TOOL TRACKING by ART

VERPOSE Manual

Version 1.3.0
April 2023

Trademarks

The following overview shows the registered trademarks of Advanced Realtime Tracking GmbH & Co. KG:

trademarks	illustrated as	**in Germany**	**in the EU**	**in the U.S.**
A.R.T.®	***ART***	×		
ART®	***ART***	×	×	×
VERPOSE®	***VERPOSE***	×		
ART Advanced Realtime Tracking		×	×	×
ART Advanced Realtime Tracking		×	×	×

Microsoft® and Windows® are trademarks registered in the United States and other countries by the Microsoft Corporation.

The company names and product names written in this manual are trademarks or registered trademarks of the respective companies.

Warranty regarding further use of open source software

Advanced Realtime Tracking GmbH & Co. KG (denoted as ***ART***) provides no warranty for the open source software programs contained in this product, if such programs are used in any manner other than the program execution intended by ***ART*** . The licenses define the warranty, if any, from the authors or licensors of the open source software. ***ART*** specifically disclaims any warranties for defects caused by altering any open source software program or the product's configuration. You have no warranty claims against ***ART*** in the event that the open source software infringes the intellectual property rights of a third party. Technical support, if any, will only be provided for unmodified software. The full license text can be obtained from ***ART*** directly.

Disclaimer

In no event shall Advanced Realtime Tracking GmbH & Co. KG be liable for any incidental, indirect, or consequential damages whatsoever (including, without limitation, damages for loss of business profits, business interruption, loss of business information, or any other pecuniary loss) arising out of the use of or inability to use the software or hardware.

ART
Advanced Realtime Tracking

Advanced Realtime Tracking GmbH & Co. KG
Am Öferl 6
82362 Weilheim i. OB
Germany
☎ +49 (0)881-92530-00
+49 (0)881-92530-01
https://ar-tracking.com

History of changes

02.12.2024	Initial user manual	Bernhard Nübling

What's new in version 1.3.0?

The following new features are available in ***VERPOSE*** version v1.3.0:

- Improve ethernet devices display

What's new in version 1.2.0?

The following new features are available in ***VERPOSE*** version v1.2.0:

- Deactivate IMU data
- Adaptive camera frame rate
- Manual camera selection

Contents

Terms and definitions

term	definition
Class	Position
Classification	Calculation of the correct position
Classifier	Part of the software algorithm that does the classification
Detection	Process of finding the correct position
Margin	Minimum of allowed difference between best class and second best class
Prediction	Result of the position detection algorithm
Score	Minimum threshold value for prediction to work
Tracking	Position detection of a specified object
Training	Calculation done by the ***VERPOSE Tool Controller*** to be able to differentiate between the given positions
VERPOSE	
Backend software	Software running on the ***VERPOSE Tool Controller*** processing all necessary calculations and operations
Frontend software	Graphical user interface (GUI) running on the ***VERPOSE Tool Controller*** to control the ***VERPOSE Tool Controller***
VERPOSE Tool Controller	Computation unit for rack mounting, calculates position detection and generates data output

1 Safety

1.1 Symbols and their meaning

You can find the following symbols and signs on the equipment or in the manual:

	Useful and important notes.
	Important notes, which may lead to system malfunction or to the loss of warranty by non-observance.
	Important safety warning to assure user's and operational safety. These warnings have to be observed, otherwise there is a potential risk for health and safety and damaging of the equipment resulting in loss of warranty and liability.
	Safety warning for infrared radiation. These warnings have to be observed, otherwise the user's eyes and sight are exposed to a potential hazard.

Table 1.1: Symbols and their meaning

1.2 Warnings

All warnings in this manual have to be observed for safe operation of the equipment.

Tous les avertissements dans ce manuel doivent être respectés pour garantir un fonctionnement sécurisé de l'équipement.

***ART* explicitly denies any warranty and liability if the product is not operated according to this manual or any other authorised documentation (e.g. quick-guides) or not according to the specifications of the equipment.**

1.2.1 Installation

The housing may NOT be damaged.

Do not install or use any equipment when it shows signs of damage (e.g. smoke, sparks, fire, smells, etc) or if parts of it show damaging.

Do not install or use any equipment when the power cord is damaged.

Some equipment employs connectors of proprietary design. Do not try to connect these to any other computer ports (e.g. COM port or LAN) !!!

Verify that voltage and frequency of your electrical grid comply with the appliance ratings of the equipment. The rating plates are found on the rear side of the equipment's housing.

Vérifiez que la tension et la fréquence de votre réseau électrique correspondent aux spécifications de l'appareil. Les plaques signalétiques se trouvent sur l'arrière du boîtier de l'équipement.

The equipment may only be powered from power sockets connected to earth/ground. If the grounding wire is defective the requirement of the safety and the electromagnetic compatibility (EMC) cannot be guaranteed. To check the function of the grounding wire ask your local electrician.

L'équipement ne peut être alimenté que par des prises de courant reliées à la terre/au sol. Si le fil de mise à la terre est défectueux, les exigences de sécurité et de compatibilité électromagnétique (CEM) ne peuvent être garanties. Pour vérifier le fonctionnement du fil de mise à la terre, demandez à un électricien local.

The power switch on the equipment does not separate the device from mains. The equipment must be disconnected from mains.

1.2.2 Mounting

Be careful with the front pane of the cameras to avoid permanent damage (e.g. scratches).

Shock and severe vibrations can permanently damage the internal calibration of the cameras. De-calibrated cameras have to be sent in for maintenance.

Do not drop the equipment.

Never unfasten screws that are not designed for mounting. All liability and warranty is void.

The ventilation holes of the *VERPOSE Tool Controller* must not be covered. Ensure unblocked airflow at all times. The minimum distance between equipment and surrounding objects has to be larger than 3 cm.

Install a strain relief to all cables to avoid damage to the equipment.

Install the cables trip-proof (e.g. cable ducts or fixings). Inappropriate cabling may pose a serious hazard to health and safety.

Installez les câbles de manière à les protéger contre les risques (par exemple, en utilisant des canalisations ou des fixations pour câbles). Un câblage inapproprié peut représenter un grave danger pour la santé et la sécurité.

1.2.3 Operation

Unplug the equipment from mains immediately in any case of damage! Please contact *ART* service

Use only original components and accessories from *ART* or authorized by *ART* . Using unauthorized components or accessories may damage the equipment, may cause malfunctioning and may compromise operational safety.

Utilisez uniquement des composants et accessoires d'origine de *ART* ou autorisés par *ART* . L'utilisation de composants ou accessoires non autorisés peut endommager l'équipement, provoquer des dysfonctionnements et compromettre la sécurité opérationnelle.

In case connectivity is provided using third party equipment please ensure compliance to all applicable standards regarding connectivity and power supply (see section 4.2 on page 20). Non-compliance may result in loss of conformity! All warranty and liability is void.

Only peripheral devices which meet the safety requirements of UL 60950-1 (U.S. only) and EN / UL / IEC 62368-1 (EU, U.S., etc.) for SELV may be attached on Ethernet-, BNC- and the DC-circuit of the equipment.

Do not change or modify the equipment in any way (e.g. mechanically or electrically). Non-compliance may result in loss of conformity! All warranty and liability is void.

Do not spill fluids over the equipment!

Do not insert objects into the equipment (e.g. ventilation openings) !

Do not expose the equipment to high levels of humidity or condensing environments.

Ne pas exposer l'équipement à des niveaux élevés d'humidité ou à des environnements où la condensation est possible.

The equipment must not be operated in environments with intensive formation of dust.

L'équipement ne doit pas être utilisé dans des environnements avec une formation intense de poussière.

The equipment must not be operated in environments with elevated temperatures above 40° C (100° F).

L'équipement ne doit pas être utilisé dans des environnements avec des températures élevées supérieures à 40° C (100° F).

Do not use the equipment outdoors (i.e. outside of buildings or potentially moist / wet locations) !

Ne pas utiliser l'équipement à l'extérieur (c'est-à-dire en dehors des bâtiments ou dans des endroits potentiellement humides / mouillés) !

The cameras emit infrared light. Keep a distance of min. 20 cm when operating near cameras. All cameras are assigned to the Exempt Group according to IEC62471-1 and therefore pose no risk or hazard to the human eye or skin at this distance.

Les caméras émettent de la lumière infrarouge. Gardez une distance minimale de 20 cm lorsque vous travaillez à proximité des caméras. Toutes les caméras sont classés dans le Groupe Exempt selon la norme IEC62471-1 et ne présentent donc aucun risque ou danger pour les yeux ou la peau humaine à cette distance.

1.2.4 Maintenance

The camera lens is sensitive to dirt and damage. If you see any interference on the screen, please clean the lens with a dry soft cloth.

Do not use any solvents, water or chemicals to clean the cameras!

Do not try to repair anything by yourself!

All warranty and liability is void when the equipment is opened.

Danger High Voltage inside the equipment (e.g. *VERPOSE Tool Controller*)! Do not open the equipment ! Risk of electric shock - even if the equipment is disconnected. Please contact *ART* service.

Danger Haute Tension à l'intérieur de l'équipement ! Ne pas ouvrir l'équipement ! Risque de choc électrique - même si l'équipement est déconnecté. Veuillez contacter service *ART* .

In order to replace mains fuses (e.g. *VERPOSE Tool Controller*) always unplug the power cord first. Risk of electric shock !

Pour remplacer les fusibles secteur (par exemple, *VERPOSE Tool Controller*), débrancher toujours d'abord le cordon d'alimentation. Risque de choc électrique !

1.2.5 Disposal & Recycling

Waste Electronic and Electrical Equipment (WEEE) should never be disposed of along with household waste.

2 General Information

2.1 Cleaning of the equipment

The camera lens is sensitive to dirt and damage. If you see any interference on the screen, please clean the lens with a dry soft cloth.

Do not use any solvents, water or chemicals to clean the cameras!

2.2 Maintenance and service

Routine maintenance of the equipment is recommended every three years. If you experience any problems please do not hesitate to contact our support.

Do not try to repair anything by yourself!

Danger High Voltage inside the equipment (e.g. *VERPOSE Tool Controller*)! Do not open the equipment! Risk of electric shock - even if the equipment is disconnected. Please contact *ART* service.

Danger Haute Tension à l'intérieur de l'équipement! Ne pas ouvrir l'équipement! Risque de choc électrique - même si l'équipement est déconnecté. Veuillez contacter service *ART* .

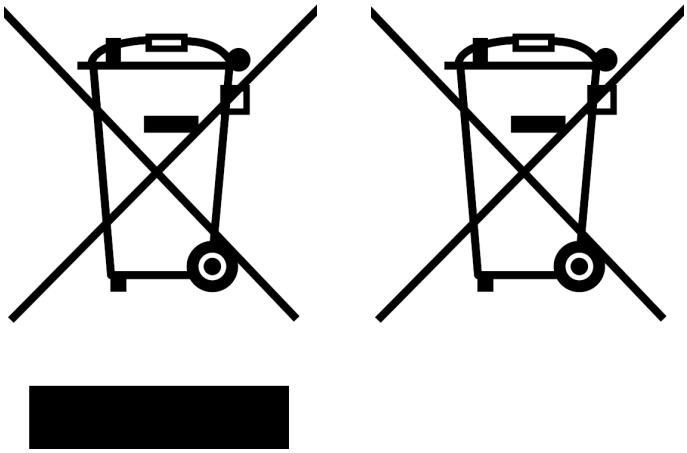
All warranty and liability is void when the equipment is opened.

2.3 Disposal and recycling of equipment

Waste Electronic and Electrical Equipment (WEEE) may contain a complex mixture of materials and hazardous substances. If not managed properly and thus exposed, these can cause serious damage to the environment, wildlife, and human health. In addition, modern electronics contain rare and expensive resources, which can be recycled and re-used to contribute to the circular economy. By ensuring that you dispose of WEEE properly, you are helping to improve sustainable production and consumption, to increase resource efficiency and to preserve our natural resources and protect human health.

The symbol (crossed-out wheelie bin symbol according to Waste Electronic and Electrical

Equipment (WEEE) Directive 2012/19/EU, see figure 2.1 (a) or (b) on page 14) indicates that the product should not be discarded as unsorted municipal waste but must be sent to separate collection facilities for recovery and recycling.



(a) equipment placed on the market prior to 2005

(b) equipment placed on the market after 2005

Figure 2.1: WEEE label

When your delivery address is outside of Germany, dispose of WEEE at your local waste facilities or recycling centers available by public waste management authorities only. Please consider that local regulations on the disposal of and recycling of electronic and electrical equipment may apply. Contact your local authority directly for more information.

For deliveries inside Germany only:

- End-users of WEEE are obliged to return the equipment or have it collected within the framework set up by ***ART*** .
- You are responsible for deleting personal or confidential data from the equipment to be disposed of. You can do this by deleting all projects on the ***VERPOSE Tool Controller*** . ***ART*** is not liable for any data on your device. Before resetting your device, you should always back up any sensitive data.
- For further details regarding the WEEE directive, including how ***ART*** ensures the safe disposal of your electrical and electronic equipment, please refer to our website at https://ar-tracking.com/de/art-geraete-ruecknahmekonzept

Waste Electronic and Electrical Equipment (WEEE) should never be disposed of along with household waste.

2.4 Warranty

General Please refer to the terms & conditions on our website at https://ar-tracking.com/en/terms-agb

Hardware *ART* warrants the hardware to be free from defects in material and workmanship, design and manufacturing for the warranty period set forth in our terms & conditions (see website) after the time of delivery. The time of delivery is defined as the day when the end-user takes possession of the equipment. If *ART* or any third party authorized by *ART* installs the system, the time of delivery is the time of the first installation.
If a defect arises during this warranty period, provided the instructions for returning the hardware are followed, *ART* will, to the extent permitted by law, initially either (i) repair or (ii) replace the hardware or any defective parts. All replaced parts and hardware shall become property of *ART* . This limited warranty applies only to hardware components that have been under ordinary and intended use and service being in their original, unmodified state and thus have not been subject to damage from external causes, alteration or unauthorized repair.

Software Software supplied is delivered on a tested "As Is" basis. *ART* explicitly does not warrant that the software is error (bug) free. If the user detects bugs and notifies *ART* , *ART* will provide a workaround or bug fix as soon as possible after successfully reproducing the error.

Warranty restrictions All warranty and liability is void, if the equipment

- is not operated according to this manual or any other authorized documentation (e.g. quick-guides),
- has not been used according to the specifications of the equipment,
- shows damages or signs of improper use,
- has been opened by the user or other non-authorized personnel (non-members of *ART* and third parties not authorized by *ART*),
- has been modified or tampered with by the user or other non-authorized personnel (non-members of *ART* and third parties not authorized by *ART*).

2.5 Liability

General Please refer to the terms & conditions on our website at
https://ar-tracking.com/en/terms-agb

In no event shall *ART* be liable for any incidental, indirect or consequential damages whatsoever (including, without limitation, damages for loss of business profits, business interruption, loss of business information, or any other pecuniary loss) arising out of the use of or inability to use the software or hardware.

Measurement results *ART* products are not authorized for use under any circumstance where human life might be at risk due to malfunction, measurement errors or interrupted operation of the system without written approval of a managing director of *ART* .
It is the user's sole responsibility to check the results of the measurement data and to protect any downstream system against malfunction, measurement errors or interrupted operation of the system. Under no circumstances shall *ART* be held liable for any incidental, indirect or consequential damages whatsoever (including, without limitation, damages for loss of business profits, business interruption, loss of business information, or any other pecuniary loss) arising out of malfunction, measurement errors or interrupted operation of the system.

***ART* explicitly denies any warranty and liability if the product is not operated according to this manual or any other authorized documentation (e.g. quick-guides) or not according to the specifications of the equipment.**

Do not change or modify the equipment in any way (e.g. mechanically, electrically). Non-compliance may result in loss of conformity! All warranty and liability is void.

3 Hardware overview

This section provides a brief summary of the ***VERPOSE*** hardware parts.

3.1 Safety instructions

For safe handling of the ***VERPOSE*** system please follow these instructions:

Keep an eye relief of min. 20cm when operating the camera! The camera is assigned to the Exempt Group according to IEC62471-1 and therefore poses no risk or hazard to the human eye or skin at this distance.

Do not use components if they appear damaged

Use only the components supplied with the system.

3.2 Components

Overview of ***VERPOSE*** in a working environment (see image 3.1 on page 18):

Standard components (see image 3.2 on page 18):

- ***VERPOSE*** camera **(K)**
- Camera adapter **(A)**, for the tool
- Ethernet cable **(E)** Cat. 5e, RJ45 (specified by ***ART*** and user)
- ***VERPOSE Tool Controller*** (VTC) **(C)** with monitor (provided by the customer)

Optional components:

- Protective housing (19“-Rack)
- Cable guide (black, plastic, along and attached to the assembly tool)
- Scratch and bump protection (camera and adapter)
- Gateway (e.g. Modbus or PROFINET)

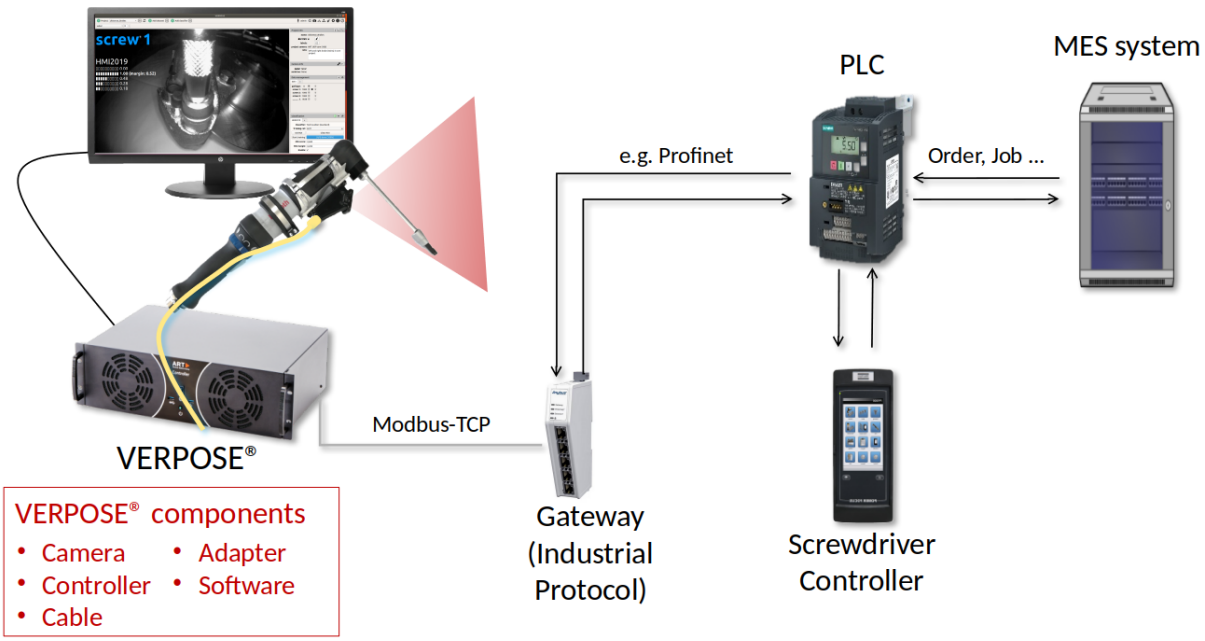


Figure 3.1: *VERPOSE* system in industrial environment

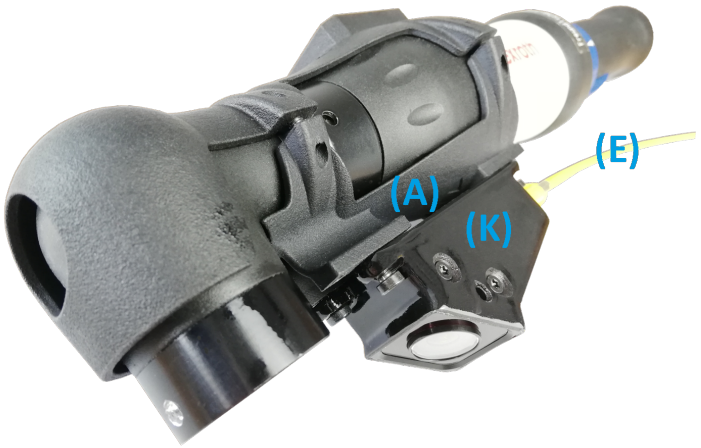


Figure 3.2: *VERPOSE* camera attached to an electric screwdriver

4 Hardware setup

This section provides information on how to set up all hardware components to work with the *VERPOSE* system.

4.1 Camera and cable

Camera The camera (K) is attached to the hand tool with an adapter (A) and must not be loose, otherwise the pictures will not be recognized. The adapter is made of aluminum. If necessary, tighten the screws (S) only hand-tight (max 1.0 Nm) with a hexagon socket tool (size 3mm).

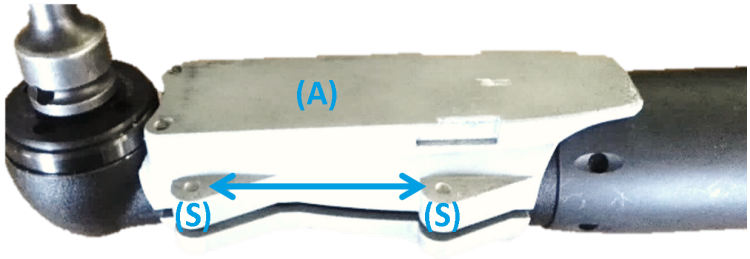


Figure 4.1: *VERPOSE* adapter attached to an electric screwdriver

Camera cable The connector (D) of the connection cable can be latched to the back of the camera (D1) or fastened (max 0.3 Nm) with screws (D2).

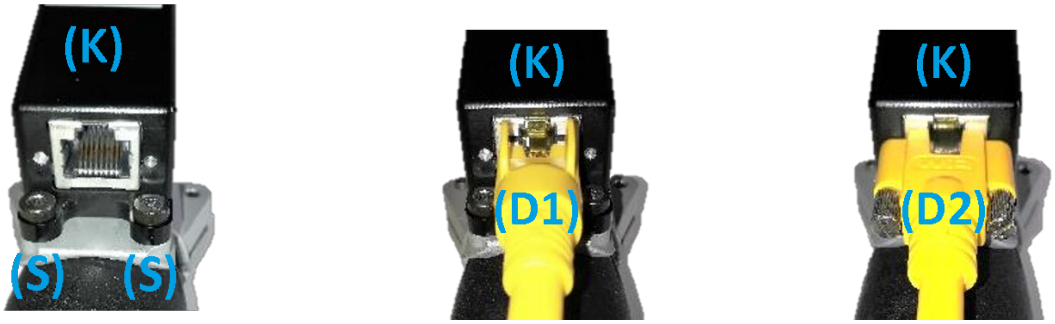


Figure 4.2: Back of *VERPOSE* camera with and without cables

The other end of the camera cable is plugged into one of the four Ethernet sockets **(B)** of the *VERPOSE Tool Controller* **(C)**. The network connection is made via one of the two jacks **(LAN2)**, **(LAN1)**, where **(LAN2)** has a static IP and **(LAN1)** is controlled via DHCP.

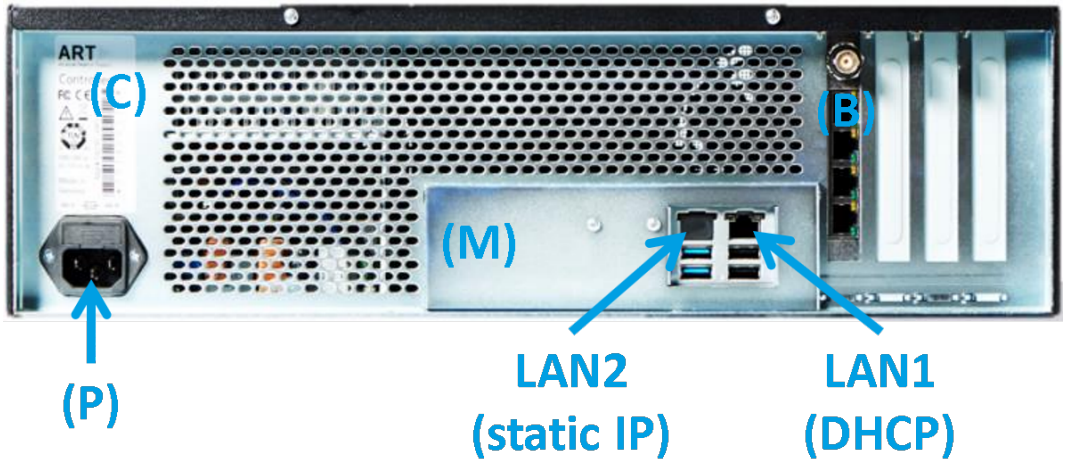


Figure 4.3: Back side of *VERPOSE Tool Controller*

4.2 *VERPOSE Tool Controller*

Controller Power is supplied via a 110V - 230V / 10A connection **(P)**. The *VERPOSE Tool Controller* provides monitor connectors DVI-D and display port. They are located under the metal cover **(M)**.

Start system The *VERPOSE Tool Controller* self-activates by turning on the switch on the front panel of the *VERPOSE Tool Controller* („I“ = on | „0“ = off).
Please note that the switch **(T)** on the *VERPOSE Tool Controller* is set to "I".
Duration of startup: approx. 40s.

Figure 4.4: Front side of *VERPOSE Tool Controller*

Operation During operation, the monitor displays the current pictures of the camera. This visualizes that the monitor is connected. If no camera image appears, please check the LEDs on the front of the camera.
The left LED **(L1)** lights constantly when voltage is applied. The right LED **(L2)** flashes when the data connection is working. If no camera image appears, please check the cable connections. If a triangle appears in the menu item "Camera info" and no double slash ("Pause", see picture), then click on it and start the camera.

☞ **The camera lens is sensitive to dirt and damage. If you see any interference on the screen, please clean the lens with a dry soft cloth.**

Stop system To stop using *VERPOSE* , set the switch **(T)** on the *VERPOSE Tool Controller* to "0“ (without shutting down the system).

5 Software setup

This section describes the steps necessary to have a system ready to detect positions.

5.1 Graphical User Interface

Basic procedure:

- Create a project ("**Project**")
- Include mounting points/record images ("**Add dataset**")
- Classify ("**Add classifier**")

Screen structure The Graphical User Interface (GUI) is divided into three main areas (see image 5.1 on page 23):

I. Horizontal menu area (tool bar)

II. Vertical menu area (menu boxes)

III. Monitor image (basic element)

The menu areas can be moved and turned on/off via right-click, whereas the monitor image is always visible.

I. Horizontal menu area This contains the elements (see below) for creating new projects or for selecting an already created project:

- Project selection („Project“)
- Record images („Add dataset“)
- Calculate (train) the detection of mounting points („Add classifier“)

The upper right corner (see image 5.2 on page 23) also contains the following actions in order from left to right:

1. The status of the user (observer/admin)
2. The copyright PDF (USB-stick needed)
3. A screenshot possibility

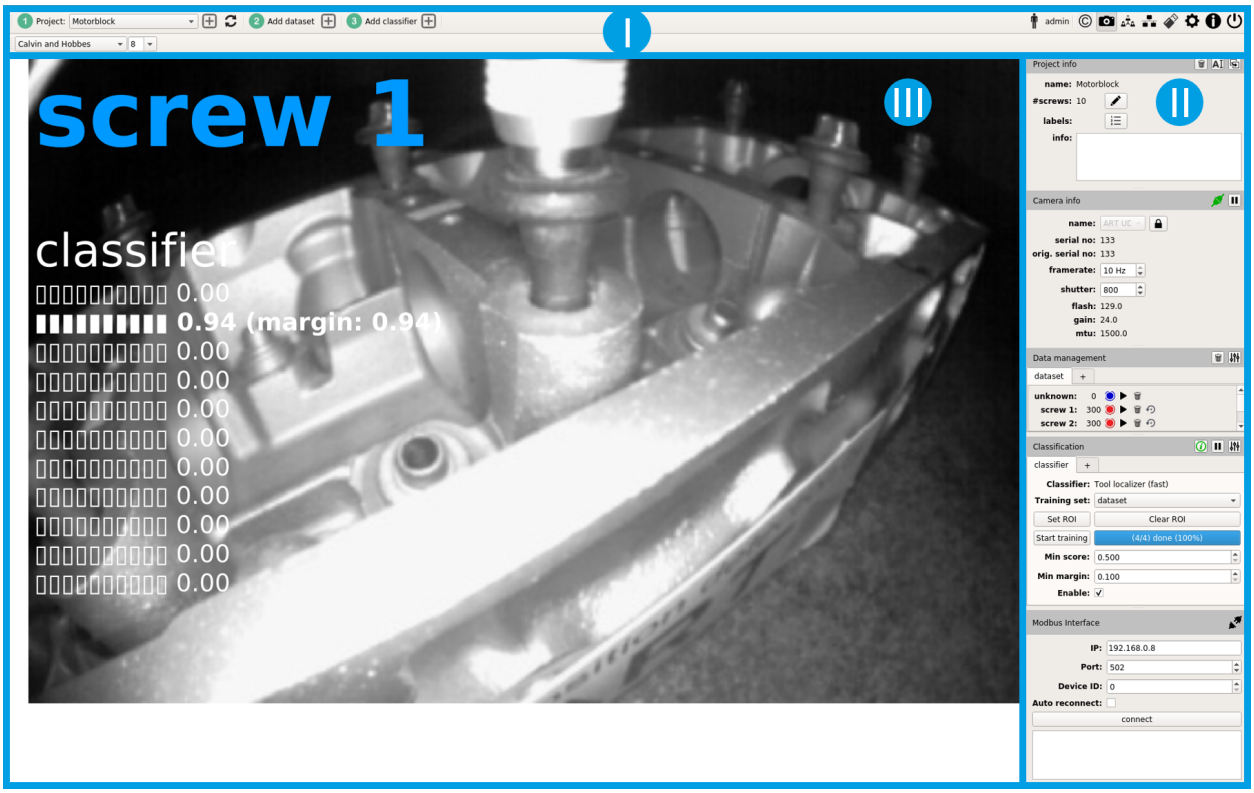


Figure 5.1: GUI overview

Figure 5.2: GUI icons

4. An active connections overview
5. The Ethernet settings
6. A "Data stick" icon for importing and exporting data
7. A settings option for global parameters (gear icon)
8. A button showing the software's version numbers
9. An off-switch symbol for shutting down *VERPOSE* in terminal mode

The modification of data and global parameters should only be performed by trained personal

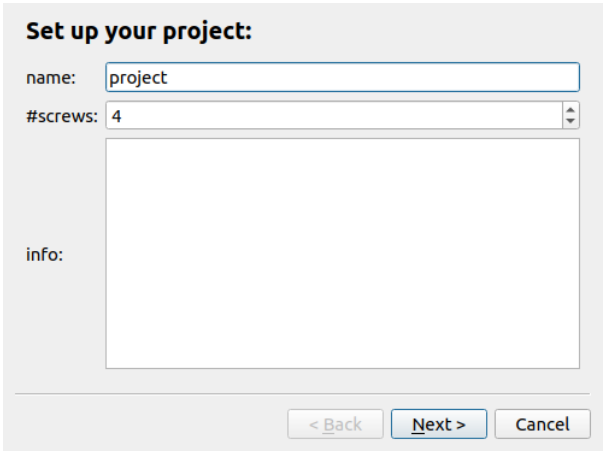
II. Vertical menu area These menu items show the current settings for the selected project. In addition to general project information ("Project info") there are also settings for the camera ("Camera info"), recording images ("Data management") and classification ("Classification").

III. Monitor image The pictures taken by the camera are displayed on the screen. In addition, an indication of the detected mounting location (e.g. "screw 1") appears. Depending on the configuration, individual classification results ("score", "margin") can also be displayed on the monitor screen below the overall result.

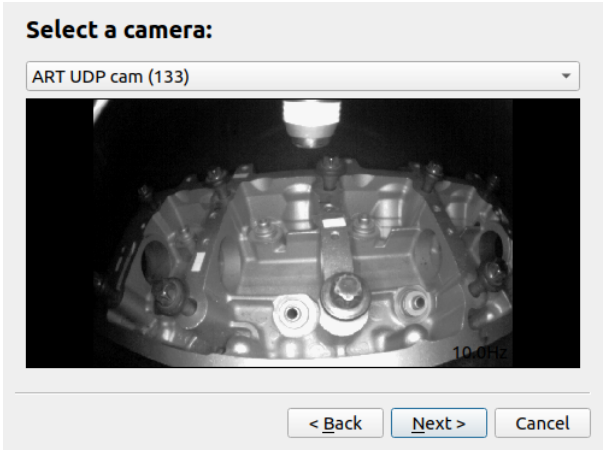
5.2 Training

Figure 5.3: GUI horizontal menu area

Creating a project (horizontal menu area I) Via the menu item 1 "**Project**" an created project (drop-down list) is called up or via the "+" -character a submenu is called in which one can create a new project:

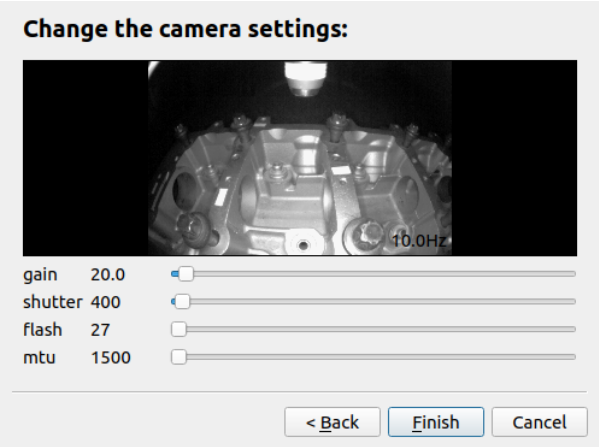


The submenu "Create a new project" appears. Here the header data "name" and number of mounting points ("# screws") are entered. In addition to the mounting points, you can enter project-specific information in the free-text area "Info" (screwdriver, adapter, socket).



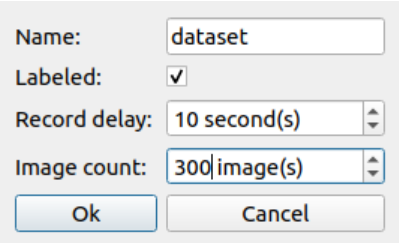
If you now select the drop down list via "next", the connected camera will be displayed with the current live image.

The settings made apply to all mounting positions. Therefore, one should first approach all positions once to find suitable parameters to avoid over- or under-exposure.

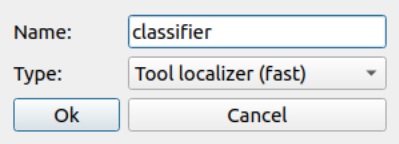


Finally, the parameters of the camera for "shutter" and "gain" are displayed, which can be varied in the menu. A smaller value in "shutter" makes the picture darker. The gain settings are less effective. The live image in the window displays the corresponding results of the selection.

Add dataset The menu item 2 "**Add dataset**" calls up a window in which the images of the recordings are organized.



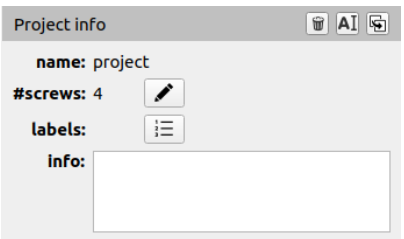
First, a name for the picture group is requested. The "labeled" option defines whether the pictures are to be assigned to a mounting point (usually active; non-labeled produces protocol or logging pictures). The "record delay" determines after how many seconds the recording should be started. Depending on the situation, a value of 3s to 10s should be set. Finally, the number of images to be captured is determined ("image count").



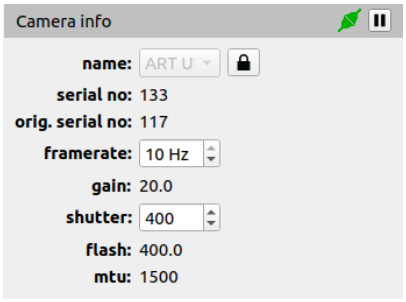
Menu item 3 "**Add classifier**" starts a query for the name and type of the classifier. By default, the default classifier "ToolLocalizer" is stored here.

The icons at the top right control global settings and data movement. This is described in "**Global settings**".

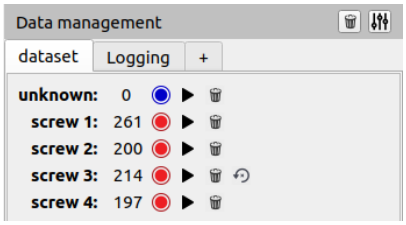
Modifying a project The vertical menu bar (**II**) contains menu groups that can be activated (right-click) and arranged as required. If one of the above fields does not appear automatically when starting the program, you can add it by right-clicking in the menu area **II**.



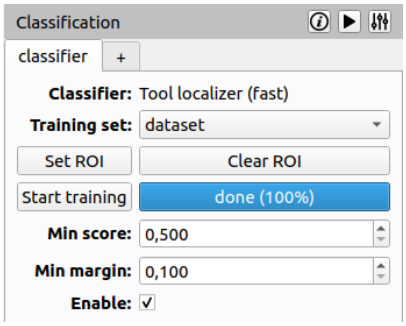
In "**Project info**" the already created data appears after selection of a project (see block 2) as well as a text field for tool information, e.g. Screwdriver, bit and extension.



The selected camera will be displayed under "**Camera info**". Here, for example, the recording frequency vary. The values for "shutter" and "gain" can not be changed after the initial project creation.

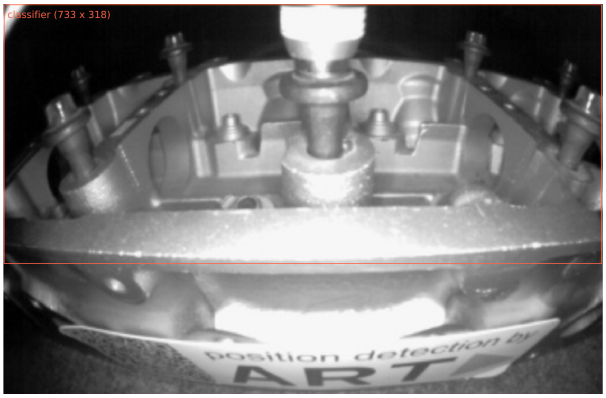


The "**Data management**" shows the number of pictures taken and is used for setting new recordings. Already taken pictures can be played by the arrow button. The trash can next to the mounting point. You can also delete the tab by right-clicking.



"**Classification**" contains the default classification parameters. Important here are the thresholds "min. score" and "min. margin". If the minimum classification results - on the "score" and "margin" screens - are below the threshold values, the detection is insufficient. Typical values are 0.500 for "min. score" and 0.100 for "min. margin". Higher values increase detection certainty (e.g., 0.650 and 0.200) but are not always achievable.

Region Of Interest (ROI) Working with the spacial case of ROI:

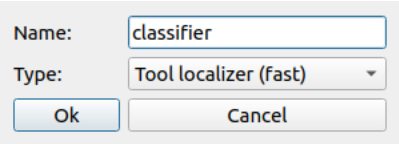


By selecting the item "**set ROI**" item, the image area used for the classification can be limited to the relevant area with the mouse. As an example serve two pictures (see left).
The image captured by the camera is reduced to the image area in the green section after the modification in "**set ROI**".
This allows the evaluation to be reduced to striking areas and possibly optimized. This may e.g. If the recording field is too large, it will help ignore the background.

Create recordings for training After setting the parameters acc. Section 2 can be taken by selecting the red "recording" icon in "**Data management**". The preselected number of images in section 2 can now be recorded. The selected delay time allows you to get to the mounting point to set up the mounting tool and not prematurely start recording.
The recording should be done by two persons. This reduces the risk of mis-taking.

After starting the recording, a counter appears on the screen showing the actual and target number of images. The recording will be finished automatically after reaching the desired pictures. Now you can approach the next (assembly) position. The black arrow in the middle of the menu plays the recording again.
If you want to delete **all created recordings** of a data set at the same time, select the "trashcan" icon in the header.

Perform classification "**Start training**" in the "**Classification**" menu triggers the generation of the classifiers. These are created after completion of all recordings. Generation takes 5-20 minutes per number of mounting points to be detected, i. e. at 4 mounting points between 20 and 80 minutes. That depends on the total number of pictures. A progress bar informs about the duration. A new calculation of already created classifiers is much faster.
The **detection function is started** via the middle icon in the “Classification” header. To check the quality of detection, the mounting points are approached with the tool and their detection is checked on the screen. If the values correspond to the specifications, the fitting indication "Screw X" appears (see image 5.1 on page 23).

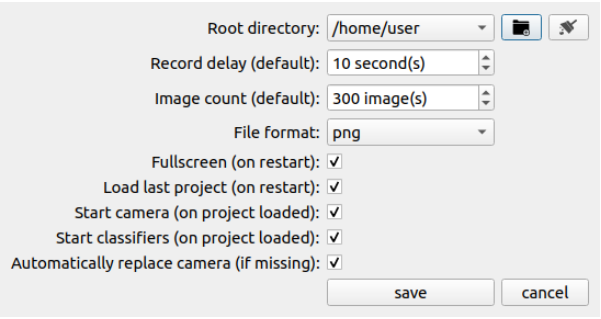


If you want to create different classifiers, e.g. because you want to check several properties at once (position, socket type), use the “+” icon "**Create a new classifier**". To enable the classifiers, select the "Enable" option.

The system is now ready to use and can manage multiple projects. These are selected via the menu item ("**Project**") in the horizontal menu area. The associated cameras and settings are stored in the project profile until the values are overwritten. Before calling up a saved project, the corresponding camera should be connected.

5.3 Settings

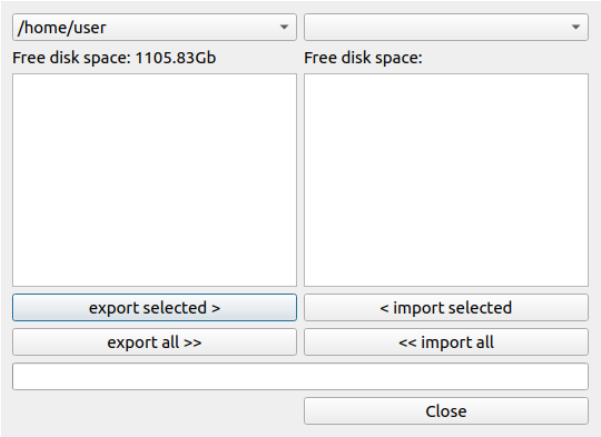
Global settings This section covers the settings that are active system wide.



The gear icon in the menu area **I** stands for the "**Global settings**", i.e. the basic settings of the program. Here, among other things, one can provide default values, like the number of images per mounting point ("images per screw"), the delay time until the start of the recording ("recording delay“) and more.

You can also define options when starting the program here. It makes sense to set values here, as they have proven for the respective customer.

Backup Important projects can be saved and transferred to other systems.



The **USB stick-icon** opens the import and export functions. After selecting the relevant folders, the project files are displayed. By selecting individual or all projects can be imported or exported at the same time.

Ethernet settings The system's connection settings can be adjusted as needed by clicking the **Ethernet settings** button (small cog). This opens an overview listing all connected devices (cameras and external components) with their respective state, **DHCP settings**, **ip addresses** and **gateway settings**. To change these settings the accordingly named button will lead to the next window, which lets the user set the aforementioned settings.

Font The **font** and **font size** of the displayed detection and their values in the menu can be set with the options in the top left of the screen. This lets the user adjust the display to their needs.

6 Frequently asked questions (FAQ)

Within this FAQ chapter we are offering solutions for easy-to-solve questions that our support encounters from time to time. The questions are grouped into specific topics to make it more convenient for you to find a solution.
In case you do not find a proper solution for your specific problem, please do not hesitate to contact us.
Our goal is to offer the best support possible. Therefore, we ask you to have the system running and that you have internet access when you call us. Additionally we will need details about your system. Please note the "GUI software version" and the "Controller firmware version" in the information section of the *VERPOSE* GUI. Please include it in your mail when you contact tech support.

6.1 Backup

⇨ What has to be done to create a backup of the *VERPOSE* system?

Copy all important projects to an USB stick and note all global settings, IP settings and if applicable the Modbus settings. For saving projects see section 5.3 on page 28. TODO
The **USB stick** is used to copy all saved projects to an ***VERPOSE Tool Controller*** and together with the settings the previous state can be restored.

6.2 Camera

⇨ What are the steps to solve camera connection issues?

First check the camera's **LEDs** and the information provided in the GUI (see section 4.2 on page 21) to exclude camera connection errors.
If this does not solve the problem **exchange** the camera's **Ethernet cable** to be sure that it works properly.

⇨ What needs to be considered when replacing cameras?

When replacing cameras it is highly advised to use an **identical camera model**. Switching to another model or layout may lead to a much worse prediction result or even prevent it from working at all.
In that case the recording of images and the training has to be repeated from the beginning to ensure a safe working procedure.

6.3 Connection

⇨ How can a connection to the *VERPOSE* system be established?

To make the system visible in a network its **Ethernet settings** have to be adjusted accordingly. It is possible to set the system to **DHCP** (default for LAN1) or specify an **IP address** (192.168.0.3 is the default for LAN2) for each of the two Ethernet ports. For each of those a **gateway** can also be set if desired (see section 5.3 on page 28).

6.4 Tool adjustments

⇨ What needs to be considered when the camera adapter is exchanged?

Replacing the camera adapter or exchanging the tool and reusing the same camera adapter may lead to worse prediction results. In some cases all previously recorded images become obsolete and the **recording** and **training** have to be **repeated** completely.

⇨ What happens when sockets or extensions are exchanged?

These changes may affect detection considerably. They may require **repeating** the **recording** and **training** processes.

6.5 Recording images

⇨ What are the steps to fasten the recording procedure?

The **frame rate** of the camera should be set to **30Hz** (maximum frame rate while predicting is 10Hz) while recording images (only possible if no prediction is running!). This ensures a more smooth recording of screw positions as well as reduces the needed time. Note that in never software versions this is the default.
Disconnecting and reconnecting a camera resets the frame rate to 10Hz.

⇨ What should and should not be visible while recording images?

While recording it is advised to have a **background that does not change** much between workpieces (e.g. frames or mounting points). Images may contain moving or changing parts like cables, but they should not be its majority.
Worker's **body parts**, especially hands in image frames, should be **avoided**.

⇨ How many images should be recorded per position?

Around **500 images** per recording position are sufficient in most cases. Surroundings with many changing features from workpiece to workpiece (e.g. cables or labels) require more than that, as well as projects that contain at least one position with bad recognition (can only be determined after training).

Additional images can later easily be added to each position. The number of images of each position should be roughly the same (Good: 300, 500, 450; Bad: 100, 2.000, 700).

⇨ What is the "unknown" position?

Unknown, no screw and garbage are all names for "**the current prediction does not recognize any of the trained positions**". The topmost position in "Data management" accompanied by the blue record circle button represents this "position" or better lack thereof. The displayed number of positions is always the one that has been set, plus the garbage position.
If either none of the trained positions can be detected or the margin between to positions is too low the prediction result will be "unknown" (default name).

⇨ What is boosting?

If certain tool angles or workpiece layouts are not detected it is possible to **add** those **missing images** to existing recordings. This process is called boosting.
This feature is activated by starting an image recording while the prediction is still running. The active prediction blocks the recording of images as long as any of the present positions is detected. Only images that are not yet recognized ("unknown" prediction) will be added to the dataset.
The record delay should be set to zero seconds.

6.6 Prediction

⇨ What are score and margin?

Score is the **minimum needed value** for the prediction to be considered a success. Basically a settable threshold. Margin is the **minimum needed difference** between the best and the second best detection result.
The score should be set as high as possible, so that the prediction still recognizes the positions in order to prevent eventual false detections. The same is true for margin. Safe high values for score are around 0.7 to 0.75, whereas margin should not be set higher than 0.2.
Both values can be adjusted while the system is active and predicting.

⇨ What is the ROI?

The **Region Of Interest** is a rectangular shaped object that can be drawn on top of the camera image to specify an **area** that is **of high importance**. At the same time this defines the area outside of this rectangle as not important.
In some special cases this feature is used to prevent unwanted image content (e.g. a highly varying cable string) to interfere with the prediction process. This may increase prediction results in difficult environments.
It is important to note that the camera is rotated around a specific position and therefor

the image's contents change accordingly. It is not possible to "mark" specific elements with this feature.

6.7 Workflow

⇨ What is a typical workflow when working with *VERPOSE* ?

A typical workflow with ***VERPOSE*** is best described with an image:

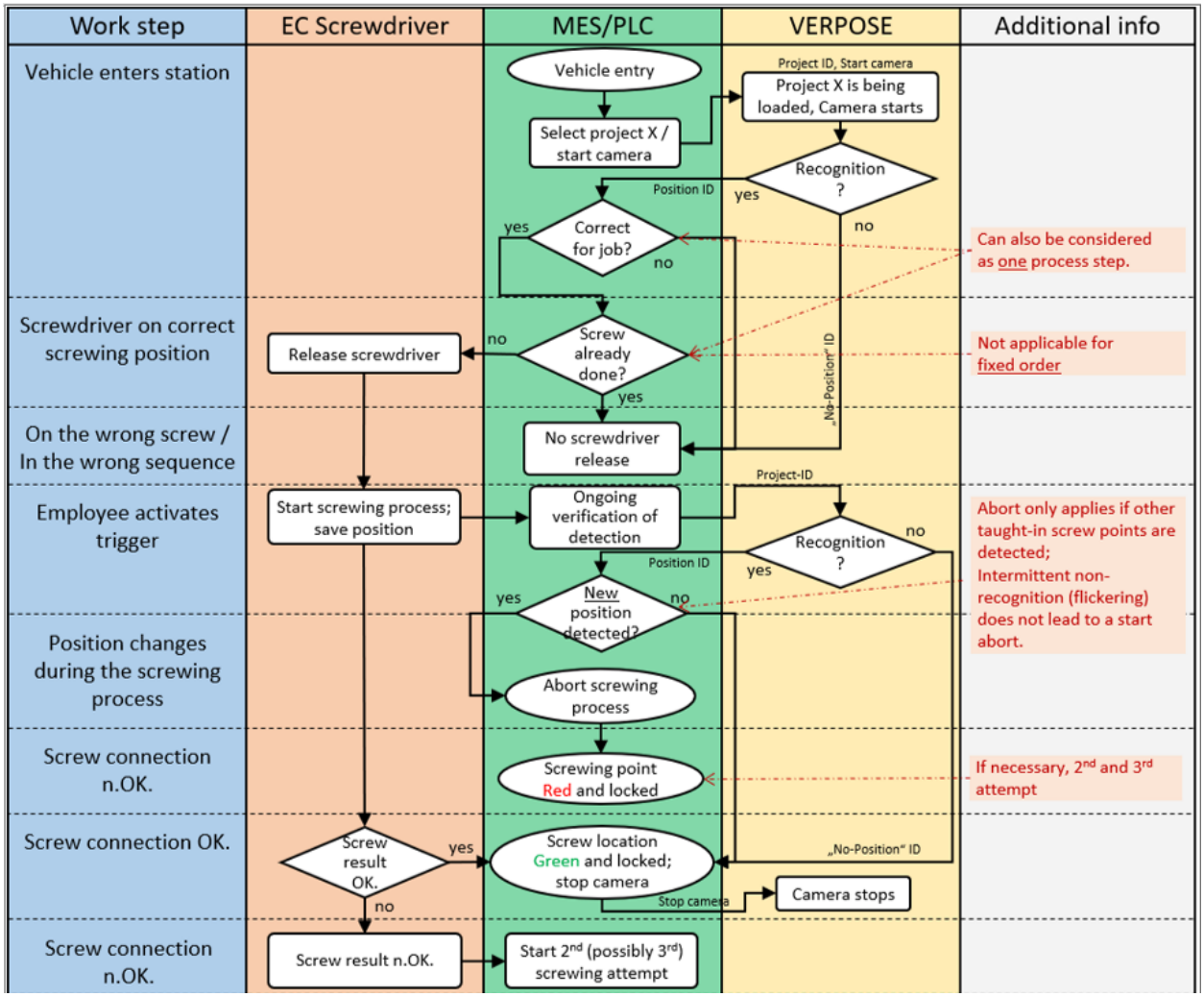


Figure 6.1: Typical workflow when working with ***VERPOSE***

List of Figures

List of Tables