Getting started (en)

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MiR AI Camera

Copyright and disclaimer

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Table of contents

1. About this document

This document describes how to install and use your MiR AI Camera. It provides the information about the following topics:

- Mounting your MiR AI Camera.
- Training the camera to identify certain objects.
- Setting up your camera with MiRFleet
- Product presentation

1.1 Document history

This table shows latest and previous versions of this document and their interrelations with product software releases.

Revision	Release date	Description	SW	HW
1.0	2017-11-27	First edition.	2.0.2	1.0

1.2 Where to find more information

At www.mir-robots.com, several additional resources are available. To access more information, sign in to the Distributor site with your distributor account at http://www.mobile-industrial-robots.com/en/account/. The following relevant resources are available:

- **Distributor site > Manuals**
  http://www.mobile-industrial-robots.com/en/account/manuals/
  This page contains the following resources:
  - **Robot Quick starts**
    The short guide that lets you start operating the robot quickly. This document is in the box with the robot in the printed format. Available in multiple languages.
  - **Robot User guides**
    The user guide of the robot. Available in multiple languages.
  - **MiRFleet Reference guide**
    The reference guide that describes the elements of the MiRFleet interface. Available in multiple languages.

  - **MiRFleet REST API reference.**
    The REST API reference for MiRFleet.
- **Distributor site > Download**
  http://www.mobile-industrial-robots.com/en/account/download/
  This page contains the following resources:
  - **CAD drawings.**
    Select **Show CAD-files** to see the list of available CAD drawings.
  - **Certificates.**
    Select **Show Certificates** to see the list of certificates for the robot.
- **Distributor site > How to**
  http://www.mobile-industrial-robots.com/en/account/how-to/
  This page contains how-to articles that describe how to perform specific tasks with MiR products.
- **Distributor site > Troubleshooting**
  https://www.mobile-industrial-robots.com/en/account/troubleshooting/
  This page contains troubleshooting guides to solve common issues with MiR products.
- **MiR AI Camera product page**
  http://www.mobile-industrial-robots.com/en/products/mir-add-ons/mir-ai-camera
  This page contains specifications, pictures, and brochures for MiR AI Camera.

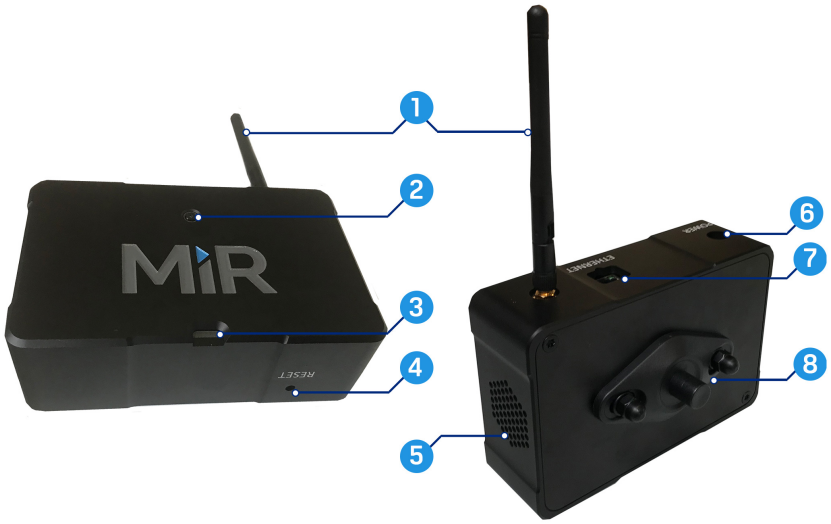
2. Product presentation

MiR AI Camera is intended to be used to improve the flow of MiR robots. It provides MiRFleet with additional information that it can use to guide MiR robots more effectively for example, by initiating missions when carts are ready to be transported or by avoiding sending robots through obstructed, narrow doorways and into crowded areas.

In MiRFleet, the camera is set up to trigger a specific action when the camera detects a certain object. The actions can either be the initialization of a fleet mission or locking a Limit-robots zone.

2.1 External parts

Figure 2.1 identifies the external parts of MiR AI Camera.



2.1. External parts of MiR AI Camera.

Number	Description	Number	Description
1	WiFi antenna	2	Camera lens
3	Indicator light	4	Reset button
5	Ventilation	6	Power socket
7	Ethernet port	8	Mount connector

To reset the camera, you must hold down the Reset button for ten seconds.

2.2 MiRFleet and operating requirements

The MiR AI Camera is a product that must be connected to MiRFleet to be used as intended. The list below describes the requirements for being able to use MiR AI Camera with your MiRFleet. Some of these points are only applicable if you choose to use a WiFi connection to the camera instead of Ethernet.

- Your MiRFleet must be configured to use a host network interface. This is the default configuration for MiRFleet.
- MiR AI Camera should be in the same physical location as MiRFleet.
- Minimum bandwidth of 1 Mbit per AI camera with a maximum latency of 150 mS.
- Signal strength not less than -75 dBm. Signal-to-noise ratio should be at least 20 dB.
- MiRFleet must be updated to a software that supports MiR AI Camera.
- MiR AI Camera performs best in well lit areas.

2.3 Light indicator

The light indicator on MiR AI Camera is used to provide feedback on its current status. *Table 2.1* describes the status linked to the various colors.

Color	Status
White	Busy, such as updating or starting up.
Yellow	WiFi setup mode active, waiting for network connection.
Green	Connected to network, but with no uploaded data model. The light blinks when changing to this state.
Red	Error, such as connection errors. The light blinks when changing to this state.
Cyan	Object detection mode active.
Dark blue	Collection mode active.

2.1. Light indicator color statuses

3. Getting started

This section describes suggested use and how to get started with MiR AI Camera.

3.1 In the box

This section describes the content of the MiR AI Camera box.

The box contains:

1. MiR AI Camera
2. Wall mount
3. WiFi antenna
4. Power supply
5. Installation guide for MiR server

3.2 Suggested use

It is important before installing MiR AI Camera to consider what you aim to use it for. This section describes some of the possible uses of MiR AI Camera, and where it should be mounted in each case.

MiR AI Camera is intended to be used to monitor a delimited area. It is important that the area of interest is within the field of view and line of sight of the camera. It is recommended to focus only on a localized area. It is not recommended to install a camera that views the entire work area where people or machinery are performing multiple tasks and are in constant motion.

Make sure to mount your camera in a well lit area with stable lighting conditions. Changing lighting conditions may affect the performance of MiR AI Camera negatively.

MiR AI Camera improves the work flow of MiR robots by triggering an action when it detects a specific object. An action can either be the initialization of a fleet mission or locking a Limit-robots zone, so no MiR robots may enter. It is important to consider which action should be linked to which detected object, and reflect if the mounted position of the camera is ideal for it. The following examples may provide insight into what MiR AI Camera should be used for.

Preventing blockages in narrow doorways

Two MiR AI Cameras can be mounted on each side of a narrow doorway to monitor incoming traffic. If a camera detects an incoming object or person, MiRFleet is alerted and

temporarily locks the area in the narrow doorway. This prevents MiR robots from obstructing the doorway for incoming traffic and avoids MiR robots attempting to pass an obstructed doorway. Instead, MiR robots wait at a reasonable distance to allow the other object or person through first.

If a MiR robot is already in the narrow doorway, MiR AI Camera will not make the robot stop in the middle of the doorway when it locks the doorway area.

MiR AI Camera can also be configured only to lock the doorway area after detecting certain objects. For example, if the doorway is large enough to allow a person and robot through at the same time, it should be considered only to set MiR AI Camera to lock the area if carts or other robots are approaching the doorway.

Autonomously initiating robot missions

MiR AI Camera can be mounted to focus on an area where the presence of a specific object triggers a fleet mission. This can, for example, be used at any pick-up and drop-off position where, if the object is detected, a MiR robot will arrive and transport the object to a drop-off point. It is important in this case that the position occupies most of the camera's field of view. This is to avoid the camera detecting the object of interest in other positions and initializing a mission even though the object is not necessarily placed on the pick-up position.

3.1. In this example, MiR AI Camera is focusing on a loading rack. In the first image, the camera detects nothing in its field of view. In the second image, it has detected a crate and initiates a mission to send a robot over to pick up the crate.

This example can also be applied to carts, shelves, and pallets where the camera is focused on a cart position, shelf position, or a pallet rack. It is also possible to use other types of missions as long as the mission trigger is an object that MiR AI Camera can identify easily in a designated area.

Foreseeable misuse

The following list includes examples where MiR AI Camera is not intended to be used:

- Monitoring heavily trafficked areas.
- Functioning as a surveillance camera.
- Identifying specific persons.
- Controlling a MiR robot or other automated mobile robots remotely.

3.3 Mounting and powering up MiR AI Camera

This section describes how to mount MiR AI Camera.

It is recommended to read through Suggested use on page 8 before mounting MiR AI Camera.

Figure 3.2 identifies the key parts of the camera mount. There are two identical mounting plates. One plate is mounted to the camera, and the other plate should be mounted to the surface you would like the camera to be fixed to. It is possible to detach or twist the plates by loosening the fastening bolts identified in *Figure 3.2*.

3.2. Parts of the AI camera mount.

Number	Description	Number	Description
1	Adjustable bending joint	2	Mounting holes
3	Fastening bolts	4	Mounting plate

To mount MiR AI Camera follow the steps below:

1. Detach the camera mount from the MiR AI Camera if they are not already separated.
2. Place camera mount in the position you want the MiR AI Camera to be mounted. Make sure the mounting plate is placed flat against the surface.

The camera mount is adjustable, so you can always adjust the orientation of the camera after fixing the camera mount.

3. Mark the position of the mounting holes on the wall, ceiling, or other structure that you would like to mount the camera to. Remove the camera mount.
4. Drill holes into the surface at the marked positions of a suitable size for M4 screws. Consider using wall plugs for a more secure mounting.

5. Place the camera mount back in the desired position, so the mounting holes align with the drill holes in the wall. Screw the M4 screws into the wall to fix the camera mount in place.
6. Fix MiR AI Camera to the camera mount. Tighten the bolt at the end of the mount, and ensure that the camera is fastened securely.
7. Adjust the angle of the camera so it is oriented in the correct direction. You must loosen up the bolts in the mounting pieces to adjust the orientation.
8. Plug in the power cable to turn on the AI camera. It may take up to a minute for the camera to turn on. The indicator light will light up in white when the camera is starting up.
9. Once the light turns yellow, the camera is ready to be connected to a network. There are two options for connecting MiR AI Camera to your MiRFleet network:
   - Connect the camera to a nearby Ethernet port that is connected to the same network that MiRFleet is on.
   - Screw in the WiFi antenna and continue to the next section for instructions on connecting the camera to the network.

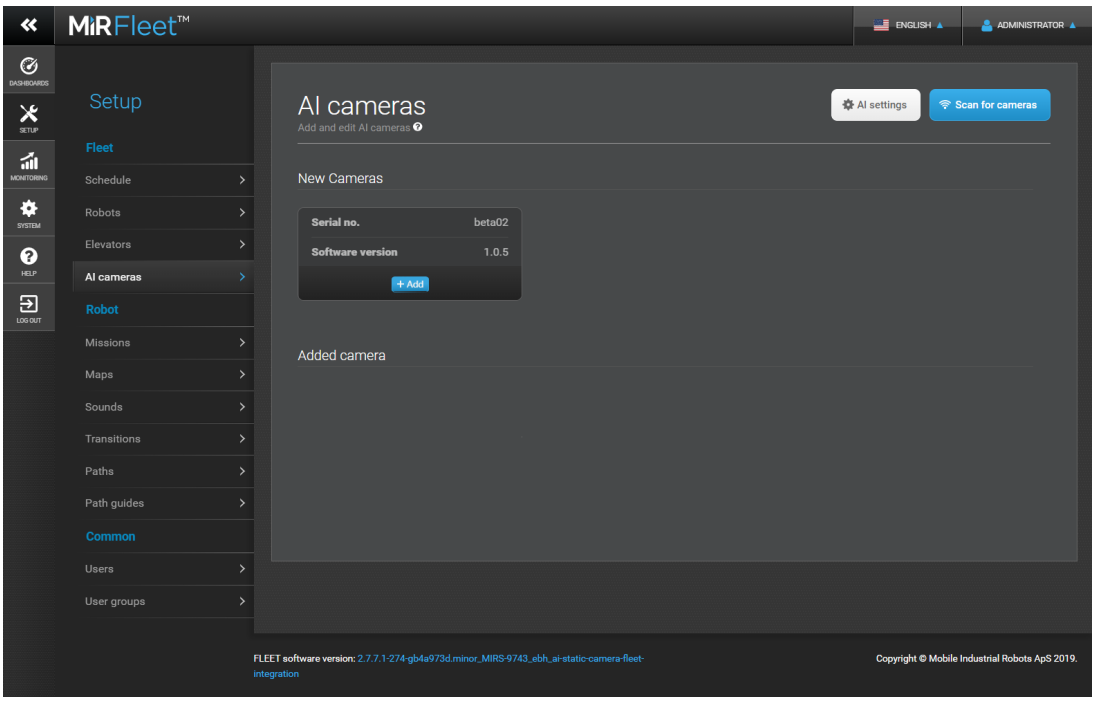
3.4 Connecting to MiR AI Camera

It is possible to connect to the MiR AI Camera directly using an Ethernet cable or wirelessly through WiFi.

Connecting through Ethernet

Connect MiR AI Camera to the same network as your MiRFleet using an Ethernet cable. Check that MiRFleet has connected to the camera by signing into MiRFleet and going to **Setup > AI cameras**. Your AI camera should appear under **New cameras**. It can take a little

time for MiRFleet to detect the camera.



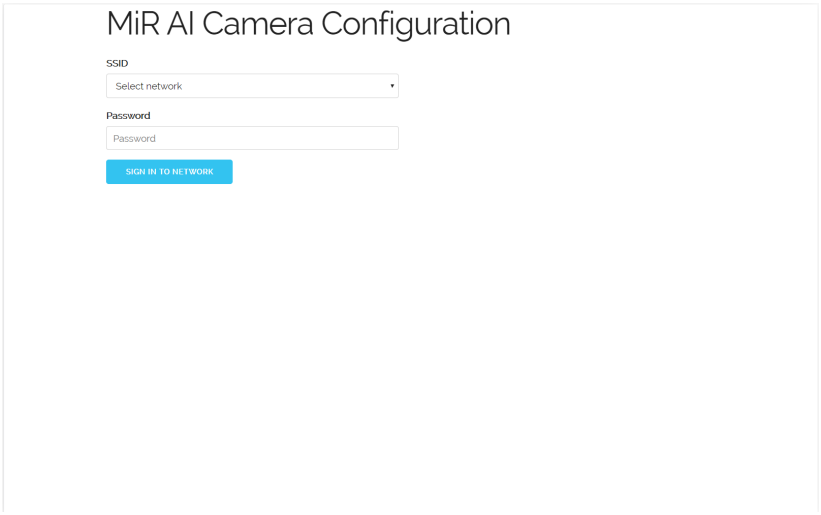
Connecting through WiFi

If your camera is mounted in a position that does not enable you to connect it to the network through Ethernet, the following steps describe how to connect through WiFi instead.

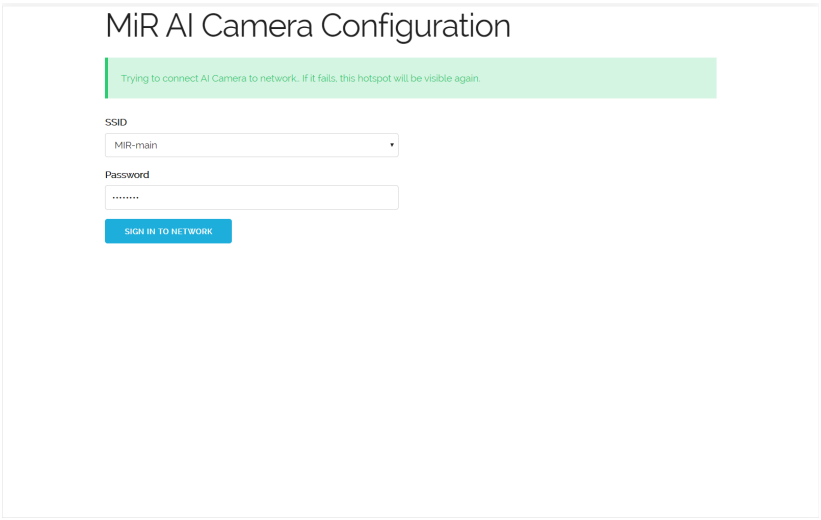
1. Turn on your MiR AI Camera. If the WiFi antenna is mounted, MiR AI Camera creates a WiFi hotspot, and the indicator light changes to yellow.
2. On your own device such as a laptop or tablet, connect to the camera's WiFi. It is named in the format: **MIR_AI_CAMERA_XXXX.**

If you cannot connect to MiR AI Camera, try to reset the camera by holding down the Reset button for ten seconds.

3. Once connected to the WiFi, open a browser and go to **camera.mir-robots-ai.com**.

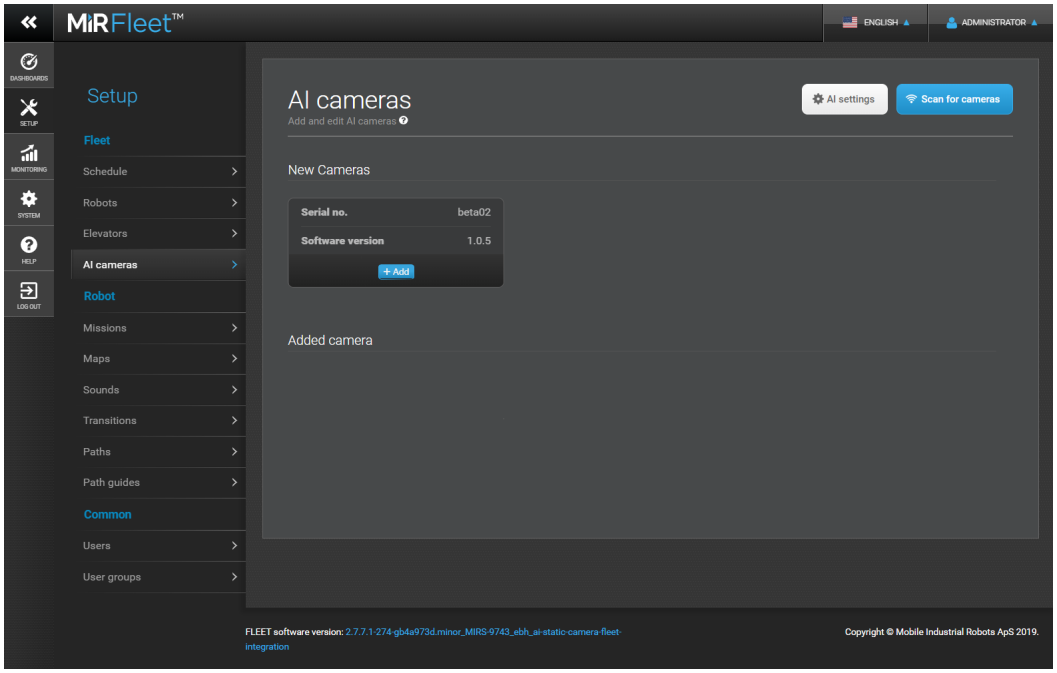


4. Select the WiFi network that your MiRFleet is connected to. Enter the WiFi password to connect the camera to the network.



5. When the camera is connected to the same network as MiRFleet the indicator light changes to green. The AI camera hotpot vanishes, and the camera is now available in the MiRFleet interface.

6. Check that MiRFleet has connected to the camera by signing into MiRFleet and going to **Setup > AI cameras**. Your AI camera should appear under **New cameras**. It can take a little time for MiRFleet to detect the camera.



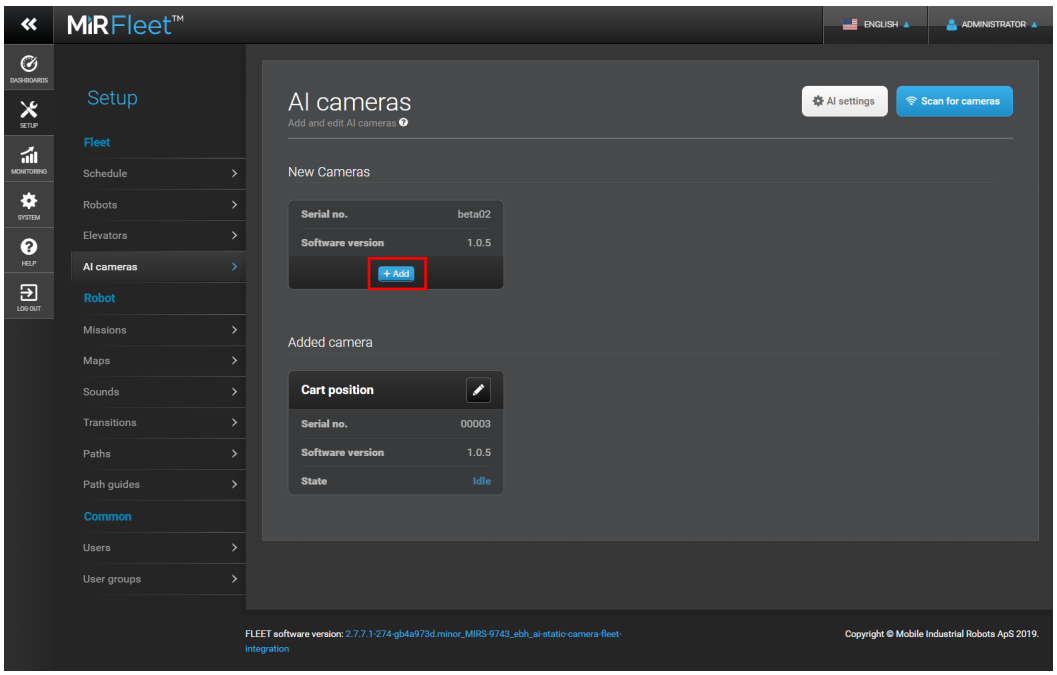
3.5 Adding cameras to MiRFleet

The process of adding cameras to MiRFleet is similar to adding robots to MiRFleet. The following steps describe how to add a new MiR AI Camera to the fleet.

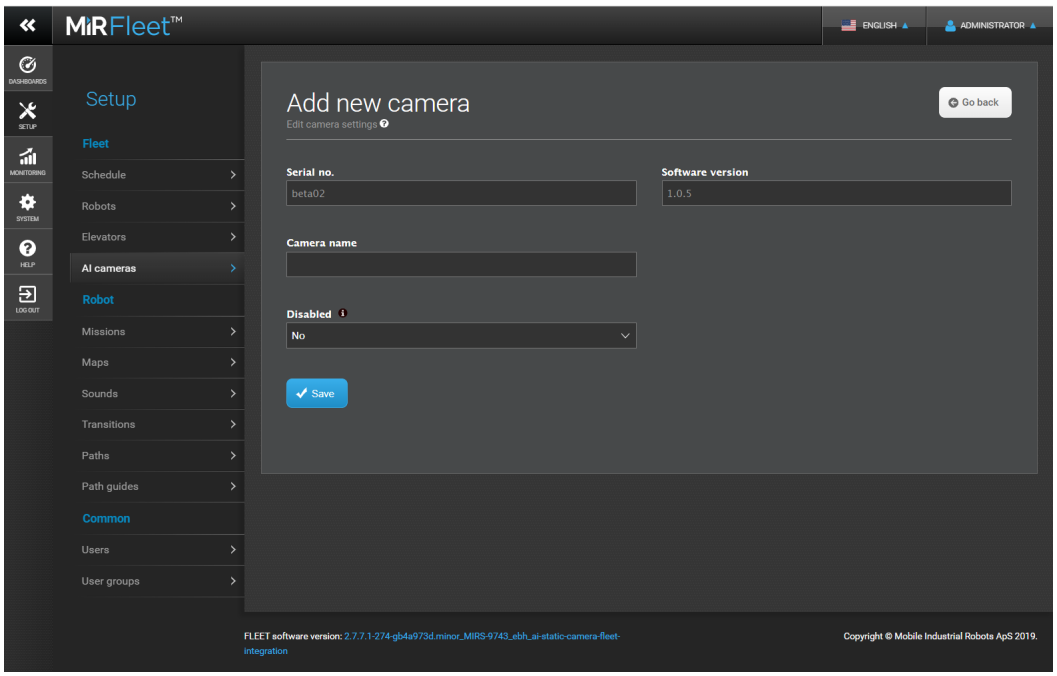
Make sure your MiRFleet is updated to a software version that supports MiR AI Camera and is using a host network interface configuration. See MiRFleet and operating requirements on page 7.

1. Sign in to MiRFleet, and go to **Setup > AI cameras**.
2. If your new camera is not available, select **Scan for cameras**. All new cameras added to the network should appear under **New cameras**.

3. To add the camera, select **Add**.



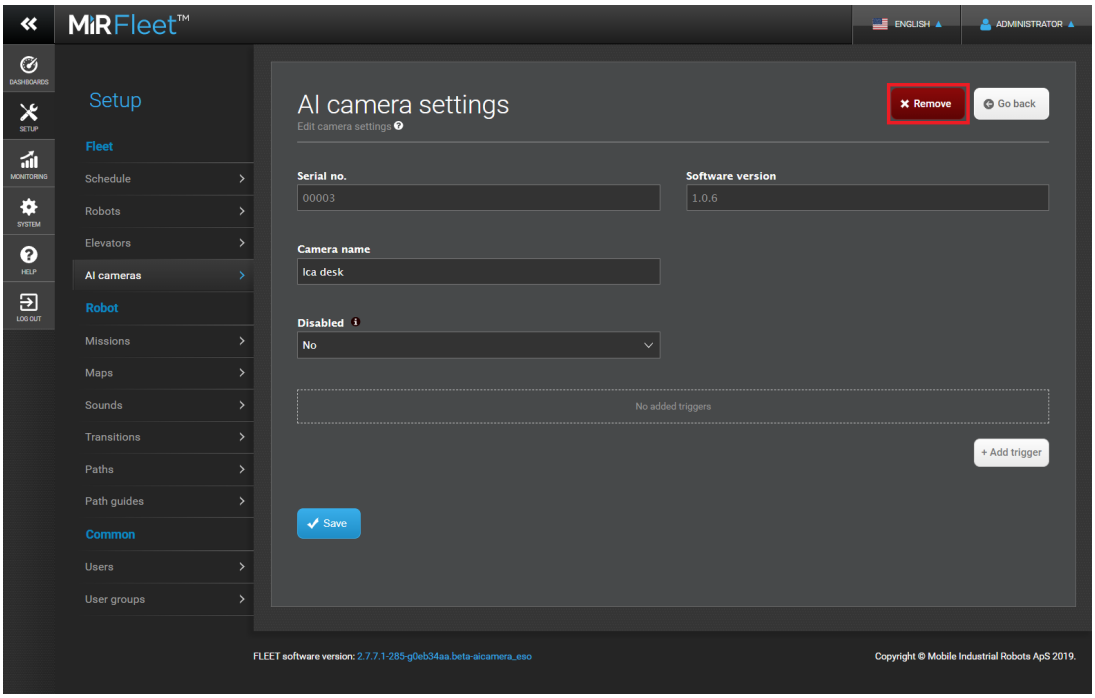
4. In the displayed page, it is possible to see the MiR AI Camera's serial number and software version. You are also able to edit the camera's name and activate the camera. It is recommended to name the cameras based on their position or function, such as *Hallway* or *Cart pickup*.



5. Select **Save** when you are done.

You can also remove cameras from MiRFleet after adding them. This is done by going into the camera's settings page and selecting **Remove**.

> **NOTICE**
>
> When you remove an AI camera from MiRFleet, the AI camera is automatically factory reset.



4. Comissioning

This section describes how to train MiR AI Camera to detect certain objects and setup which actions should be triggered when the camera detects specific objects. There are four main phases included in the training of MiR AI Camera:

1. **Collection phase**
   Sample images are collected autonomously by the AI cameras. These are required for training the AI camera.
2. **Pre-processing phase**
   Objects in the collected images are detected and framed. Images containing similar objects are clustered into a groups.
3. **Validation phase**
   You must label the collected images based on the detected object in the image, and only select images with accurate framing.
4. **Training phase**
   Based on the validated images, MiR AI Camera is trained to detect future observations of the labeled objects.

4.1 Collection phase

For MiR AI Camera to detect specific objects, it must first be trained using a collection of sample images of those objects. The objects you would like the camera to be able to detect are referred to as target objects. Each camera autonomously collects the necessary images over an eight hour period, optimally while the work area is in operation. In other words, do not leave the camera to collect data after work hours or in a time span where it is not intended to be used.

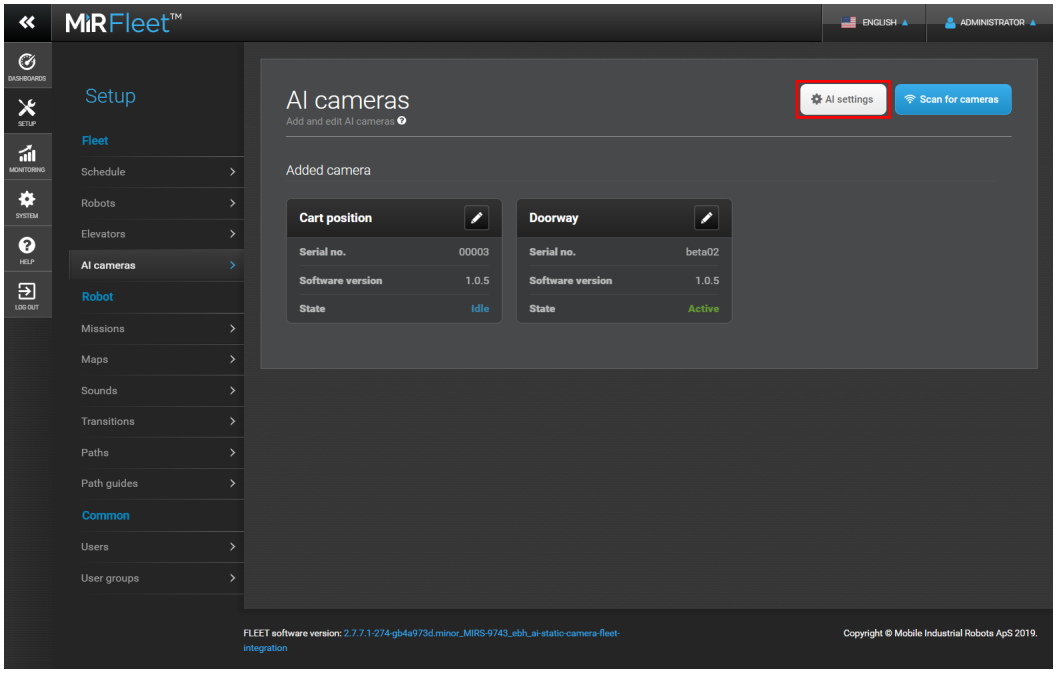
It is important that you gather images of objects where they are alone in the camera's field of view. It is less efficient to train MiR AI Camera when there are multiple target objects in the images.

When the cameras are set to collection mode, all cameras connected to the fleet are set to record images whenever they detect motion. It is important during the collection phase that the desired target objects enter the camera's field of view.

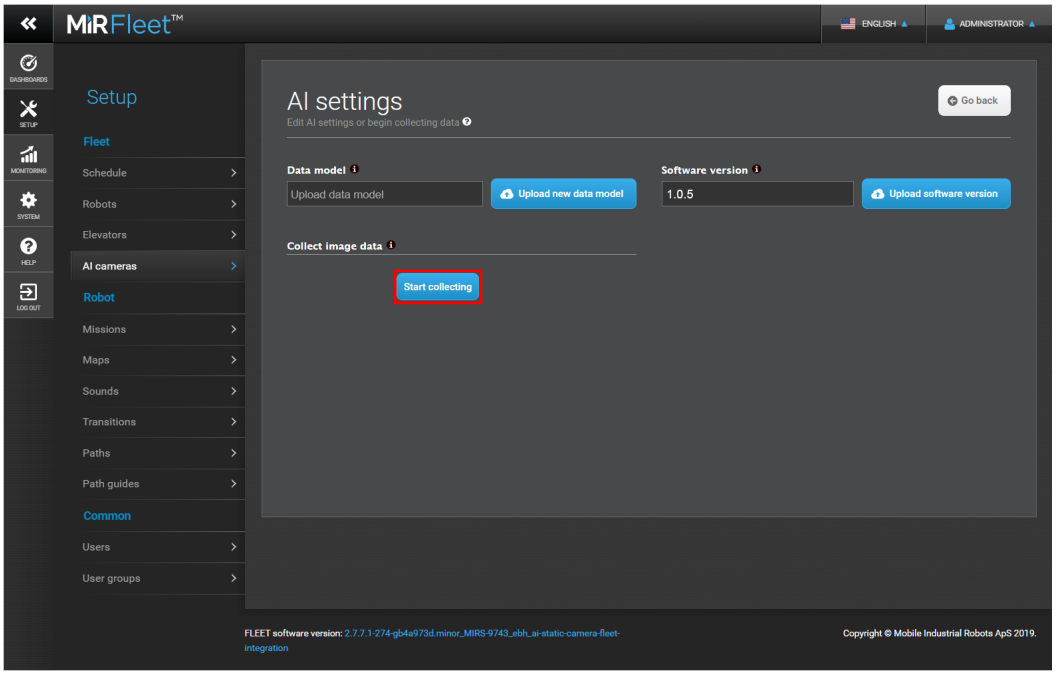
Make sure you have added all of your MiR AI Cameras to MiRFleet before you begin collecting data.

Follow the steps below to begin the Collection phase, and download the data necessary to begin the next phase:

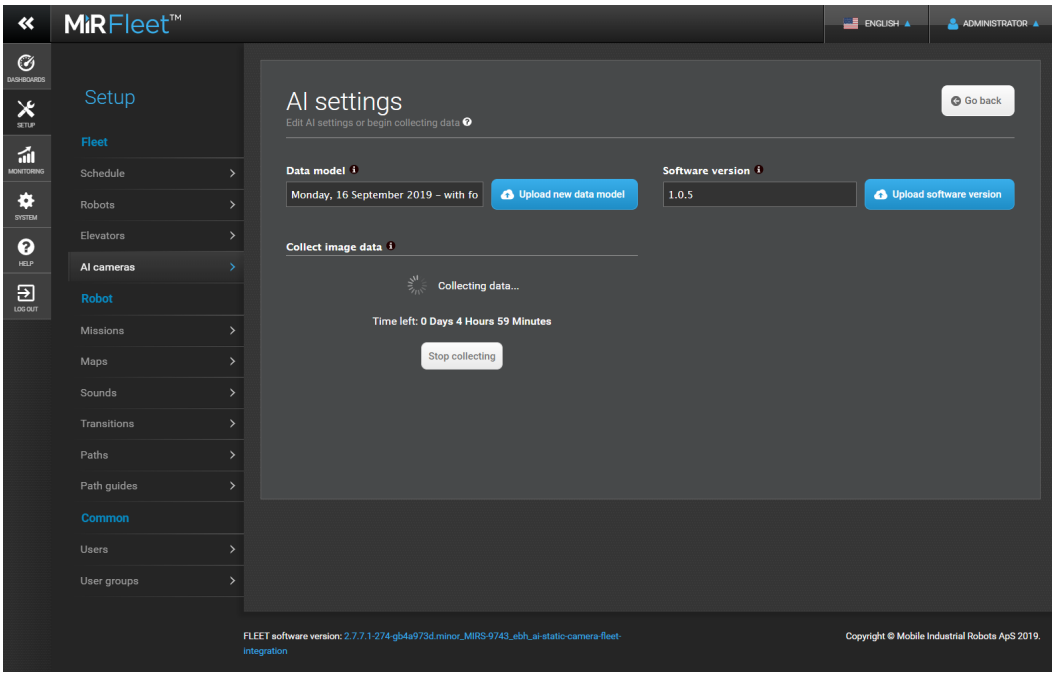
1. Go to **Setup > AI camera** and select **AI settings**.



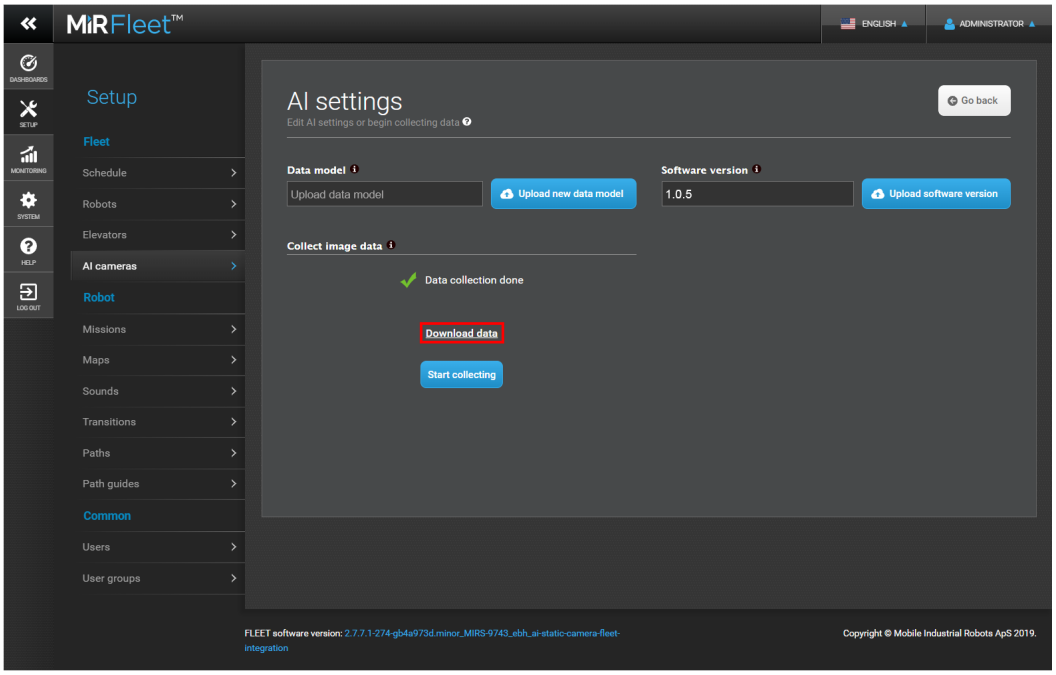
2. Under **Collect image data**, select **Start collecting**.



3. The remaining time of the collection phase is displayed. When the displayed time has passed, return to the MiRFleet interface and navigate to **AI settings** again to download the data.



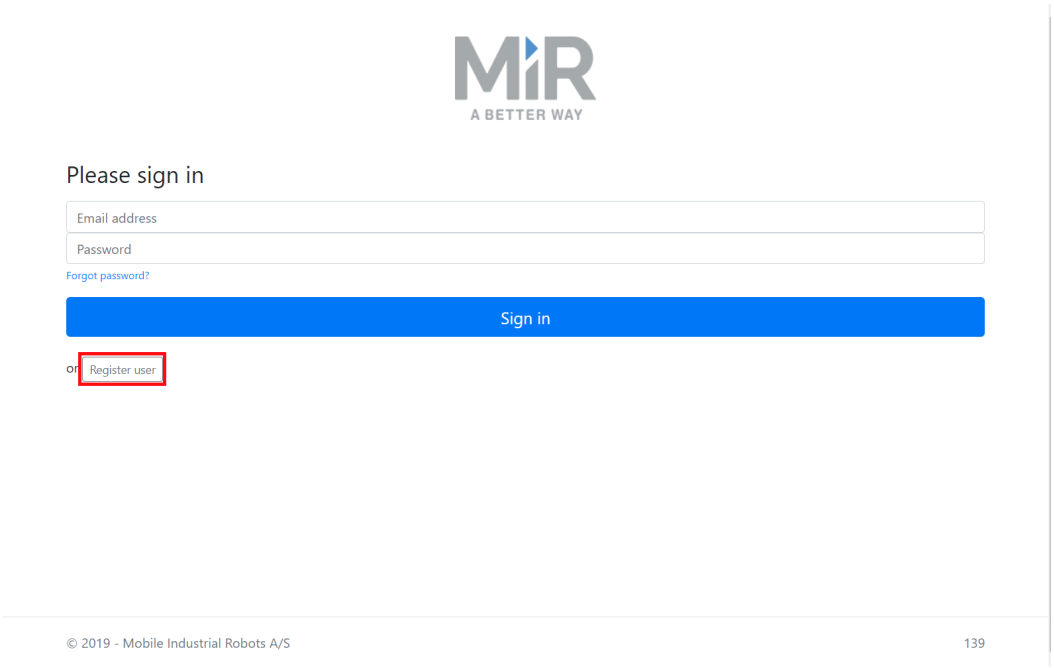
4. Download the file containing all the images by selecting **Download data**. Make sure to use a computer that can be connected to the internet, as you will need to upload the data to an online training server in the next step to begin training.



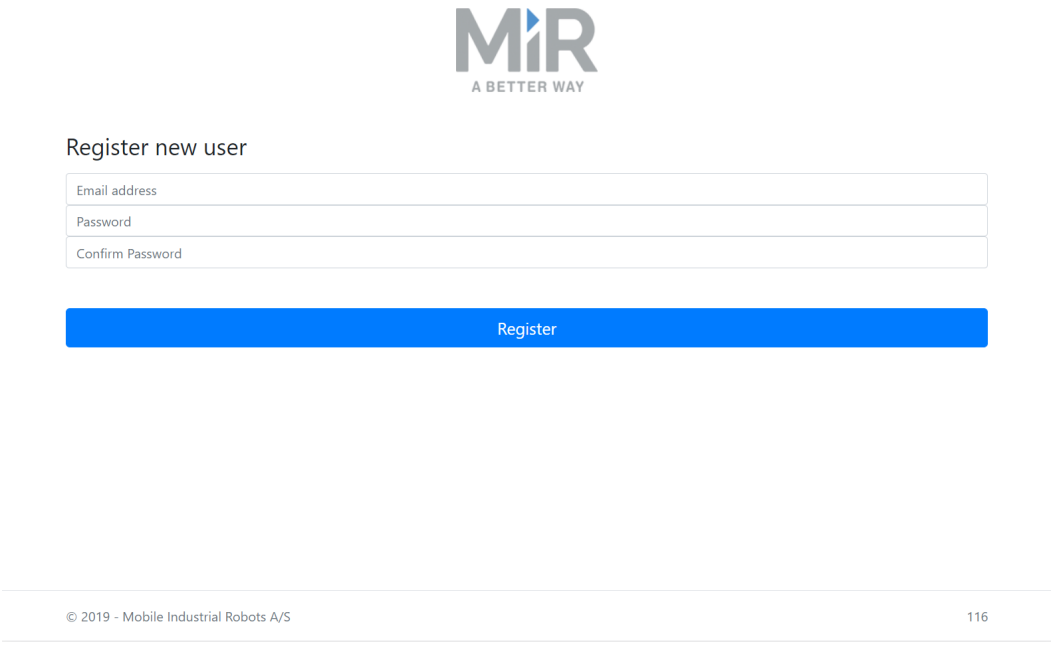
4.2 Pre-processing phase

The data preparation and training take place on the following website: https://training.mir-robots-ai.com. This site is known as MiR AI Training Tool. The following steps describe how to upload the training data collected in the Collection phase:

1. Open your preferred web browser and go to https://training.mir-robots-ai.com to access the MiR AI Training Tool. If you have not used MiR AI Training Tool before, select **Register user**.



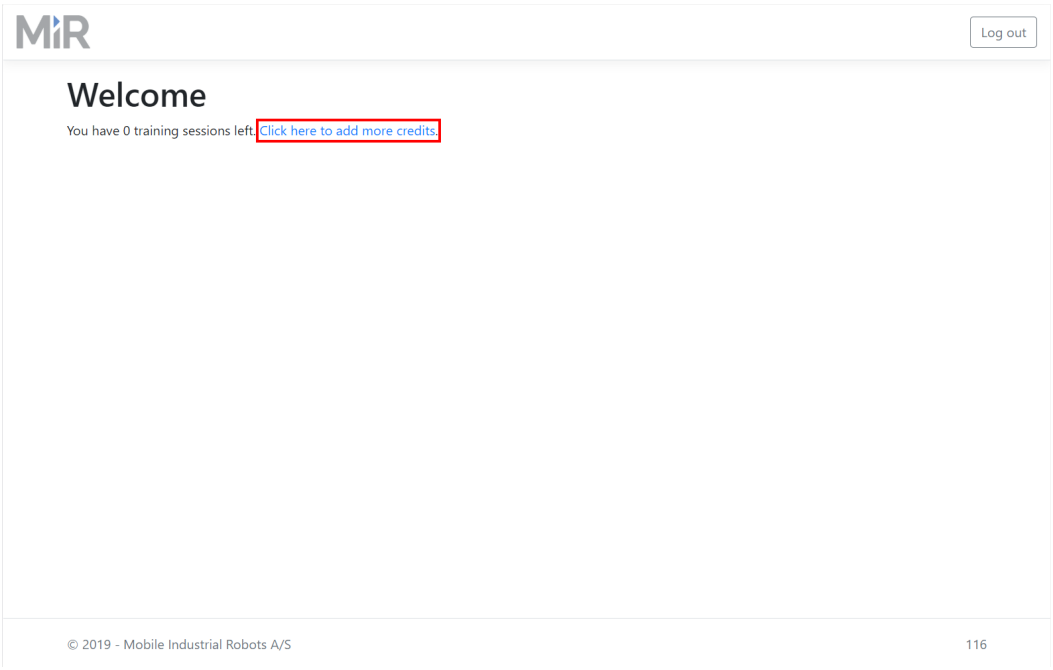
2. Insert your email and create a password. Select **Register** when you are done, and sign in with your new user.



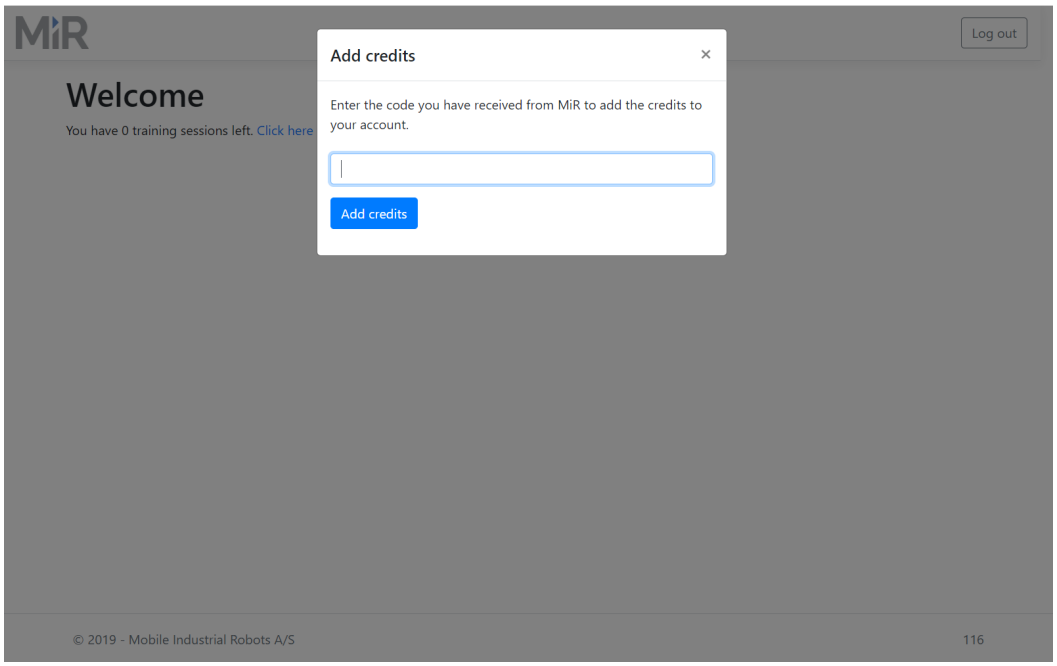
3. To start a new session, you will need to add credits. Credits are used to limit the number of data models you create for your MiR AI Camera from your training sessions. You use a credit each time you train a new data model in any of your training sessions.

Credits are added to your account by inserting credit codes. You should have received a code for this from your distributor. If you have not received a code, contact your distributor.

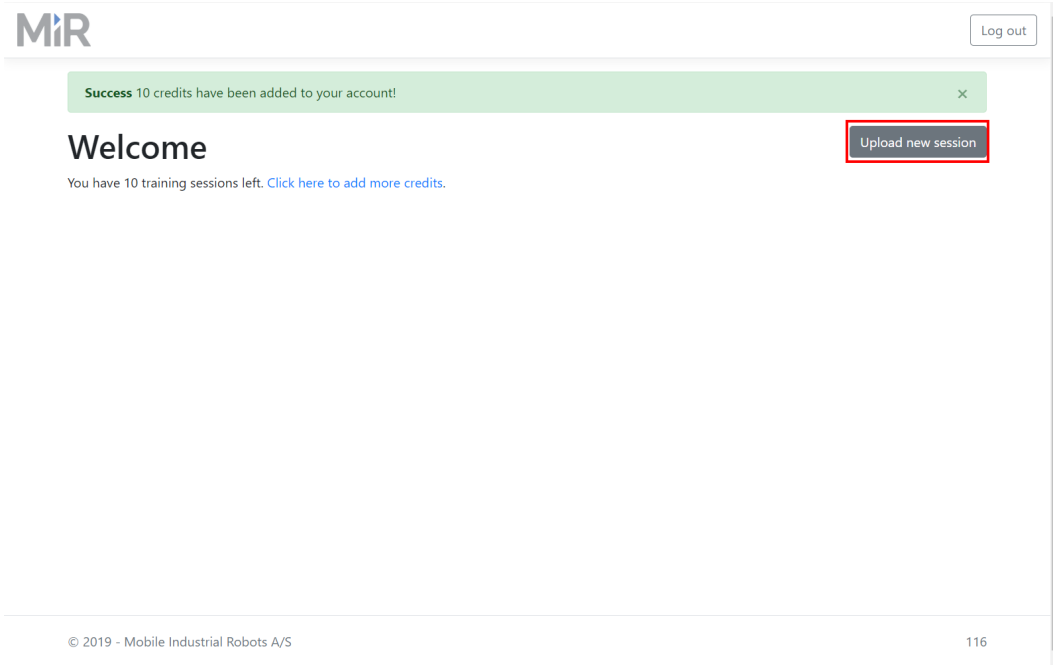
Select **Click here to add more credits**.



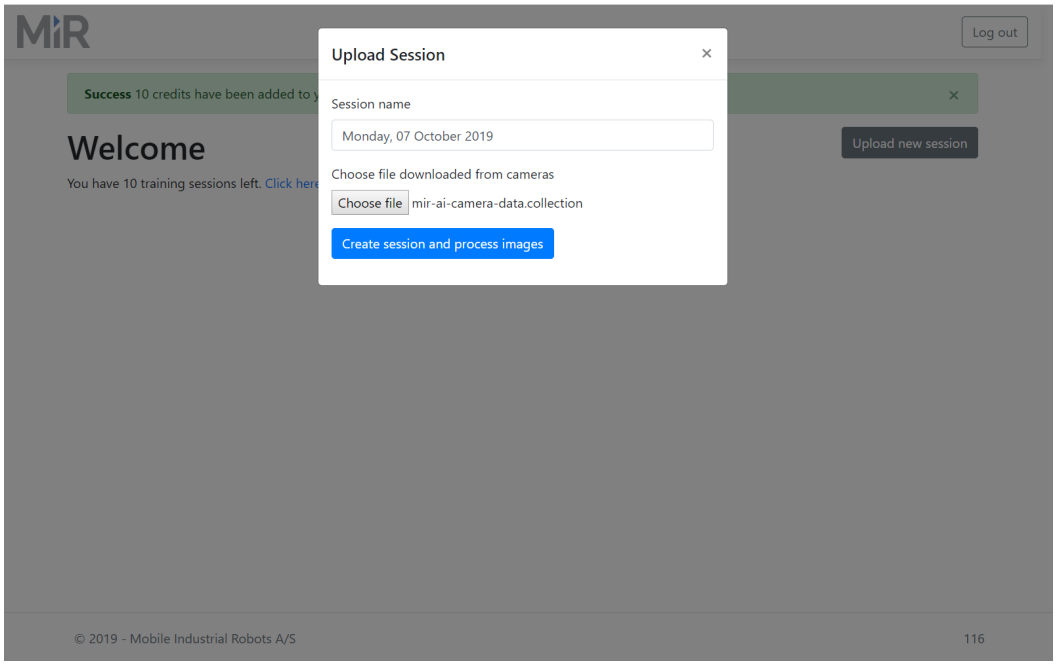
4. Type in the code that accompanied your MiR AI Camera. You will receive the number of credits that is linked to that code.



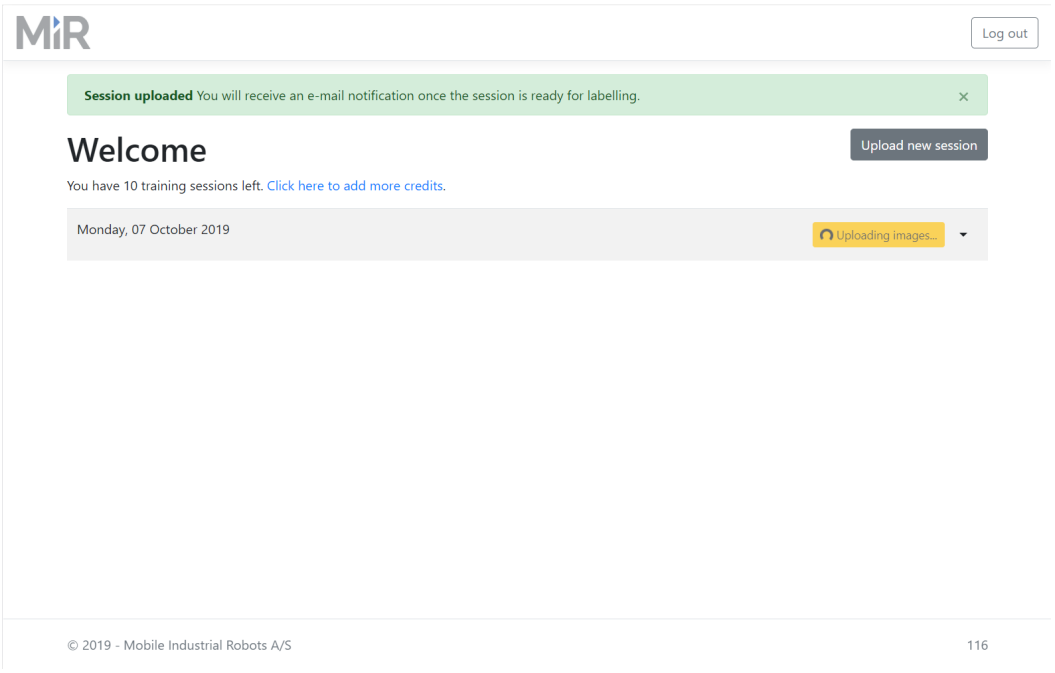
5. To upload a new set of collected data select **Upload new session**.



6. Enter a name for your session. By default, the session is named the current date. Select **Choose file** and browse for the data file you saved at the end of the Collection phase, containing all the collected images. Select it and upload it to the site.



7. The server will pre-process the images. This can take up to an hour, depending on the number of images collected. The pre-processing is handled autonomously, so you can leave the site and return later once the pre-processing is complete. You will receive an email notification when the pre-processing is done.



After you have uploaded the data, if **Error** is displayed in your training session, delete the data and begin a new Collection phase. Make sure your MiR AI Camera is mounted in a well lit area and that objects of interest enter its field of view during the Collection phase.

4.3 Validation phase

In the Validation phase, the images must be labeled based on the target object found in the image. The candidate target object is framed by a green box. To start the process, you must create a new label for a target object you would like MiR AI Camera to detect. After creating a new label, you validate which images include the same target object and should be used for training. This section presents an example of this process and provides guidelines for which images to validate for training.

CAUTION

This is one of the most important stages when setting up your MiR AI Camera. It is vital that you follow the guide accurately to make sure your MiR AI Camera performs as expected. The following section describes how to label your MiR AI Camera the images correctly. It is highly recommended to read this description before continuing to the step by step instructions following the description.

Labeling

During the Pre-processing phase, MiR AI Training Tool detects candidate target objects, frames them in the images where they appear, and attempts to cluster images with the same target objects. In the Validation phase, there are two actions that must be performed:

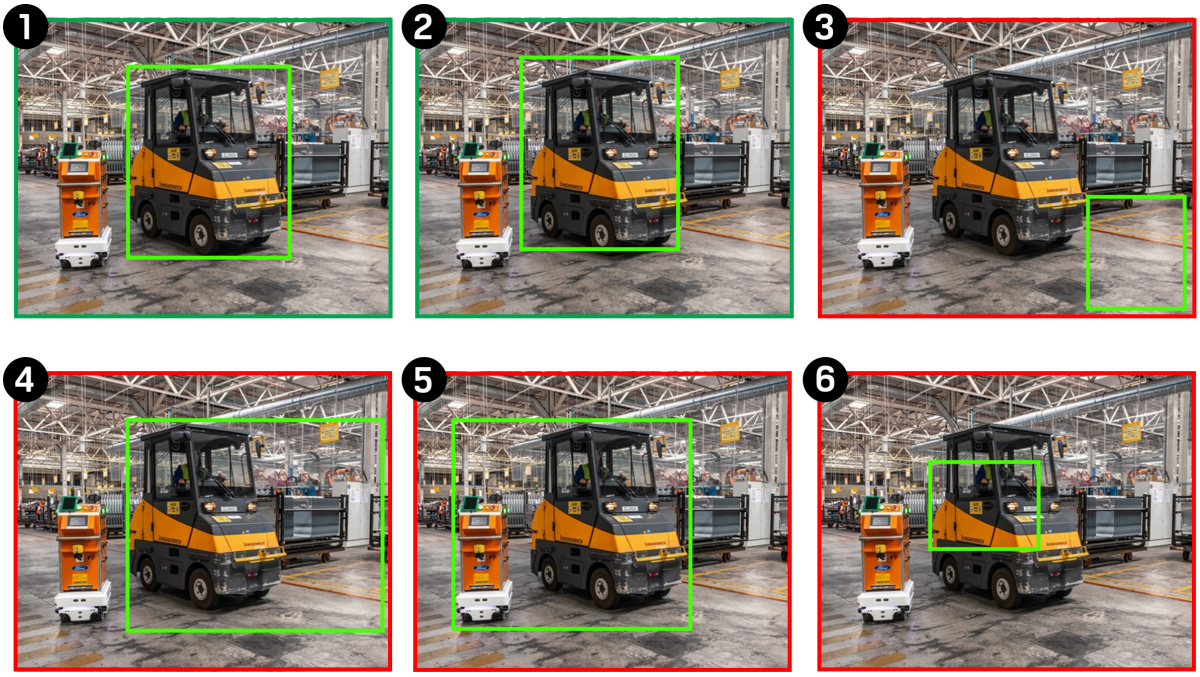
- **Create new label**
  The target objects must be given an appropriate label to categorize them under an object type. The first time you select an image with a new target object, you must create a new label. Only one target object is found per image, thus only one label must be applied per image. As a general rule, if the appearance of target objects are the same, they should be grouped under the same label. If two target objects similar in appearance are given two separate labels, it is not guaranteed that MiR AI Camera can distinguish the difference. For this reason, when creating a new label, it is important to choose a label name that correctly encapsulates the target object type that you are categorizing. *Table 4.1* provides an overview of the correct and incorrect usage of labels for some example target objects. You can train your camera to detect other target objects than those listed in the table.

Example target objects	Correct labeling	Incorrect labeling
People	All people go under one collective label. Example: **person**	Creating individual labels for certain people. Example: **Sarah**, **John**, **workers**, **intruders**, **guests**

Example target objects	Correct labeling	Incorrect labeling
Robots and vehicles	All robots or vehicles of the same type go under a product specific label. Example: **MiR100**, **MiR200**, **AGV robot**, **forklift**	All robots go under the same label, or each individual robot receives its own label. Example: **Robots**, **Sarah's forklift**, **MiR100 1**, **MiR100 2**
Carts and shelves	All carts or shelves of similar size and appearance can be categorized under one label. Example: **medicine shelf**, **blue cart**	All cart and shelves go under the same label, or each cart or shelf receives its own label. Example: **medicine shelf 1**, **medicine shelf 2**, **shelves and carts**

4.1. Overview of correct and incorrect use of labels

- **Validating**
  Once you have labeled a target object, MiR AI Training Tool presents other detected target objects where similarities have been detected. You must validate which detected target objects should receive the same label. It is important that only images where the green box correctly frames the target object are validated for training. *Figure 4.1* illustrates examples of valid and invalid framing of target objects.



4.1. Examples of valid framing have a green border (examples 1 and 2), and in-valid framing have a red border (example 3-6).

Example image	Valid or invalid	Description
1	Valid	The frame fits tightly around the target object, and very little background is included in the frame.
2	Valid	The frame almost fits around the target object. Only small sections of the object is outside of the frame, and little of the background is included.
3	Invalid	The target object is not in the frame. Only background is included.
4	Invalid	The target object is inside the frame, but too much background is also included.
5	Invalid	Two different objects are in the frame. Only one target object should be in a frame.
6	Invalid	The frame includes only very little of the target object.

4.2. Descriptions of the framing examples in *Figure 4.1*.

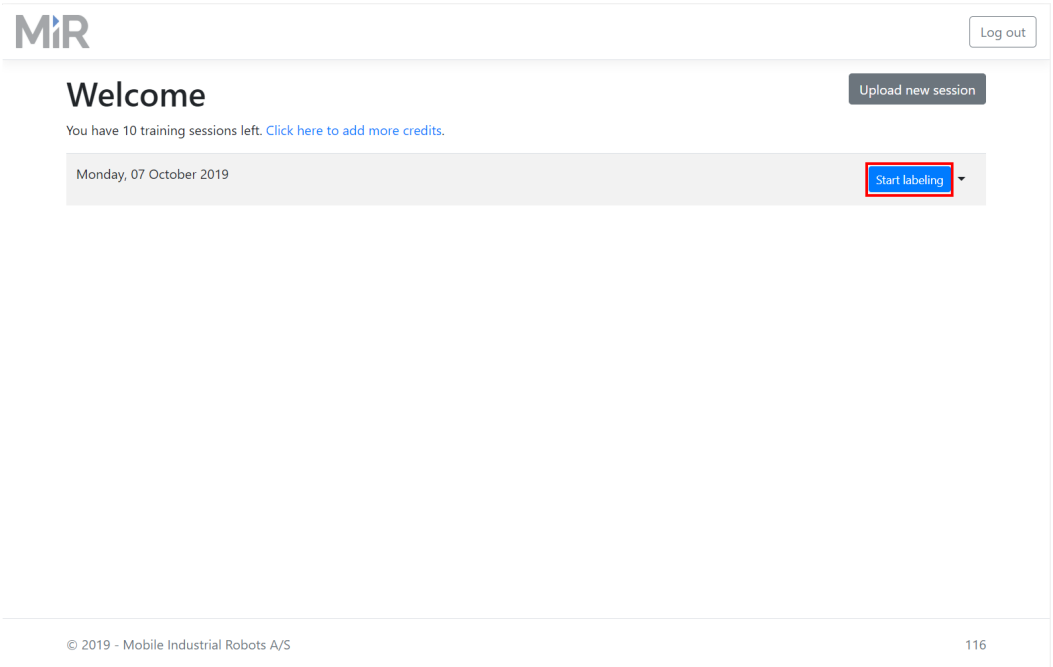
It is highly recommended only to include images with high quality framing, even if it means that fewer images are accepted.

It is not necessary to complete the validation phase in one sitting. All labeling and validation is saved as you work, and you can return to MiR AI Training Tool at any time to complete it.

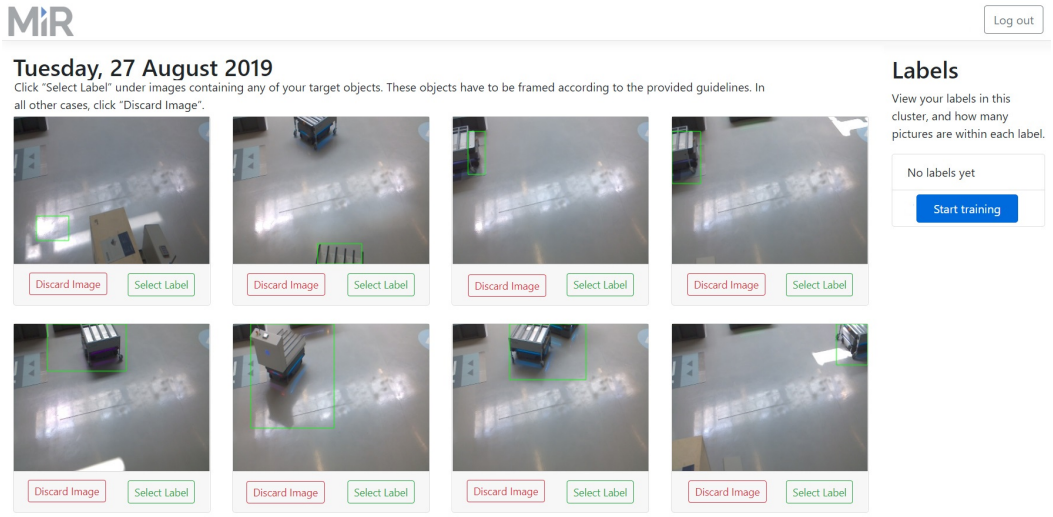
Validation phase step by step instructions

The following steps describe an example of how to begin the Validation phase. While going through these steps, it is important to keep in mind that the images used in the example will not be the same images your MiR AI Training Tool displays. Follow the guidelines above to determine whether an image is valid for labeling.

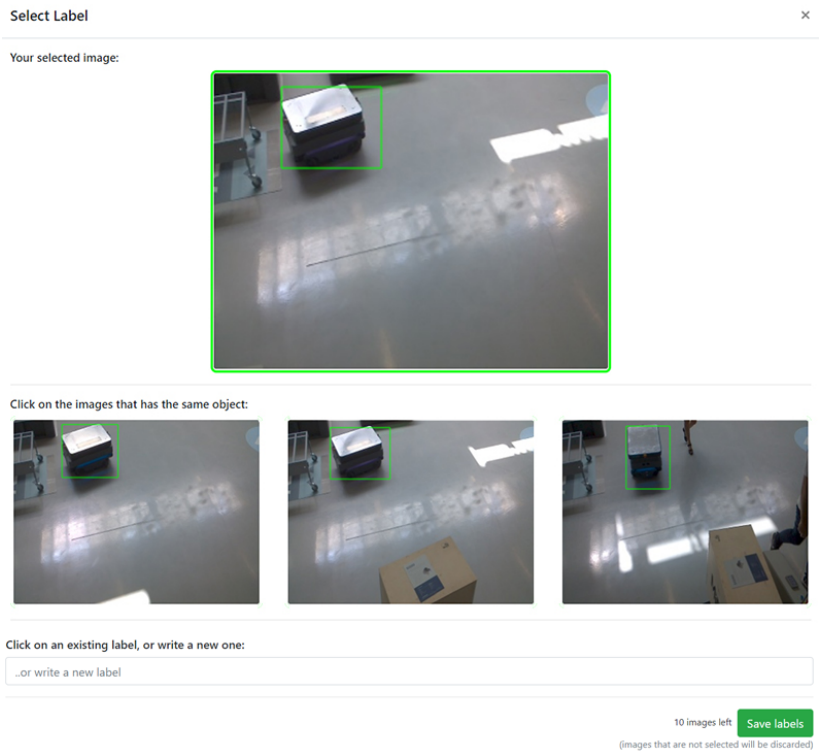
1. In MiR AI Training Tool, select **Start labeling** for the session where you would like to begin labeling.



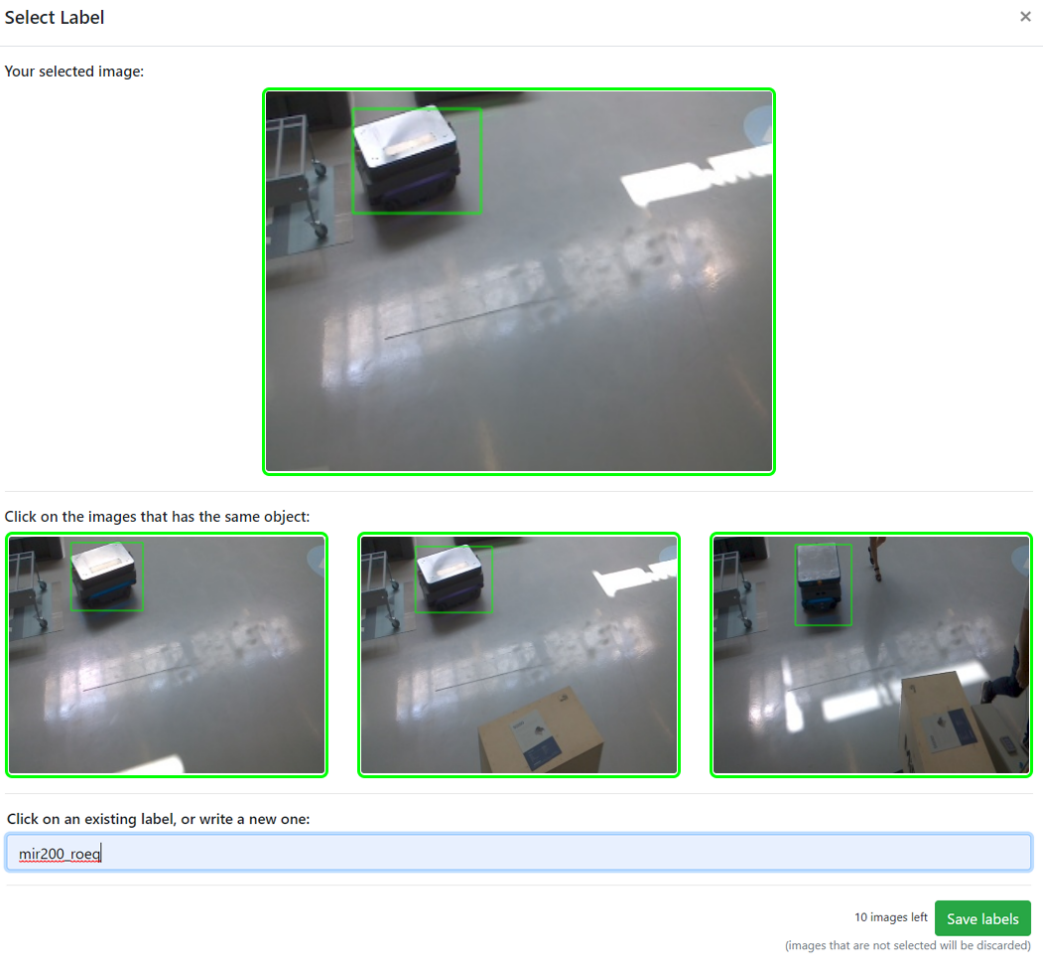
2. The labeling session opens and displays several images where candidate target objects are framed. Browse through the images until you find one of your target objects that has been framed according to the guidelines described previously. Once you have found a suitably framed target object, select **Select Label**.



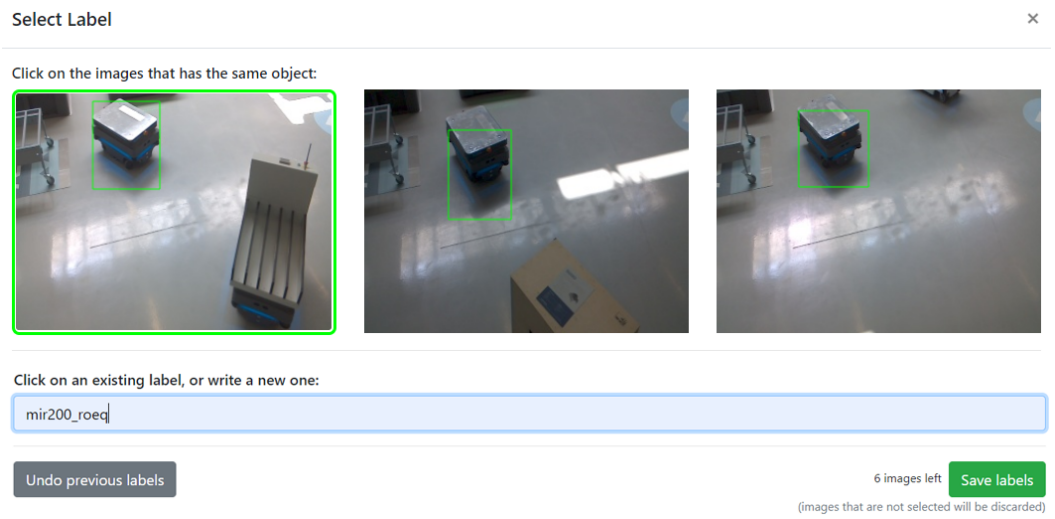
3. A dialog box similar to the following image is displayed. The large image is the one you selected, and the three smaller images are images that MiR AI Training Tool identifies as containing the same target object.



4. Of the three suggested images below, select those that show the same target object, and follow the framing guidelines. The selected images are framed with a green box. Then select an appropriate label, or create a new one. In this case, all the images should be validated and have the label **mir200_roeq**. Select **Save labels** when you have finished.

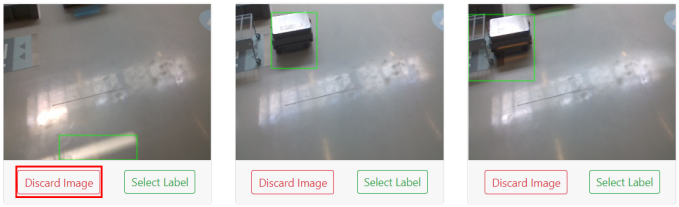


5. MiR AI Training Tool continues to provide images where it identifies the same target object. Validate the images that display and frame the same target object correctly. In this case, although all images feature the same object, only the first image frames the object correctly.



6. Eventually, MiR AI Training Tool will not have anymore suggested images. Select a new object image to begin the same process.

Images that do not frame any target object may be removed by selecting **Discard Image** for that image.



7. It is recommended to continue labeling and validating images until you have at least 150 images of each target object. Often, more images result in a better performance from the camera, but this also depends strongly on the quality of the labeled images. It is highly recommended only to include images with high quality framing, even if it means that fewer images are accepted.

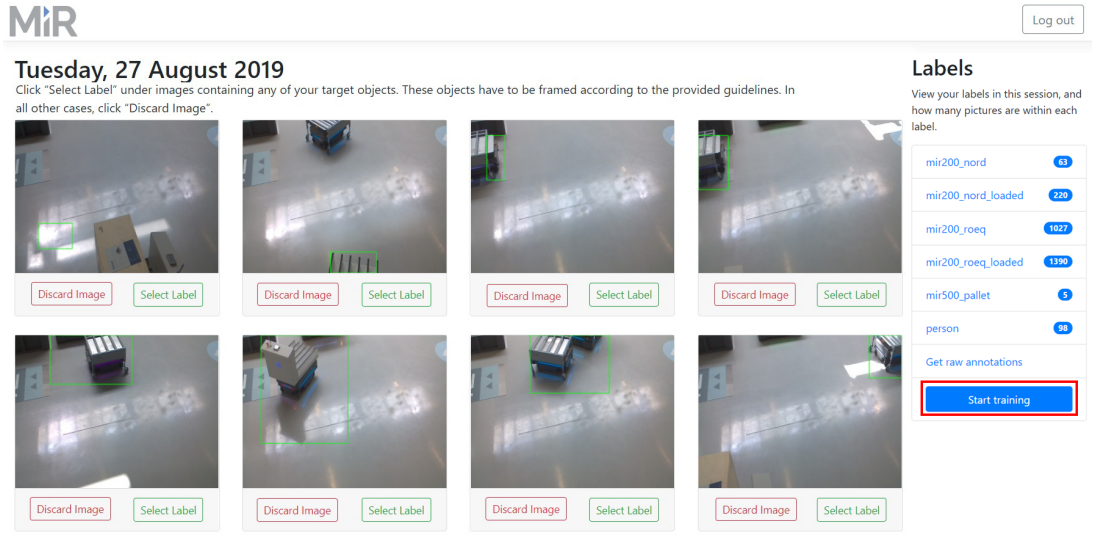
4.4 Training phase

The Training phase can begin once you have labeled your images. You are able to begin the training without labeling all images, but it is recommended to label as many images as

possible to improve the performance of the MiR AI Camera.

To begin the Training phase, enter the training session where you have finished labeling, and select **Start training**.

> **NOTICE**
>
> Only select **Start training** when you have finished labeling. You use one of your credits for each training session you begin.



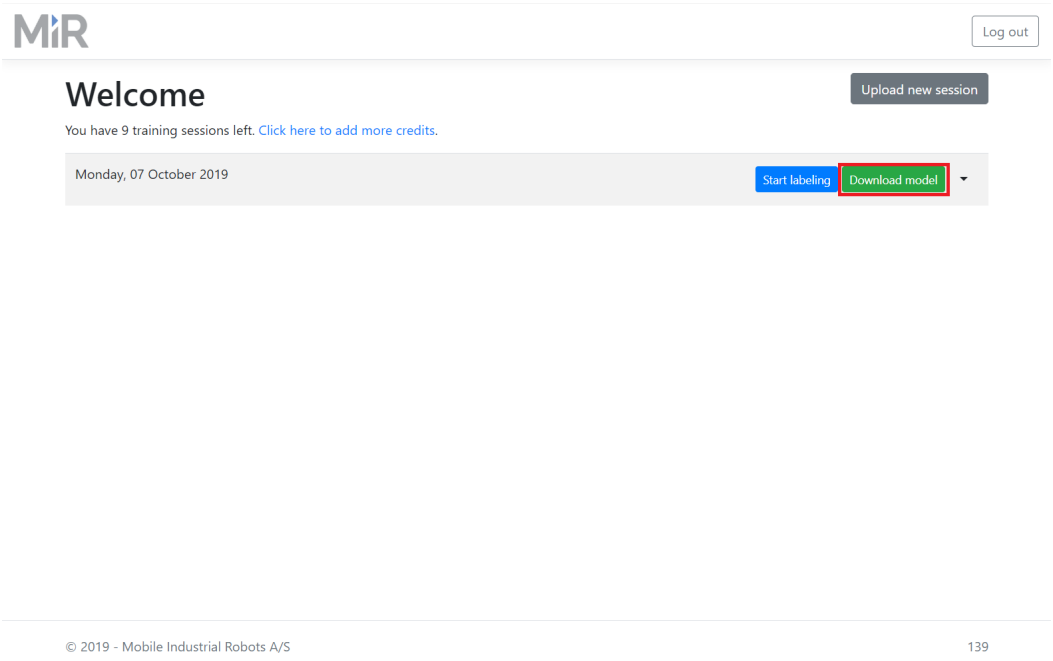
The Training phase does not require any more interaction. MiR AI Training Tool will automatically complete the training for the MiR AI Camera. This can take several hours to complete, but it is not necessary for MiR AI Training Tool to be open on your PC throughout the training. Once the training is complete, you will receive an e-mail, and can continue to set up your MiR AI Camera through MiRFleet.

4.5 Upload the data model

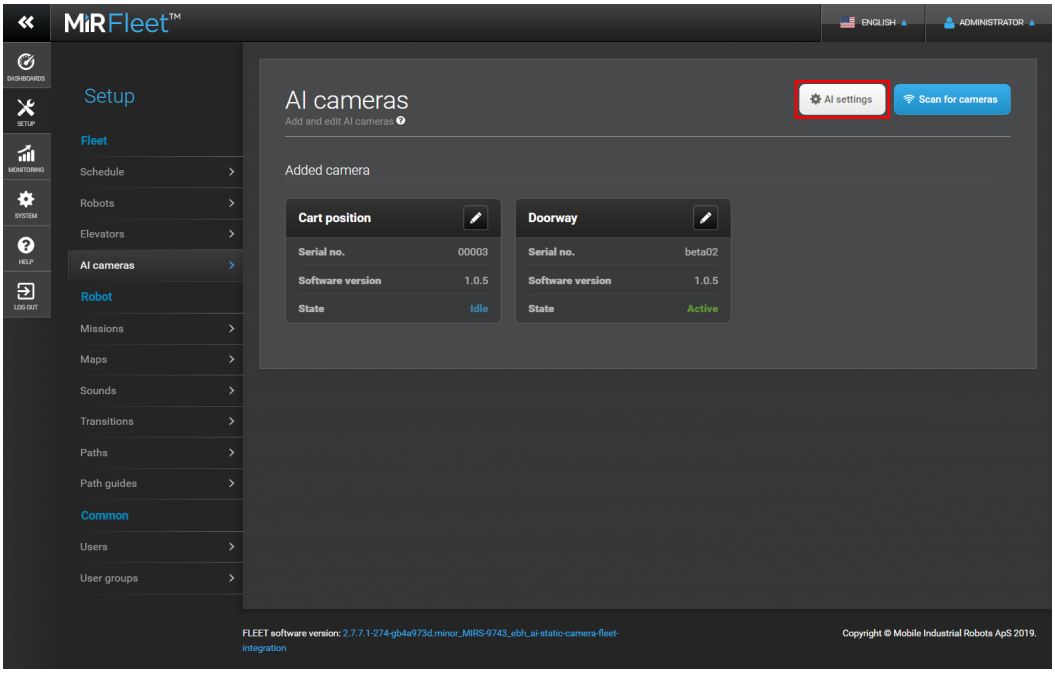
The training phase outputs a data model. This model contains the information required for MiR AI Camera to detect the objects labeled in the validation phase. The following steps describe how to upload the file to the connected MiR AI Cameras:

1. Select **Download model** for the session you have created for your MiR AI Cameras.

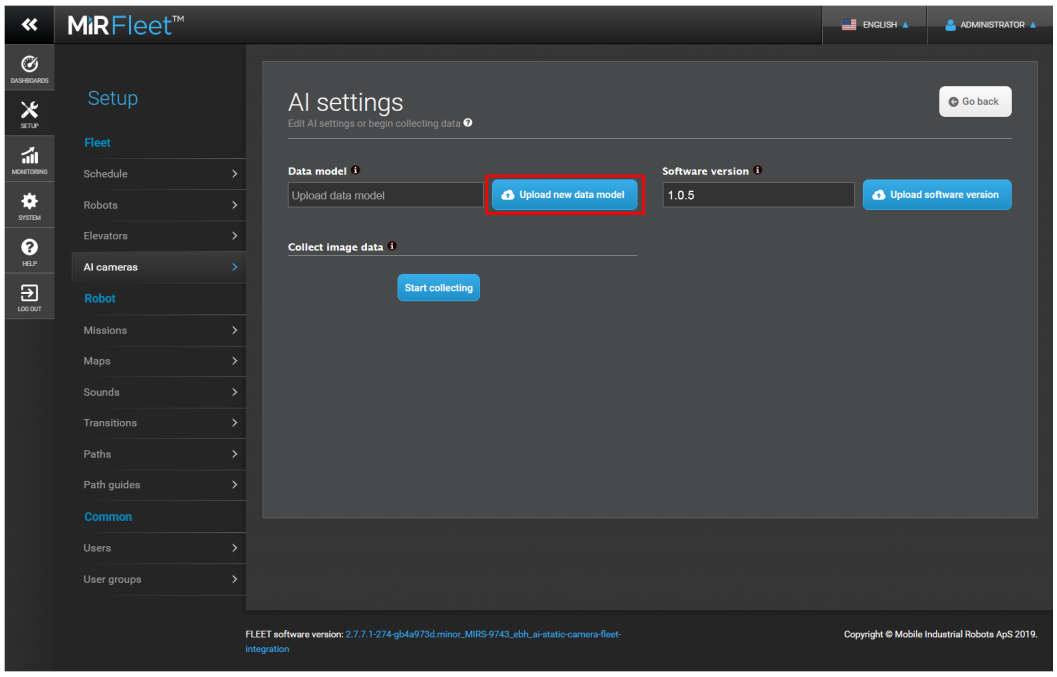
> The data model is usually approximately 20-30 MB.



2. Connect your PC to the MiRFleet network, and sign in to the interface. Navigate to **Setup > AI cameras**, and select **AI settings**.



3. Select **Upload new data model** and then the data model you just downloaded from MiR AI Training Tool.

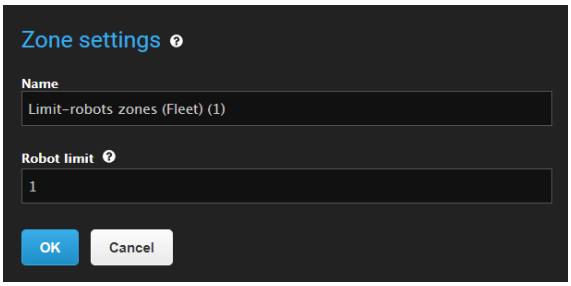


It may take a while for the data model to be uploaded and read. Once the model is uploaded the indicator light on the camera turns cyan and the status is displayed as **Active**. The camera is now ready to detect objects. The next step is to create triggers, so certain actions are triggered when the cameras detects specific target objects.

4.6 Setting up triggers and actions

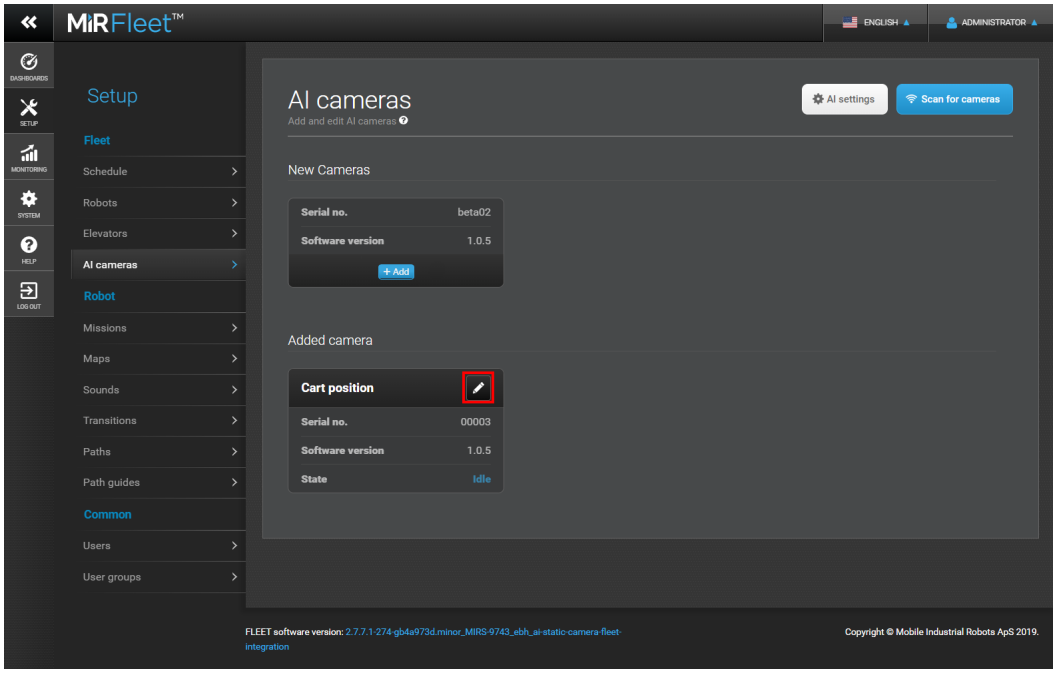
Each MiR AI Camera can be set up to send different actions to MiR robots, depending on the detected object. There are two types of actions you can trigger: Lock zone or Fleet mission. Lock zone actions are used to stop MiR robots from entering a Limit-robots zone, and Fleet mission actions initiate a fleet mission.

If you want to create a zone that MiR AI Camera can lock, but does not otherwise limit the number of robots that can be within the zone, make sure to increase the **Robot limit** to the number of robots you have in your fleet. You can change this value when editing a selected zone in the map editor.

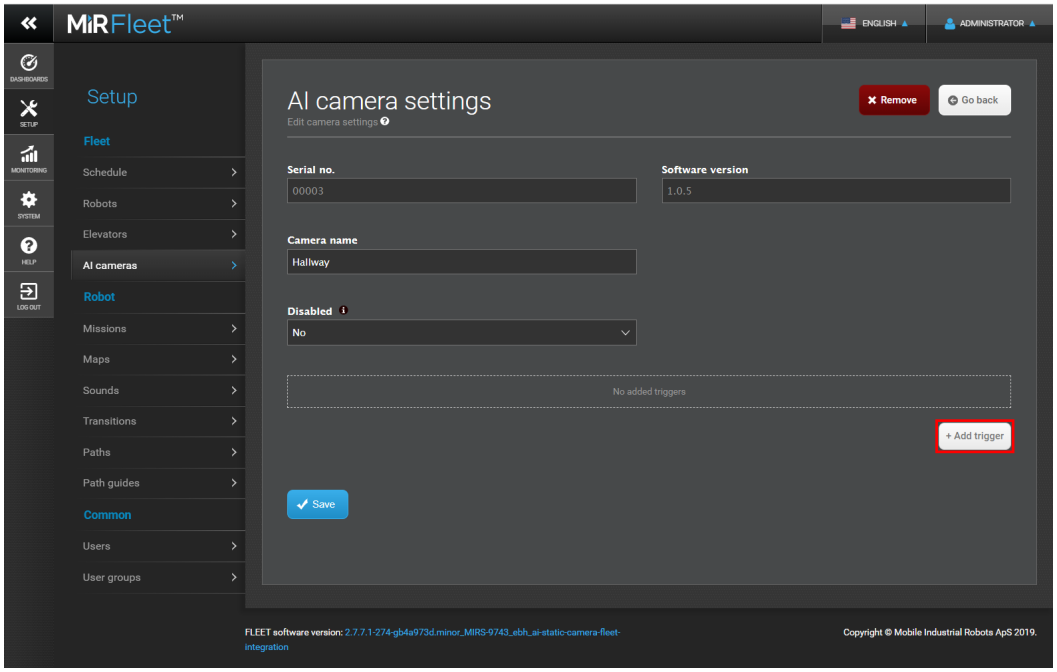


The following steps describe how to set up a trigger:

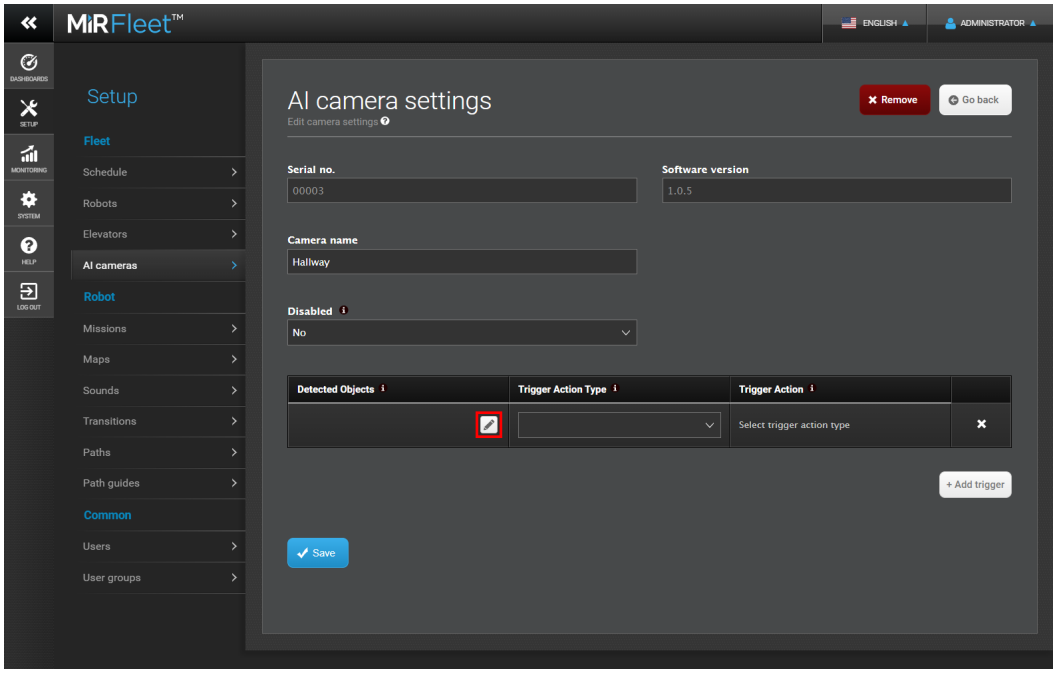
1. Select the Edit icon for the AI camera you would like to set up triggers for.



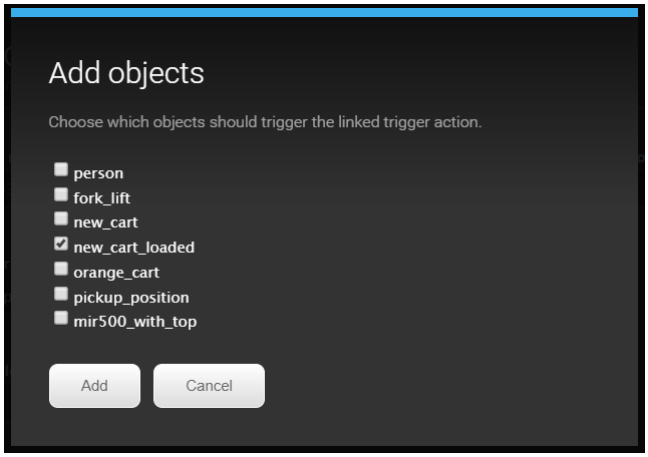
2. Select **Add trigger** to create a new trigger



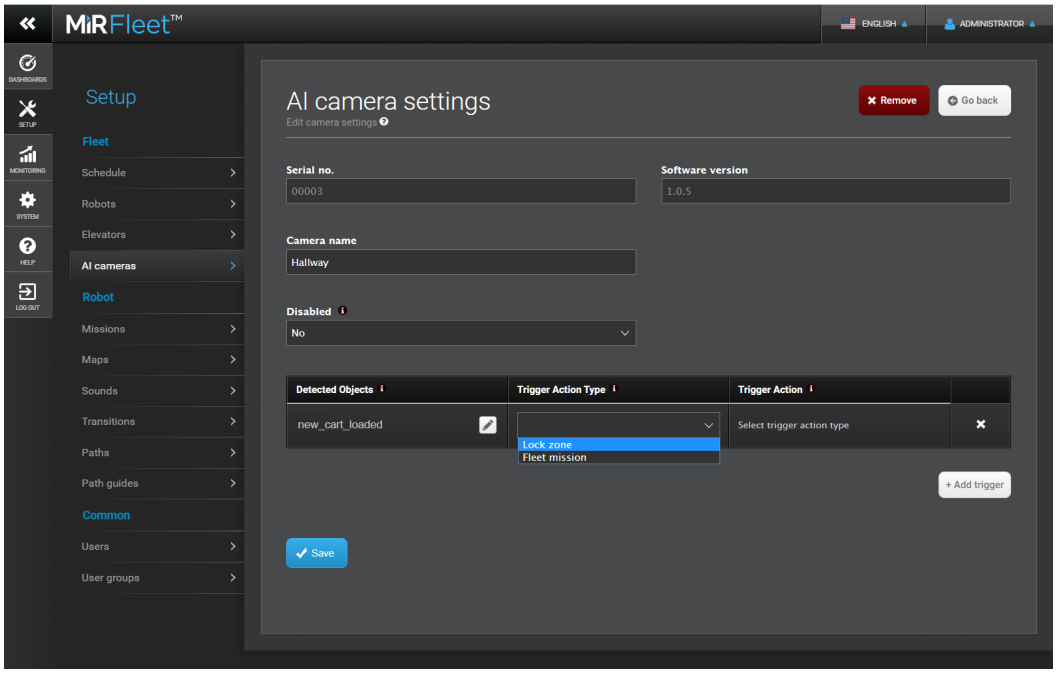
3. You can now select a detected object and a trigger action. To add an object, select the Edit icon.



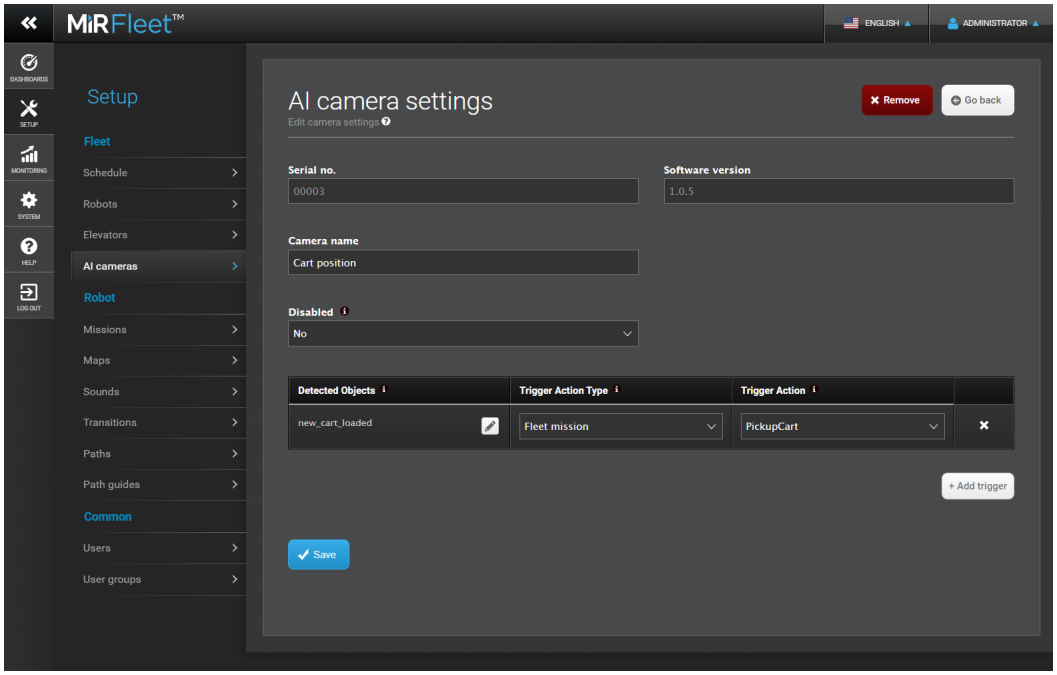
4. The available objects match the labels created in MiR AI Training Tool. Select the object or objects you would like to trigger an action when the camera detects them. In this case, **new_cart_loaded** is the selected target object that will trigger an action.



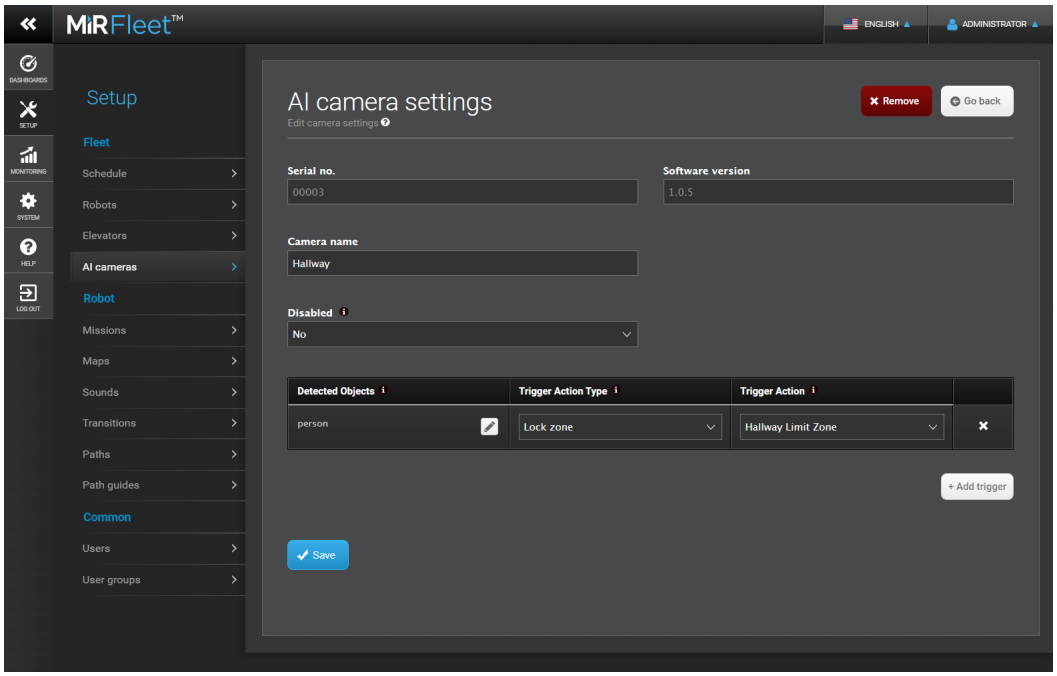
5. Select the type of action you would like to be triggered when the camera detects the selected object in the previous step. You are able to choose between two types of actions:
   - **Fleet mission** enables you to choose a mission within MiRFleet that should be initialized as soon as possible when the camera detects the linked object. It can take a few seconds for new missions to be accessible in the AI camera settings.
   - **Lock zone** enables you to choose a Limit-robots zone and lock it, so no MiR robots may enter if the camera detects the linked object.



6. Under **Trigger action**, select the Limit-robots zone or fleet mission you would like to link to the chosen object. In the example image below, the trigger initiates the **PickupCart** mission when the camera detects a loaded cart.



Another example, using a Lock zone action, sets the camera to lock a zone in a narrow hallway when the camera detects a person.



7. You can create as many triggers as you need. Once you have finished creating triggers, save your changes by selecting **Save**. The camera is now ready to trigger actions when it detects specific target objects.

4. Troubleshooting

This section describes possible reasons why your MiR AI Camera may not be detecting objects reliably. With each reason, there is a workaround or solution that you should apply to avoid or solve the issue.

- **Not enough training data**
  During the Collection phase, if the target objects did not enter the camera's field of view, you may not have collected enough images for training. If the Validation phase did not include many images of the target objects, you should set the cameras to run the Collection phase again and make sure that the objects enter the cameras' field of view more frequently. It is recommended that there are at least 150 well framed images labeled for each target object.
- **Change in lighting after collection phase**
  If the lighting has changed significantly since the Collection phase, the camera may not be able to recognize the objects. Run the Collection phase again, while the lighting conditions are the same as when the AI camera is operating.

If the lightning conditions around your MiR AI Camera change throughout the day, make sure to run the Collection phase in all the different lighting conditions.

- **Incorrect labeling**
  If you have labeled any images incorrectly, the data model may be corrupted. Repeat the Validation phase or review all the labeled images in the training server to ensure that all images have been labeled correctly.
- **Inclusion of too many invalid image samples**
  If invalid images are used in the Training phase, the data model may be corrupted. Repeat the Validation phase or review all the labeled images in the training server to ensure that the validated images follow the guidelines for valid sample images.
- **Objects have changed appearance**
  If the objects you have trained your MiR AI Camera to detect have changed appearance significantly, MiR AI Camera may no longer be able to recognize them. Run the Collection phase again and make sure the new objects are included.

- **MiR AI Camera has been repositioned without retraining**
  If you change the position of your camera so its field of view is occupied by an area that is significantly different from the areas included in the images collected in the Collection phase, the MiR AI Camera may not be able to detect target objects correctly in that area. Run the Collection phase again where images of the new area are included.