AR VISION

— ARTIFICIAL VISION —

APPLICATION USER MANUAL

THEIA SYSTEM

Version 1.0.0.01

1. INTRODUCTION

This manual is to provide detailed instructions for the installation, configuration, calibration, use and maintenance of the Tea USB Camera, intended for machine vision inspection applications in industrial and laboratory environments. The manual also covers common troubleshooting and best practices to ensure efficient and safe operation of the camera.

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2. HARDWARE DESCRIPTION

2.1. Main Components

2.1.1 USB Tea Camera.

The camera is equipped with a high-resolution image sensor and a manual focus ring. Designed to be compact and easy to install on industrial supports.

2.1.2 USB Cable.

The USB connection is used to provide both power and data transfers. It is compatible with USB 2.0 and 3.0 ports, which does not affect the transfer speed and capture quality.

2.1.3 Control Software (Theia system).

An application that allows complete configuration and management of the camera, including adjustment of capture parameters and execution of image processing algorithms.

2.1.4 Manual Focus Ring.

The camera features a manually adjustable focusing mechanism, allowing the user to control the sharpness of the image by focusing the lens on the object of interest.

Figure 1 Camera TEA

2.2. Technical Specifications

2.2.1 Maximum Resolution

It allows you to capture images with a high level of detail.

2.2.2 Frame Rate (FPS)

Up to 60 FPS (frames per second), depending on the selected resolution and system capacity.

2.2.3 Video format:

MJPEG or other compression formats as supported by the software.

2.2.4 Connection Interface

USB 2.0 or USB 3.0, for different bandwidth requirements.

2.2.5 Operating System Compatibility

Windows 10/11, Linux y macOS.

Figure 2 Technical specifications

3. INSTALLATION AND CONFIGURATION

3.1. Prerequisites

Before proceeding with the installation, make sure you have the following:

3.1.1 Compatible PC or Laptop

Make sure the computer has an available USB port and is capable of handling the required workload (for example, Core i5 processor or higher, 8 GB RAM minimum).

3.1.2 S Compatible Operating System

Verify that the operating system is supported by the camera drivers (for example, Windows 10/11, some Linux distributions, or macOS).

3.1.3 Administrator Privileges

Administrator permissions will be necessary to install the software and drivers correctly.

3.2. Physical installation

3.2.1 Camera Mount:

- Place the camera on a stable support using the appropriate tripod or mounting accessory.
- Make sure the camera is facing the inspection area at an angle that maximizes visibility.

3.2.2 USB Cable Connection:

- Insert the camera's USB connector into a USB port on your computer. The camera should be recognized automatically if the drivers are installed.

3.3. Software and Driver Installation

1. **Download Theia system Software:**

Go to the official ARVision website and click on "**Downloads"**.

2. **Instalation:**

A. Connect the camera to the computer and make sure it is recognized in the Tea Vision Control software.

Figure 3 Devices

B. In the "Devices" section, verify that the camera appears as a connected device.

C. Run as administrator "**setup.exe"** downloaded from the official website ARVision.

D. In the case of not having the dependence of "**SQL Server 2019 Express LocalDB**" installed we press the button "**Accept**".

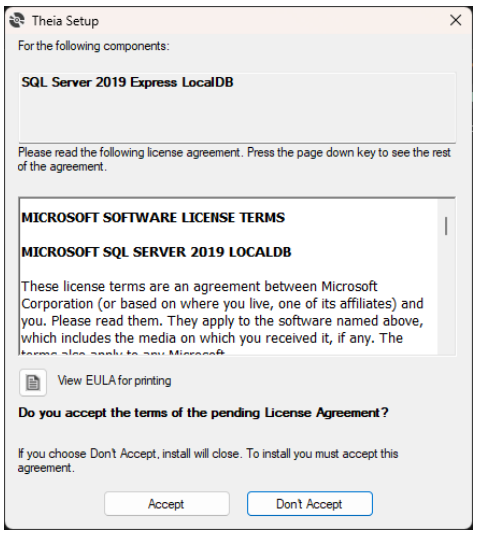


Figure 4 Instalation

- We press the button “**Next**”.

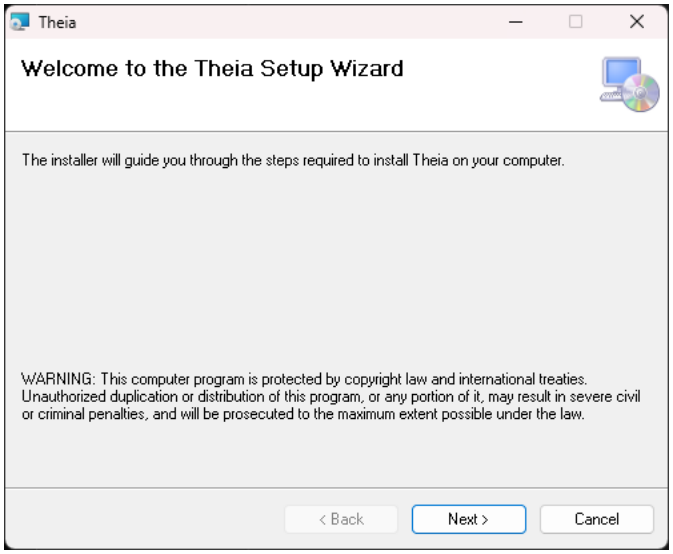


Figure 5 Press NEXT

- Here the user chooses the location where the application will be installed and the reach to the computer users and we press the button “**Next**”.

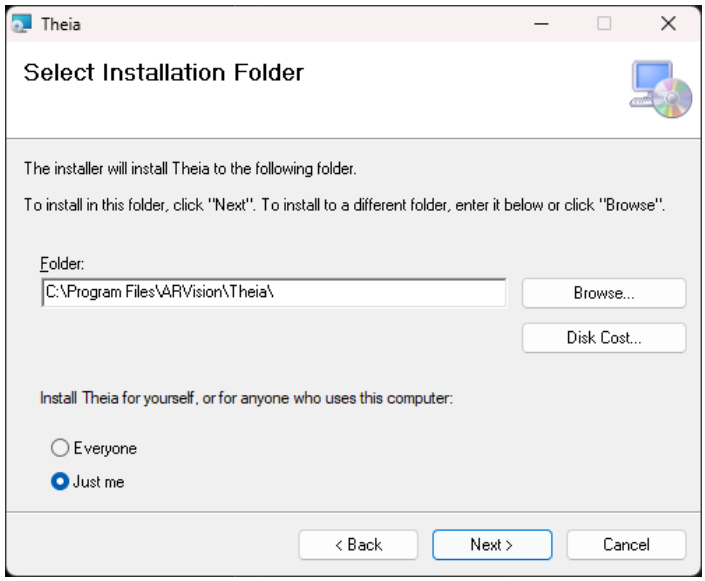


Figure 6 PC users and press NEX

- Here, press the button “**Next**” to begin with the installation

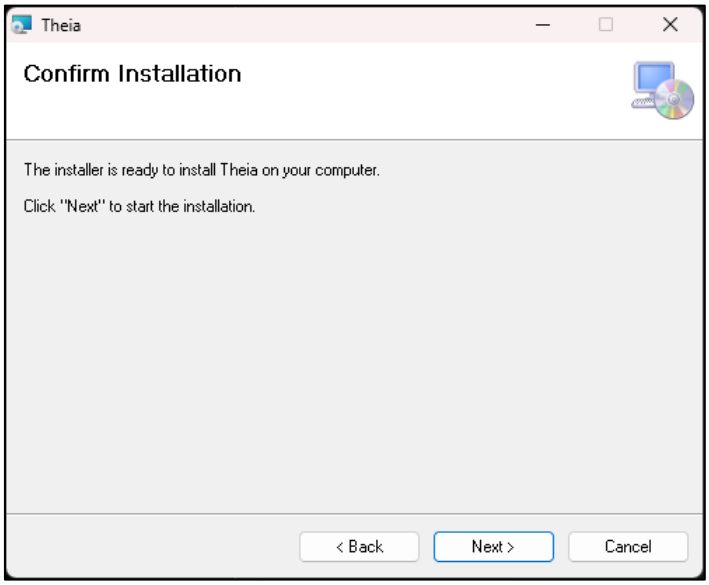


Figure 7 Press NEXT

- Wait a few seconds, to finish the installation

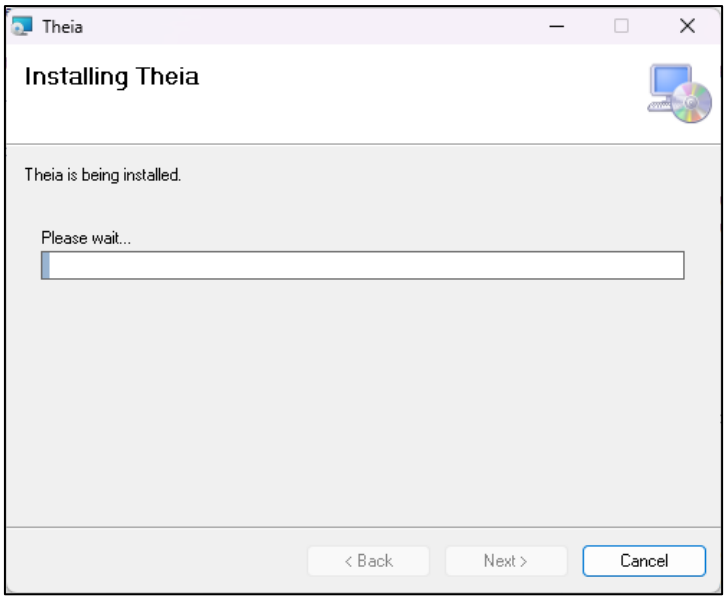


Figure 8 Wait for the installation to finish

- When the installation is finished, press the button **“Close**”

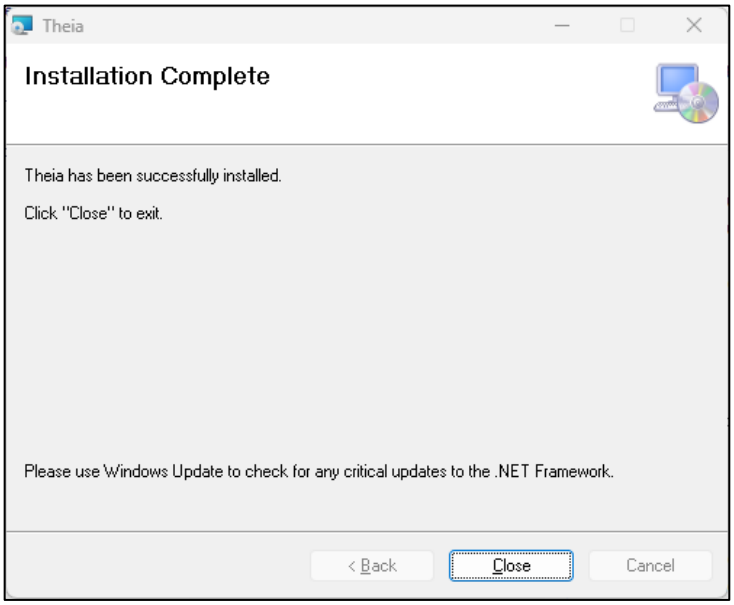


Figure 9 Press CLOSE

4. CONFIGURACIÓN DEL SOFTWARE

4.1. User Interface

The Theia system interface is divided into:

4.1.1 Production

Shows what the cameras are evaluating with the inspection and pre-training tool.

Figure 10 Production screen - Part 1

1. Name of the running camera previously registered.
2. Chart showing inspection and result.
3. Area where inspections recorded by camera are grouped.
4. Running camera phalanx detection area.
5. Button that activates or deactivates phalanx detection.
6. Real-time video of running camera.
7. Phalanx detection time captured by the camera.
8. The highlight time of phalanx detection.
9. Button that resets the highlighted time of phalanx detection.

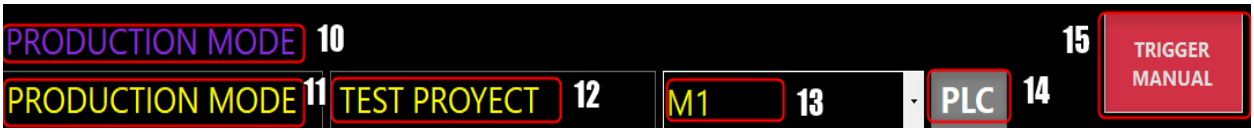


Figure 11 Production screen - Part 2

10. Inspection status message in production window.
11. Status of the application at that moment.
12. Name of the inspection project in progress.
13. List of model of the running project.
    - Here the user can choose the model he wants to inspect.
14. PLC connection indicator.
15. Button to manually inspect the selected model.

4.1.2 Project Panel

Where inspection projects are managed (name training models, cameras).

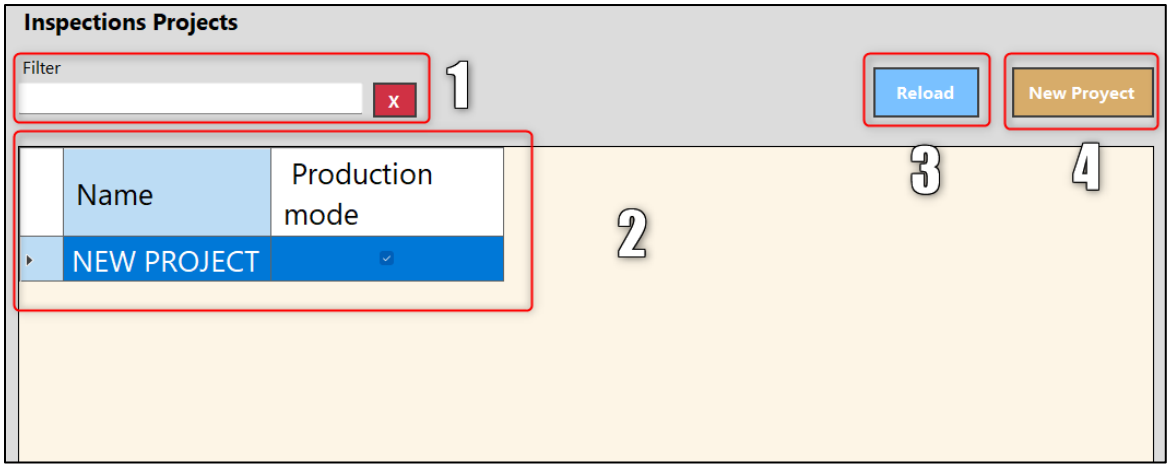


Figure 12 Inspection Projects

1. Filter to search for projects.
    - Here the user can write the name of the project for faster searching.
2. Table of saved projects.
3. Button to reload projects.
4. Button to create a new project.

4.1.3 Project Settings

Project configuration section.

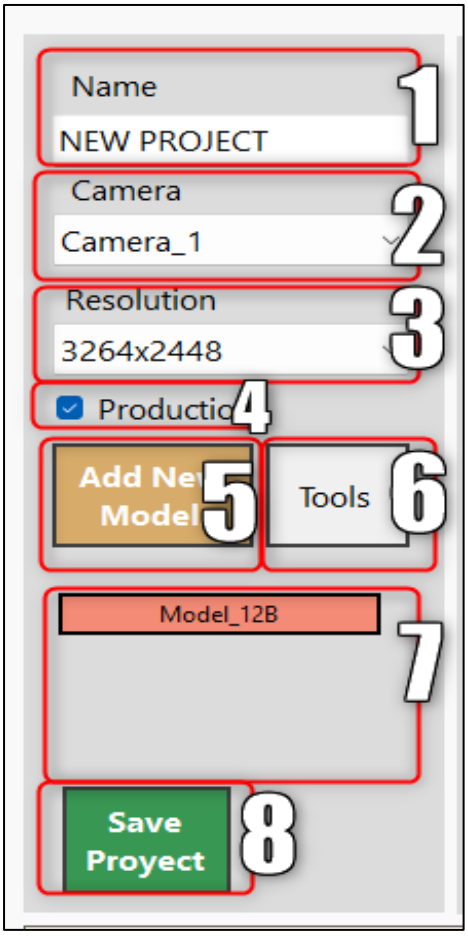


Figure 13 Project settings

1. Project name field.
    - Here the user will define the name of the project.
2. List of registered cameras of the project.
    - Here the user can choose the camera with which they wish to register inspections.
3. List of resolutions supported by the camera.
    - Here the user can define what resolution the camera that will be used in the project can have.
4. Indicator showing whether to run alongside the application.
    - Here the user marks the project so that when the application starts it loads this project.

5. Button to add the model to the project.

6. Button to hide or show learning tools and filters.
7. Area where the registered models of the project are viewed.
8. Button to save project changes.

4.1.4 Camera Manager

Allows you to select the resolution and add an alias for the vision project.

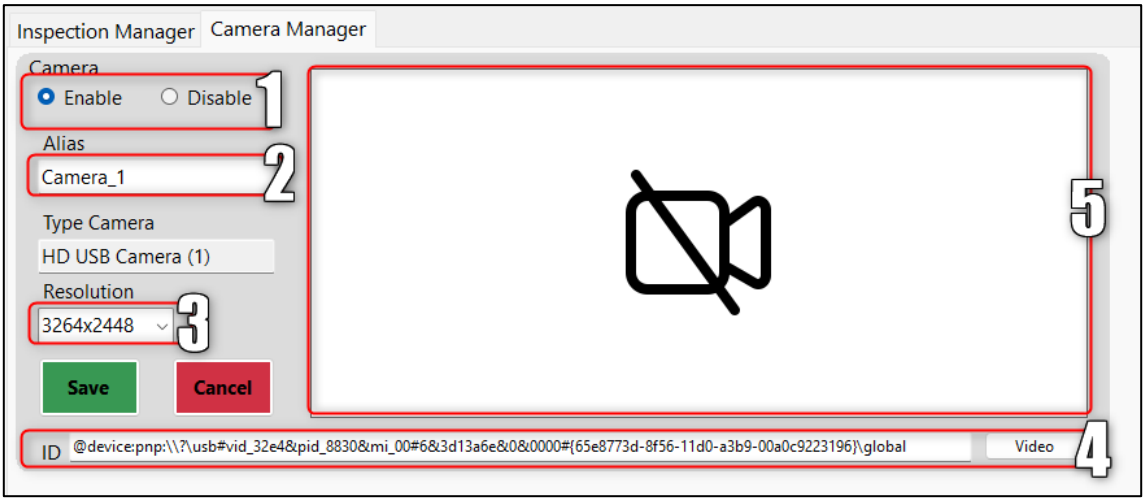


Figure 14 Camera manager

1. Camera status indicator.
    - Here the user disables the camera.
2. Field to add an alias to the camera.
    - Here the user defines the short name of the camera for easy selection in the project.
3. List of resolutions supported by the camera.
    - Here the user can choose the resolution supported by the camera.
4. Camera ID.
5. Video from camera running.

4.1.5 Regions of Interest Definition Area (ROI).

It allows you to select specific areas within the field of view for detailed analysis.

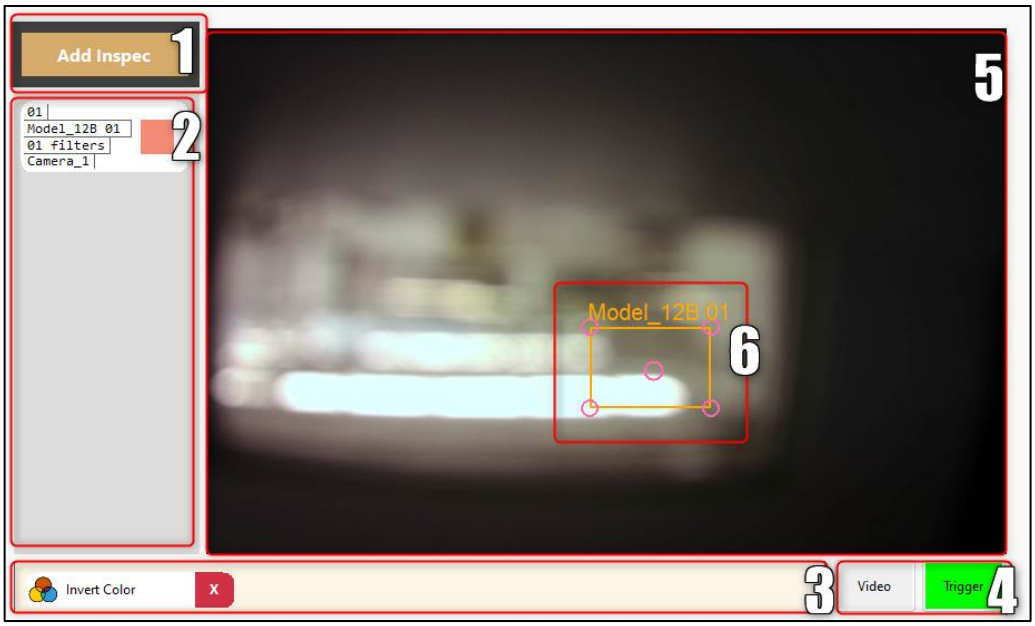


Figure 15 Regions of interest definition area

1. Button to add an inspection to the model.
2. Area of inspections recorded in the model.

- Here the user can choose the inspection that needs to be trained or adjusted.

3. Area of filters applied by inspection.

- Here the user can delete filters applied to inspections.

4. Camera operation mode (trigger or video) for project settings.

- Here the user can choose between the mode of how the camera is viewed, trigger (photo) or video (continuous video).

5. Area showing running camera video.
6. Registered model inspection region of interest.

- Here the user can modify the area of interest, size and location.

4.1.6 Image Treaty

Allows you to apply a filter to the region of interest for better training.

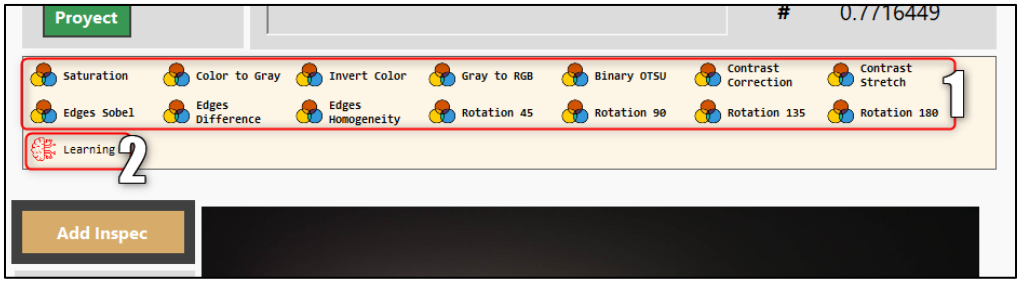


Figure 16 Treaty of images

1. Group of image processing filters applicable to the area of interest.

   Here the user can apply any of the filters to the inspection, for example: colors, rotation, image highlight, etc..

2. Learning tool.

   Here the user activates the object recognition tool.

4.1.7 Inspection Tool

Artificial vision tool already pre-trained with object and pattern recognition.

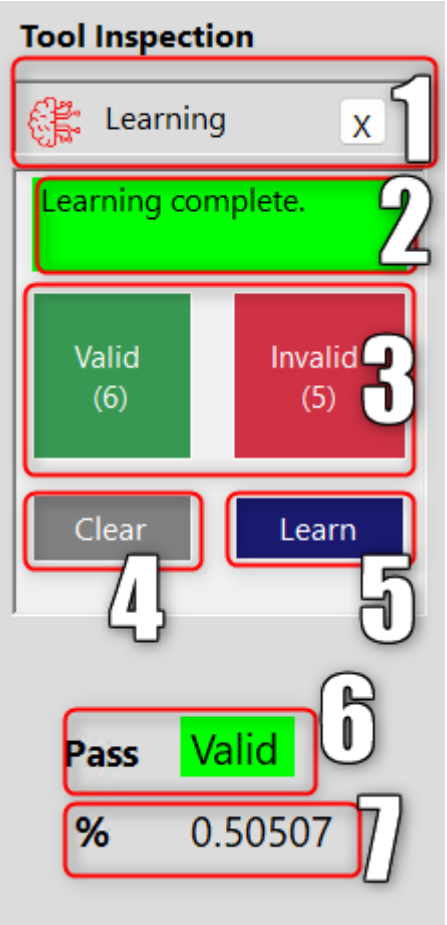


Figure 17 Inspection tool

1. Machine vision tool type name
2. Machine vision status message
    - Here it shows the learning status of the AI (in training, complete learning)
3. Valid and invalid buttons to classify photos.
    - Here the user presses the valid button when the image is correct and invalid when it is not.
4. Button to clear learning.
    - When pressed removes all inspection learning
5. Button to view saved photos.
    - When you have the necessary images, press so that the system starts classifying photos.
6. Learning test result

7. Confidence percentage of the result

4.1.8 Administrator

The password of users registered in the application is managed.

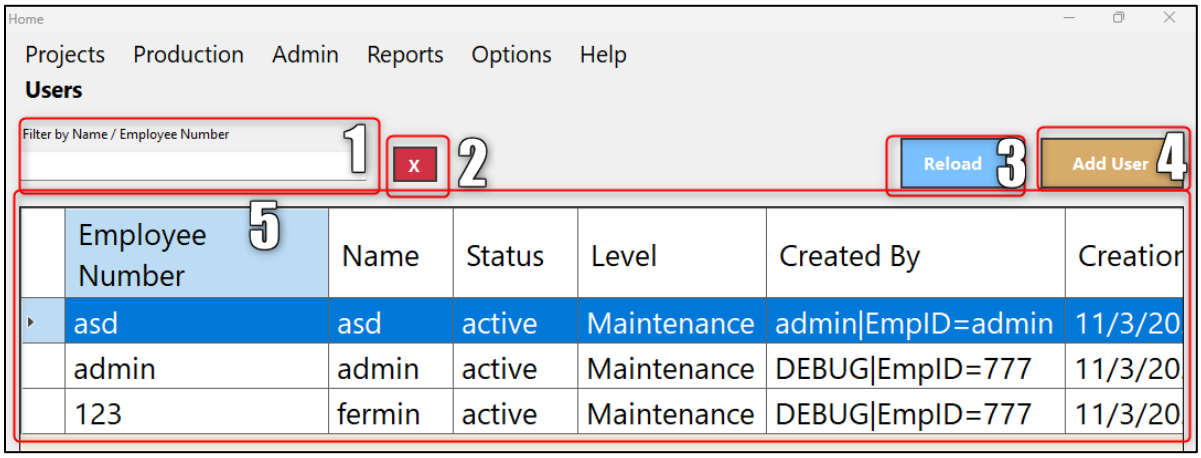
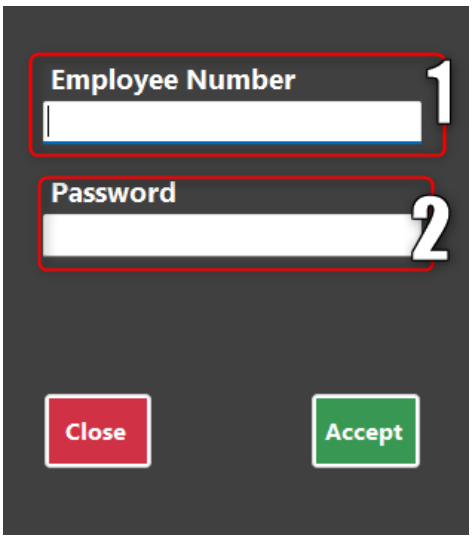


Figure 18 Manage registered users

1. User finder by employee number and name in table.
    - Here the user can enter by employee number or name for search in the table.
2. Button to clear the table browser.
3. Button to update user table data.
4. Button to add a new user to the application.
5. Table of registered users in the application.



NOTA: The first account is

- 1. Employee Number: **Admin**
- 2. Password: **Admin**

4.1.9 New user registration

1. Field to enter the user name.
    - User can define the name.
2. Field to indicate the user's status
    - Here the user can activate or deactivate a user.
3. Field to enter the employee number.
    - Here the user can define the employee number.
4. Account access level.
    - Here the user can rate the new user.
5. Field to enter the user's password.
    - Here the user can define the password for the new user.
6. Button to save changes to the database.
7. Button to cancel actions and changes.

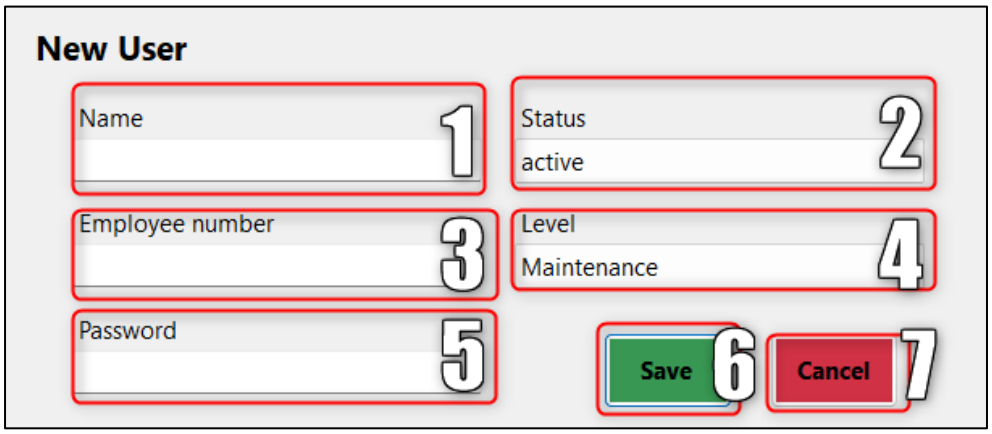


Figure 19 New user

4.1.10 Reports

Application activity monitor (modification, training, inspection report).

4.1.10.1 Hand detection time reports

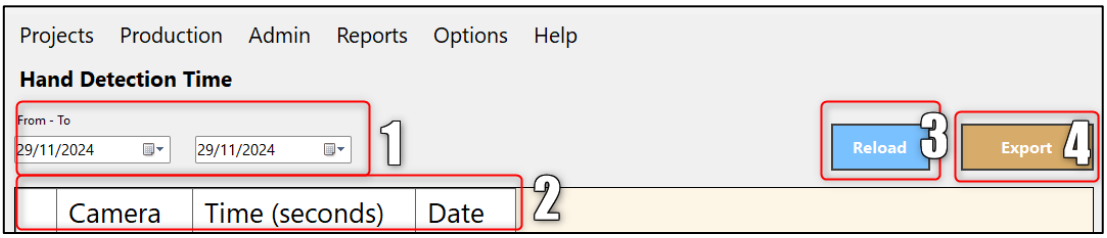


Figure 20 Hand detection time report

1. Phalanx detection table date filter for your search.
    - Here the user can define a range for filtering reports.
2. Report table for the detection of phalanges recorded in the table.
3. Button to update table data.
4. Button to export the table report

4.1.10.2 Inspection results reports

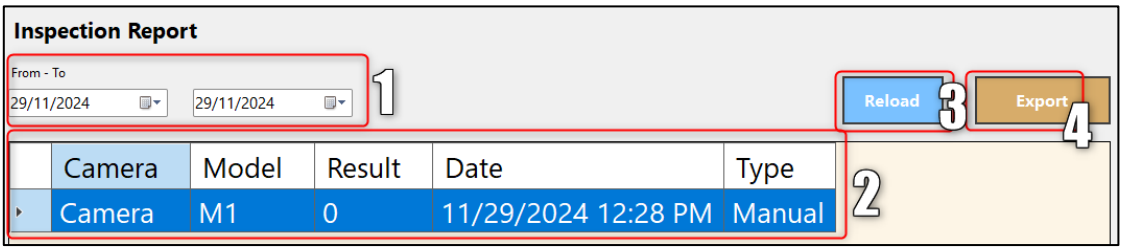


Figure 21 Inspection results reports

1. Inspection table date filter for your search.
    - Here the user can define a range for filtering reports.
2. Inspection results reporting table.
3. Button to update table data.
4. Button to export the table report.

4.1.10.3 Application activity reports

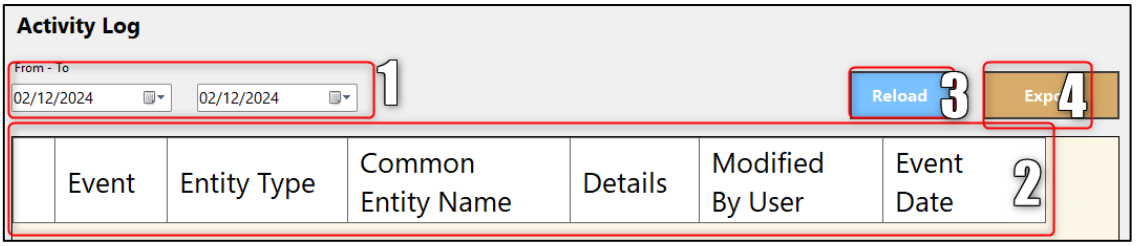


Figure 22 Activity report

1. Application Modifications Activity Table Date Filter for Your Search.
    - Here the user can define a range for filtering reports.
2. Report table of application modification activities.
3. Button to update table data.
4. Button to export the table report.

4.1.11 Settings

1. Field to configure the PLC IP address.
   - Here the user can define the IP address of the PLC for communication with the application.
2. Button that returns the PLC IP address to the default.
3. Button to save or not save the activity reports in memory
4. Button to save or not save the inspection reports in memory.
5. Button to save or not save the hand detection reports in memory.
6. Field to add the machine cycle time for inspection calculation.
   - Here the user defines the machine cycle time to calculate the communication times with the PLC.
7. Button to save application settings to internal memory

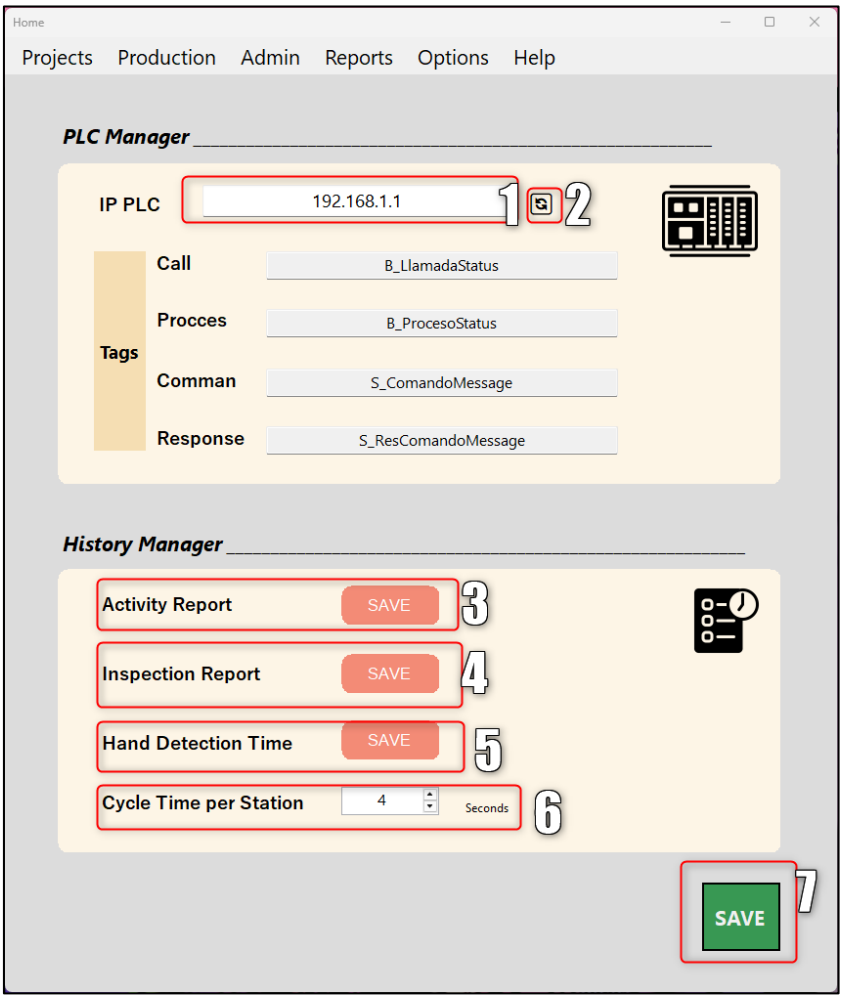


Figure 23 Settings

4.2. Initial Configuration

4.2.1 Image Parameter Adjustment

1. **Light:** Adjust these values to optimize the visibility of details in the image.
2. **Exposure:** Controls the amount of light captured by the camera to avoid images that are too bright or dark.

4.2.2 Manual Focus Settings

1. **Focus:** Turn the ring to sharpen your subject. Use the viewer to verify.
2. **Aperture:** Adjust the ring to control the light:
    - Wide aperture for low light and blurred background.
    - Closed aperture for greater sharpness and depth.
3. **Clarity:** Rotate to adjust sharpness and contrast to desired details.
4. **Test and Adjustment:** Take a test photo and fine-tune the rings if necessary.

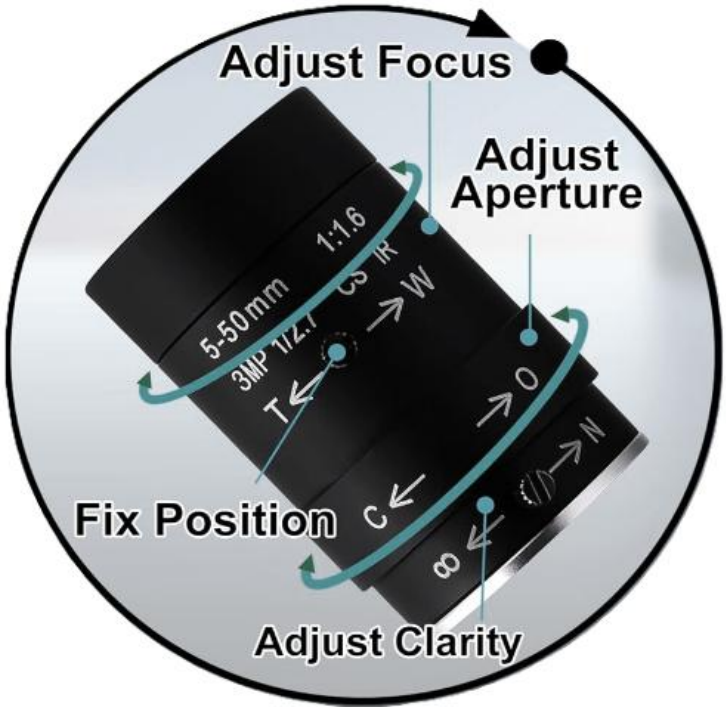


Figure 24 Manual focus

4.2.3 Program settings (Theia system)

1. Theia system application is launched.

2. Enter "**New Proyect**".

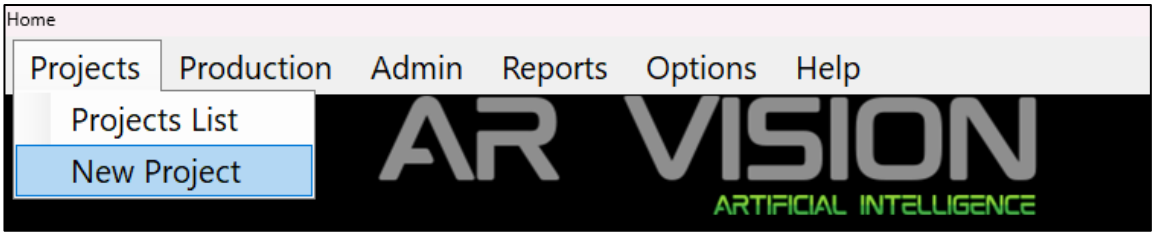


Figure 25 New proyect

3. Shows the number of Tea cameras with their settings, serial number, supported resolutions.

4. In the "Alias" field, write the name with which the camera will be registered in that project and press the "Save" button.**"**

5. Enter the tab "**Inspection Manager".**

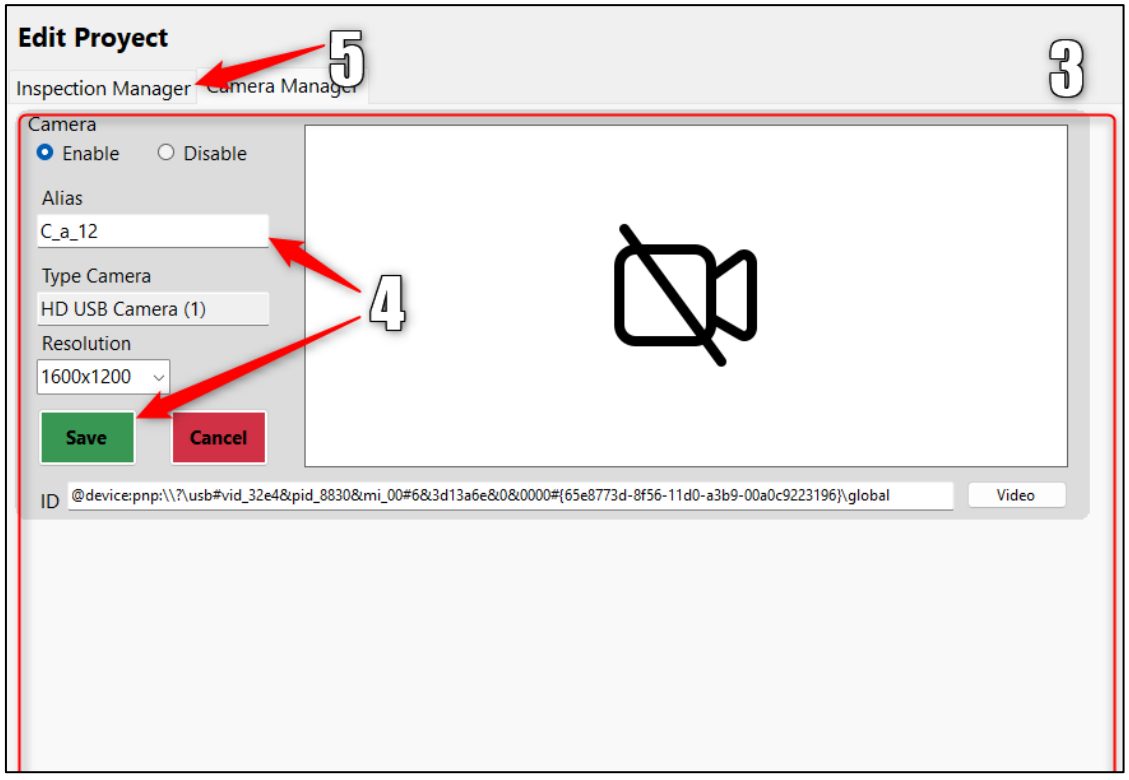


Figure 26 Camera Configuration 1

6. In the field of “**Name”** enter the project name.

7. Choose the camera you are going to work with “**Camera”**.

8. If you want the application to start with a project already preloaded in the production window, we enable the check “**Producction”**.

9. We press the button “**Add New Model”.**

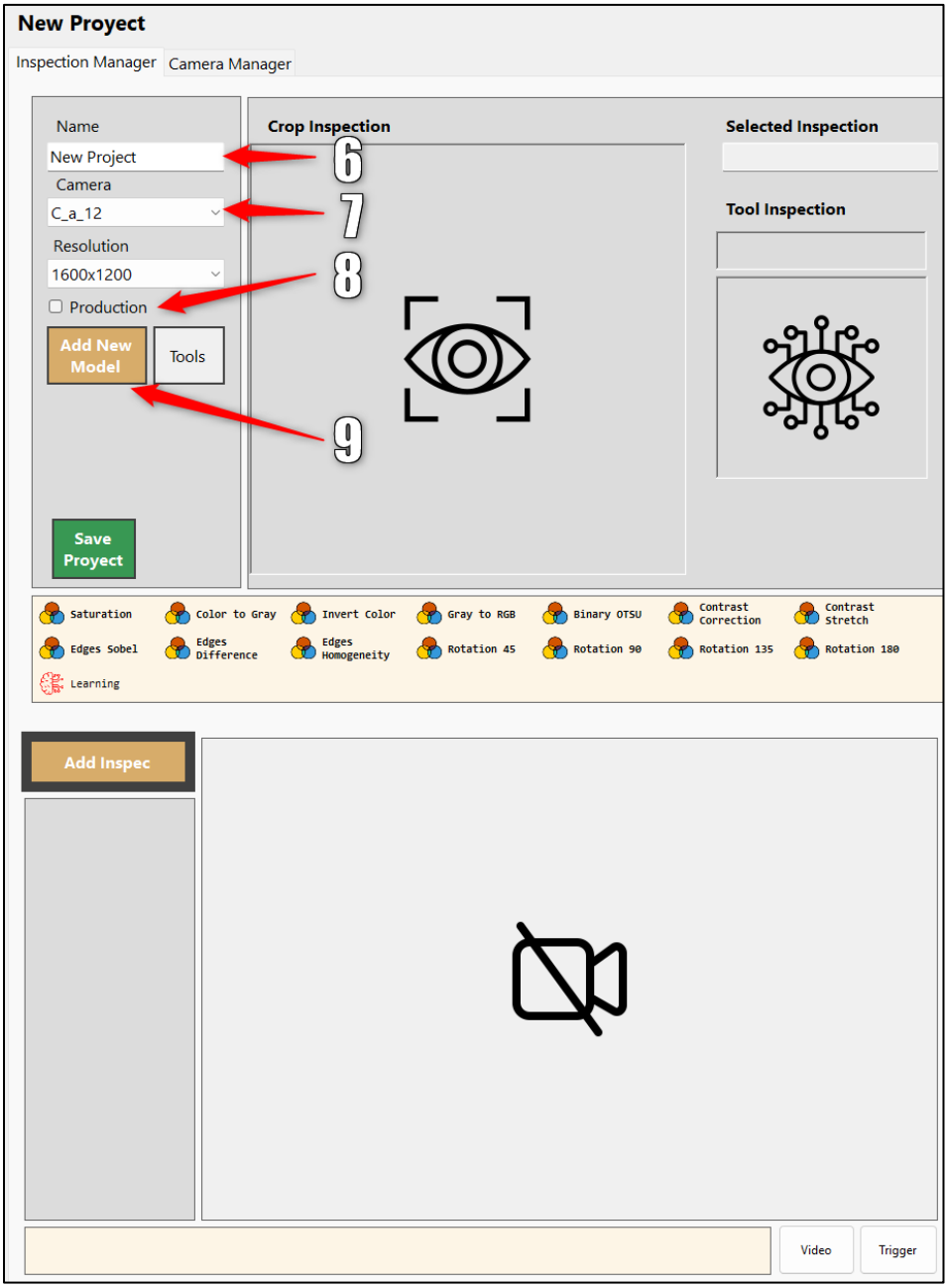


Figure 27 camera configuration

10. In the field “**Model Name”** enter the name of the model to be inspected and then in “Accept”, a model will be created in the models area.

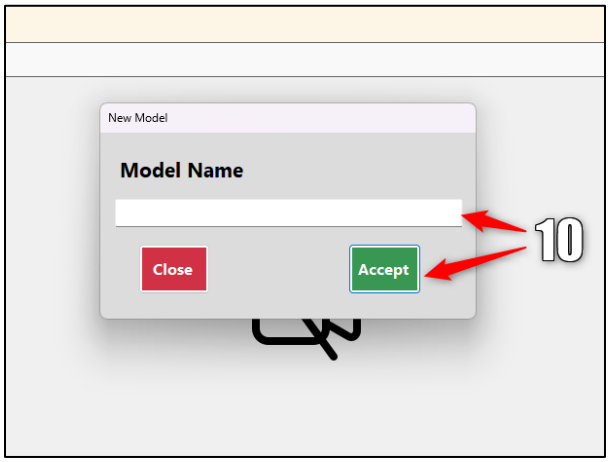


Figure 28 Model registration

11. Press the created model “m1_qwe0” the camera will start to start creating the inspections.

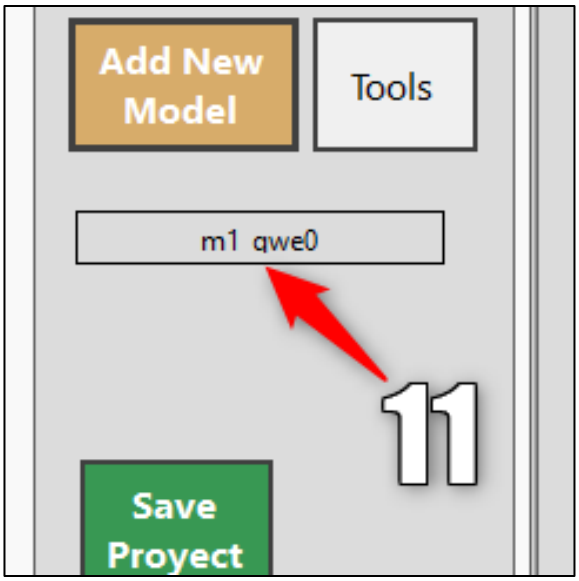


Figure 29 Press the created model

12. We press the “Add Inspec” button and an inspection will be created with the name of the model followed by a number “m1_qwe0 01”.

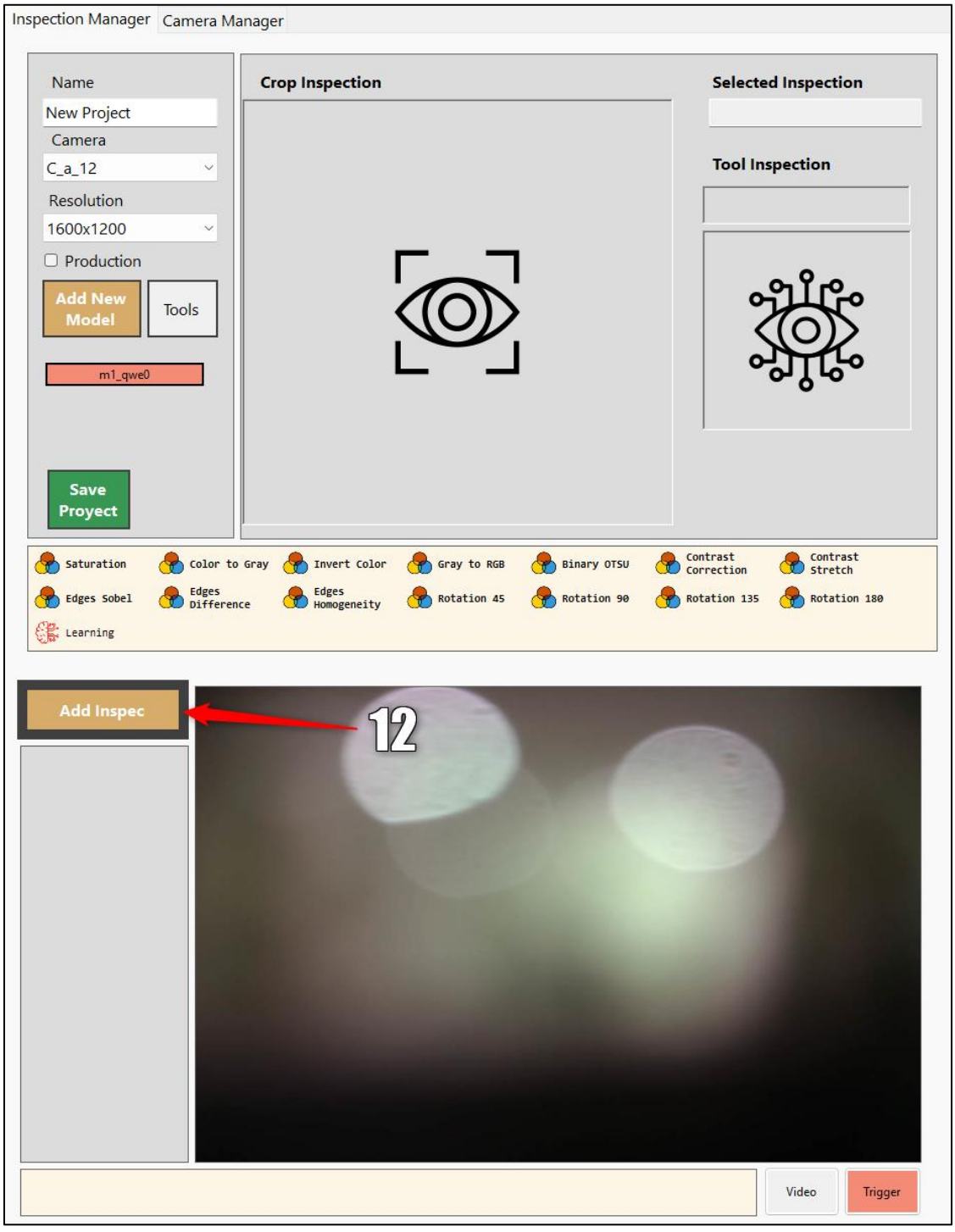


Figure 30 Press button “Add Inspec”

13. We press the inspection “m1_qwe0 01” and a delimited area will be created in the camera preview.

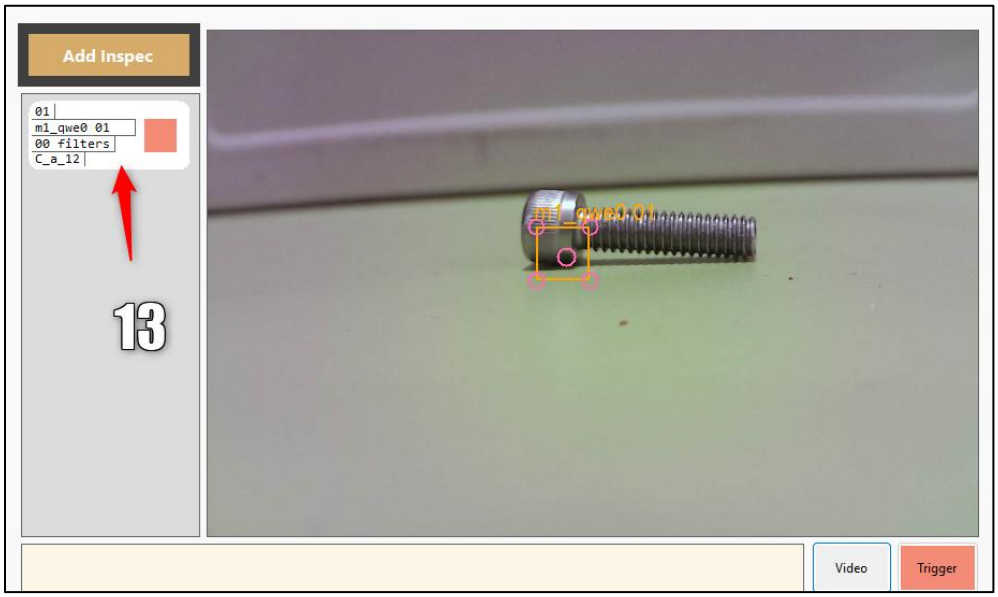


Figure 31 Press the added model and create the bounded area

14. An orange delimiter is generated with the name of the inspection and the ends can be resized to change the area of interest. There are two buttons at the bottom to run in “Video” mode for continuous images or “Trigger” mode for a single photo.

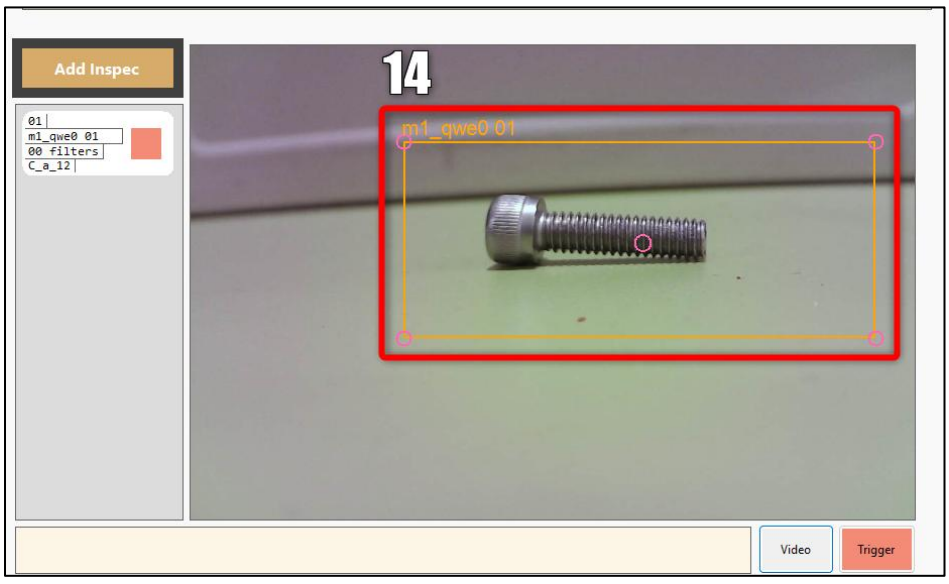


Figure 32 Delimiter orange color

15. In the filter area we choose the necessary filters to highlight the characteristics necessary to identify the difference, an invert color filter and the “Learning” learning tool will be added.

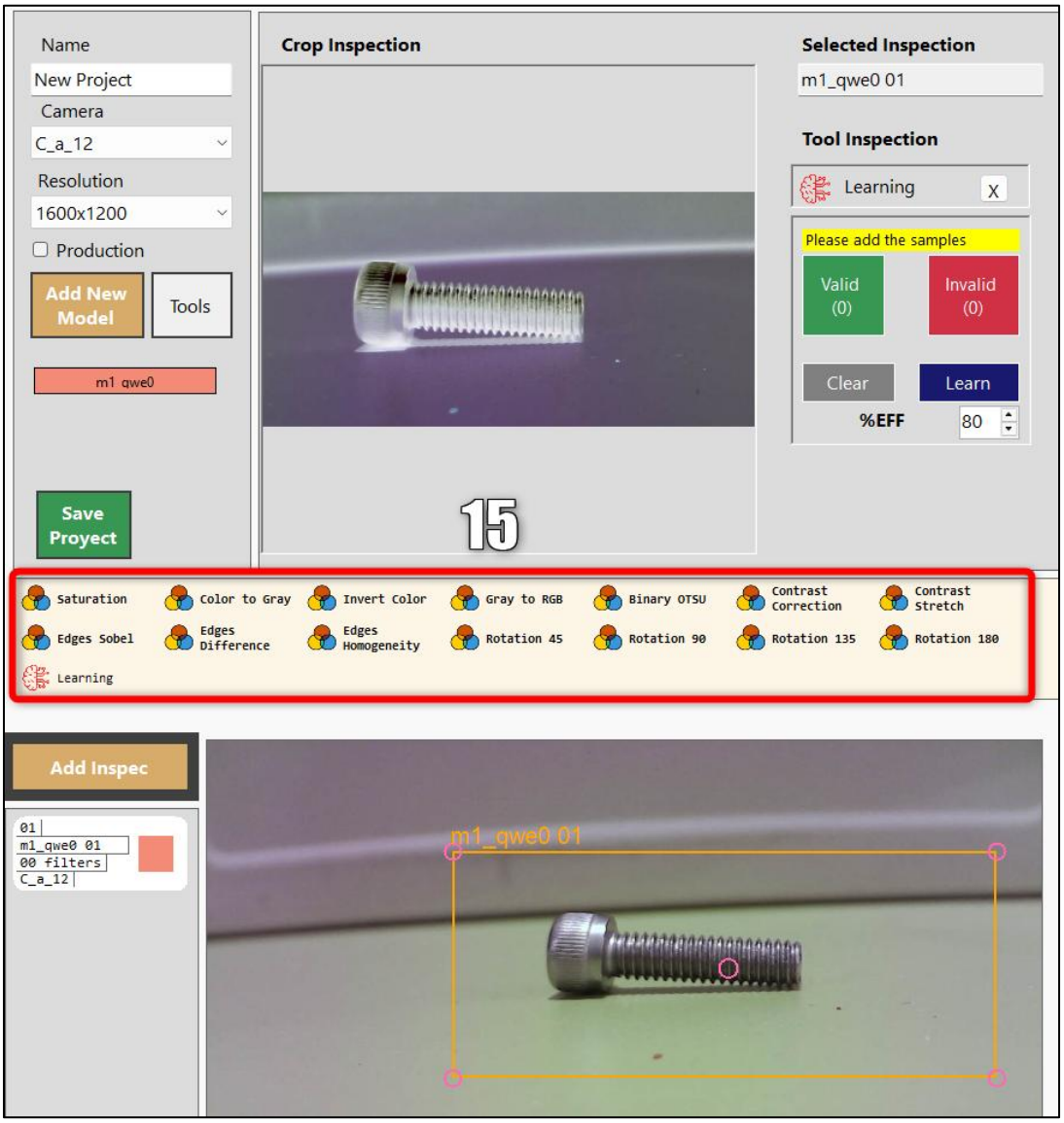


Figure 33 Highlight filter

16. Artificial vision configuration tool will be added to be trained.

17. If the image shown in “Crop Inspection” is the desired one in the tool, press the “Valid (0)” button to validate the image, otherwise if it is incorrect, press the “Invalid (0)” button. At least 5 “Valid (5)” and 5 “Invalid (5)” are necessary for it to learn the general differences and press the “Learn” button to save the learning

18. A valid or invalid indicator will appear in the “Pass” part and the confidence level in “**%”**.

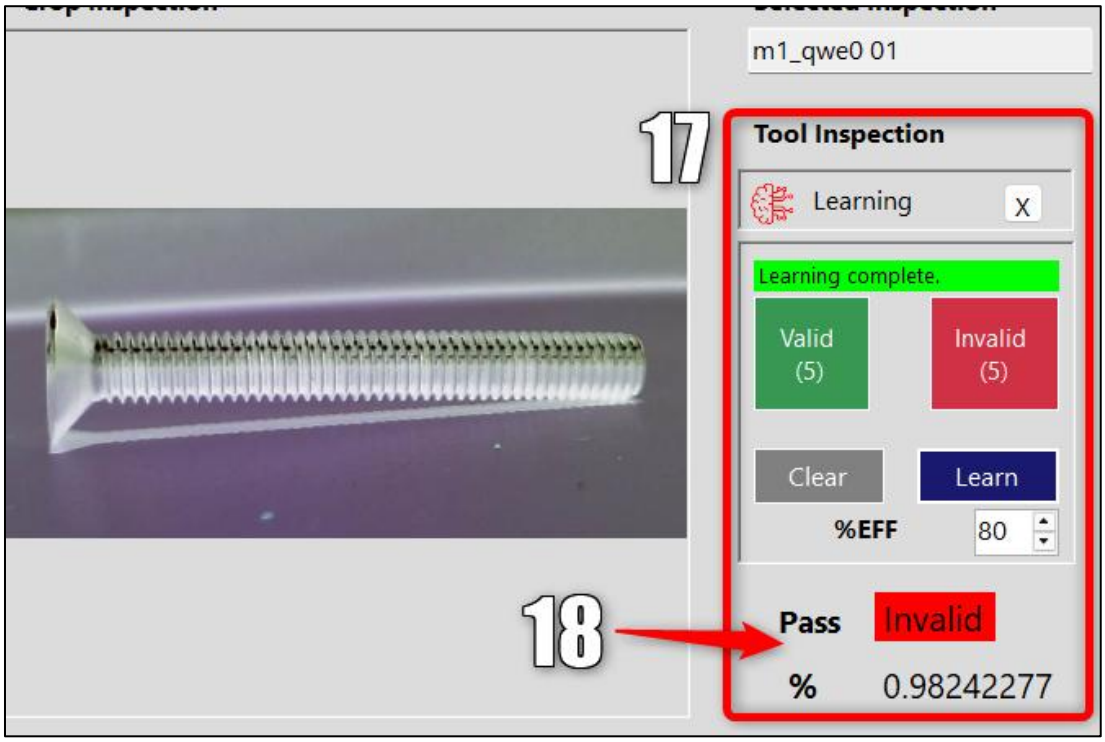


Figure 34 Model configuration

19. When we are sure that the inspection is correctly trained, we press the “Save Project” button to save the saved inspections and adjustments and activate the production mode in “Production” – “Production Mode”.

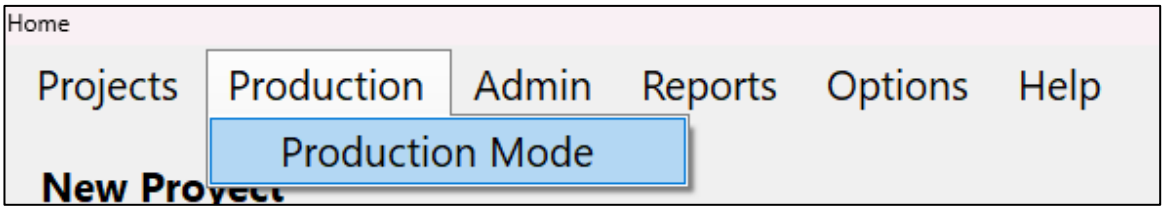


Figure 35 Save project

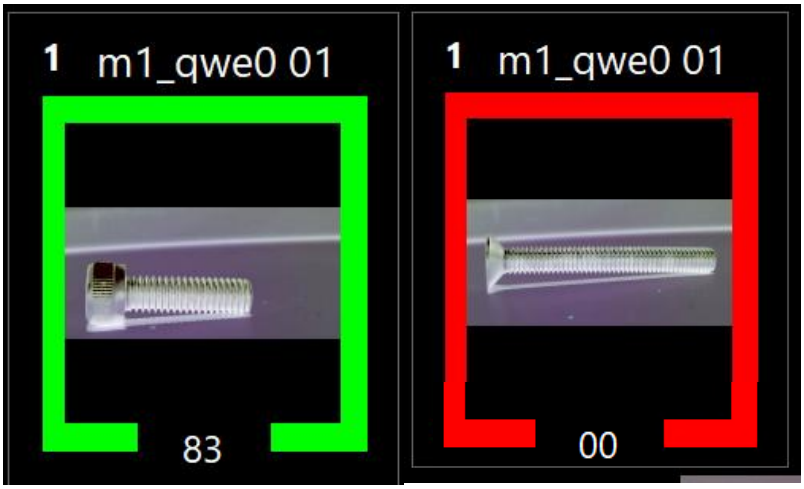
20. The production mode will be loaded where you can see the inspection that we delimited next to the hand detector in inspection.

Figure 36 inspection detector

21. To test the connection with the PLC, the “PLC” indicator on the screen will turn green when it is synchronized, otherwise it will remain gray.

22. To perform an inspection, the PLC sends the inspect command so that the application inspects or manually using the “MANUAL TRIGGER” button**”.**

23. The inspection will be painted green when it is valid or red when it is invalid and at the bottom it shows the percentage of accuracy or security of the A.I.



accuracy	
Valid	100%
	90%
	80%
	70%
	60%
Invalid	50%
	40%
	30%
	20%
	10%
	0%

5. IMAGE PROCESSING

5.1. Basic Analysis Tools

A. Dimension Measurement

Use calibration tools to accurately measure distances or.

B. Edge and Contour Detection

Uses algorithms to highlight the boundaries of objects in the image.

C. Pattern Recognition and OCR

Implements pattern detection or character recognition (OCR) for advanced applications.

5.2. Filters and Preprocessing

A. Noise Reduction

Apply smoothing filters to remove unwanted artifacts.

B. Sharpness Adjustment

Improves fine details in the image.

6. SOLVING COMMON PROBLEMS

6.1. Connection Problems

A. Check the USB Cable

Make sure the cable is not damaged and is connected correctly.

B. Driver Update

If the camera is not recognized, update or reinstall the drivers.

6.2. Poor Image Quality

A. Adjust Manual Focus

Turn the ring until you get the best possible sharpness.

B. Lighting Conditions

Improve lighting in the inspection area if necessary.

6.3. PC to PLC communication problems.

- Check network cable connection in the control cabinet.
- Verify that the computer's IP address is within the range.
- Verify that the IP address of the PLC in the application is correct.

The application and the PLC have indicators to know if the computer can communicate with the PLC and vice versa.

7. MAINTENANCE

This section describes the maintenance recommendations.

7.1. Preventive maintenance.

7.1.1. Cleaning the chamber (daily recommended)

A. Use a microfiber cloth for the lens and avoid abrasive products

B. Be careful not to miscalibrate the camera lens or the focus and distance rings. In the case of miscalibration, calibration is mandatory to have a more precise inspection.

7.1.2. Regular inspection.

7.1.2.1 External connections:

- Check that all external cables (power, monitor, keyboard, mouse, etc.) are connected securely.
- Check that there are no extreme cuts, peels or bends in the cables.

7.1.2.2 Ports:

- Inspect the computer ports (USB, HDMI, Ethernet, etc.) to make sure they are not damaged or dirty.
- Final Recommendations

If you find any damaged cables, replace them immediately.