement to avoid distortion of the camera body. The drilling pattern and the dimensions of the camera can be found here in the Ensenso manual.

2.2 X-Series

The X series is always powered via an external 24 V power supply unit. Power supply via PoE is not possible here. As the projector consumes a relatively high amount of power during recording, a cable with a larger cable diameter should be used for any extensions. The mono cameras are connected to the projector and supplied with 12 V from it.

There are two options for data transmission with the X series:

- The two cameras can be connected to the projector's integrated switch. The switch in turn is connected directly to the Mikado controller.
- Alternatively, only one of the two mono cameras can be connected to the switch. The other camera and the switch are then connected directly to the Mikado controller.

The second variant doubles the data transfer rate and the recording time can be reduced accordingly. The projector is mounted with four M4 screws, the drilling pattern and dimensions can be found here in the Ensenso manual.

3 Fastening the calibration plate

For hand-eye calibration (HAK), an Ensenso calibration pattern must be attached to the flange or gripper in the case of a stationary camera. With a moving camera, however, this can simply be placed in the cell.

3.1 Stationary camera

In principle, the position and axis angle of the robot during calibration should be as close as possible to a typical gripping position. As can be seen in the figure below, axis 6, i.e. also the flange, should be aligned in the negative Z direction and the calibration plate (pattern) in the direction of the camera. Furthermore, the mounting of the calibration plate should be sufficiently stable and not move, but the exact position is irrelevant. The boom for the camera must be long enough so that the camera has a good view of the entire pattern or at least the majority of it. Last but not least, an uncomplicated conversion is helpful so that recalibration can be carried out quickly and easily at any time.

The simplest design is an elongated plate with drill holes for the robot flange and a glued or clamped calibration plate next to the flange. The disadvantage here is the need to dismantle the gripper. The pattern must not be drilled into, as there is a risk that it will warp. The pattern is a measuring instrument and should also be protected from scratches after use.

If the gripper has a stable form fit, a part with a glued pattern can also be gripped. Attaching a section of top-hat rail to the side of the gripper and gluing a corresponding counterpart to the pattern has also proven successful.

Hint: Provide a backstop for the ceramic patches in case the gripper is opened unintentionally.



Fig. 1: Example of attaching a calibration plate to the robot flange for a stationary camera

3.2 Moving camera

With a mobile camera attached to the robot flange or gripper, the pattern can be placed anywhere in the workspace. It is best to place it in the center of the subsequent pick-up area, e.g. on or in the parts box. The pattern does not need to be fixed in place, it simply needs to rest in a non-slip position during the robot movements during the calibration process.