PTZ Camera Audio Tracker Installation and Operation Manual

PTZ Camera Audio Tracker v2.0

Date issued	August 2023
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Document version	2.0.0

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1 Introduction

This document provides an overview of the installation and operation for the PTZ Camera Audio Tracker Application. Installation should be undertaken by experienced application installation engineers or system administrators.

1.1 Terminology

Table 1 Terminology

Term	Explanations
Preset	A camera preset is an on-camera saved position and defined by the camera's pan, tilt and zoom values.
Beam	Beams are signals received from the microphone to indicate the direction of an audio source. A beam consists of azimuth and elevation values.
Azimuth	Azimuth is an angular measure in a spherical coordinate system. Azimuth is part of a beam position received from microphone (the other element is elevation), with value between 0 - 359 degrees in the clockwise direction.
Azimuth Range	A range of azimuth, e.g., 10 – 50 degrees, or 320 to 40 degrees (note azimuth wraps around 0-359 degrees).
Outlier Azimuth	Azimuth data that are outside of the determined azimuth range of a given dataset.
Calibration	Calibration is a process to establish correspondences between a camera preset and microphone azimuth range. The system uses calibration results to continuously evaluate azimuth info received from the microphone to control the camera.
Calibrated Preset	A camera preset that is associated with a microphone azimuth range.
Uncalibrated Preset	A camera preset that does not have associated microphone azimuth range. When a preset is created, it is always uncalibrated at first.
Calibrated Preset with Poor Quality Data	A calibrated preset has poor quality data if the azimuths recorded is too dispersed to accurately calculate the azimuth range for this preset, or if the percentage of outliers is too high (>30%)
Home Preset	The home preset in the PTZ camera, which is always the first preset.

Term	Explanations
Priority Preset	A camera preset that is given higher priority during camera tracking. i.e., a lecturer's stand, or guest speaker podium
Priority Preset Threshold	The level of priority given to the priority preset. At a higher threshold level, the camera will move to the priority preset faster, and more readily stay on the preset when multiple people are speaking. Three levels are available (Max, Mid, Low).
Microphone Silence Threshold	A configurable threshold measured in decibels (dB), to allow the user decide at what level of sound below which should be determined as background noise in an otherwise silent room. Sound below this threshold will not be considered in camera tracking.
Main Speaker	A speaker in the room is a main speaker if during a window of the last few seconds (defined by the Delay Period), the microphone beams have primarily come from their location. The camera will track the preset the main speaker is in, if no priority preset is set.
Room Profile	A room configuration that is used to store the camera and microphone connection, camera preset calibrations and tracking configurations.

1.2 About This Application

This application allows a Canon PTZ camera to track a speaker based on sound pickup from a Sennheiser TeamConnect Ceiling 2 microphone or a Shure MXA920 Ceiling Array microphone. The application has a web interface to set up and use the system. Currently, only the Azimuth (0-359 degrees) data transmitted by the microphone is used for tracking.

The application requires the connected camera to be configured with at least two presets. The camera can then be instructed to move to an active preset based on signals received from the microphone.

1.3 System Requirements

- 1x camera and 1x microphone[1]
- PTZ Camera set with two or more presets defined
- Ethernet connectivity is used
- Windows 10 / 11 x64 Computer used to run the application. The latest 64-bit (x64) versions of the ASP.NET Core Runtime 6.x and .NET Runtime 6.x must be installed. It is recommended that the ASP.NET Core Runtime Hosting Bundle 6.x should be installed, as this includes both the ASP.NET and .NET runtimes in a single install package. Please note that on machines with IIS installed, the Hosting Bundle will install the ASP.NET Core IIS Module. See the References section for link.
- Suitable Power over Ethernet (PoE+) switch for power / data needs of the camera, microphone, and data for the computer
- The ports e.g., TCP port 80 (HTTP default), TCP port 443 (HTTPS default), UDP port 45 (default for Sennheiser microphone) and TCP port 2202 (default for Shure microphone) are not blocked or in use by other applications or firewall
- Supported browsers: Chrome, Edge, Firefox, Safari (latest versions are highly recommended)

1.4 Network Diagram

Both camera and microphone are connected to a PoE (Power over Ethernet) switch. The PC for the application should also be connected to the switch. They shall all have static IP addresses.

Optionally, a monitor can be connected to the camera via the HDMI cable to show the camera image.

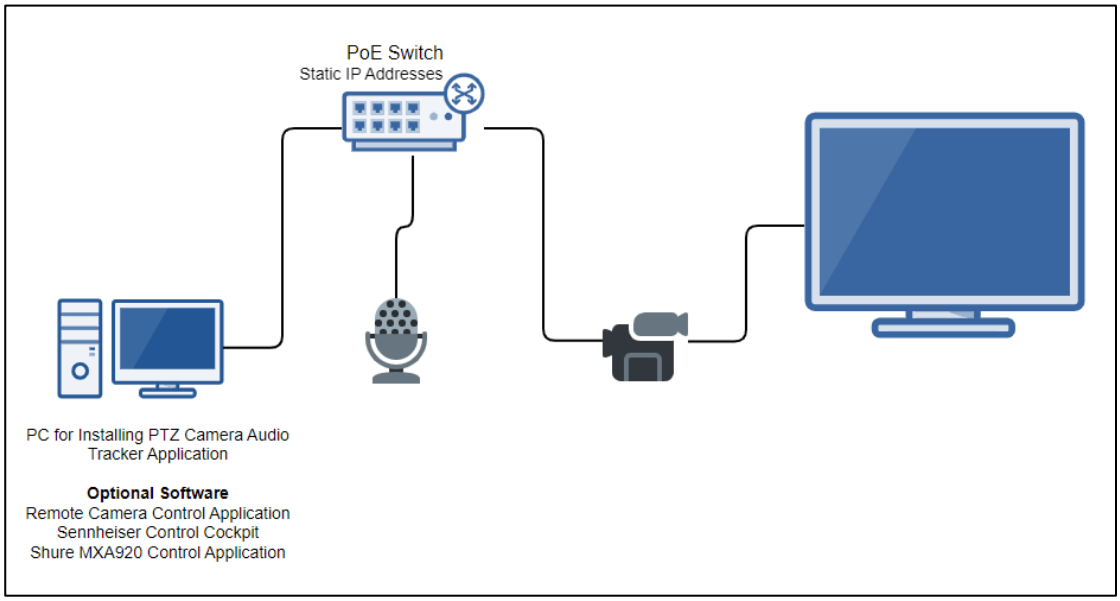


Figure 1 Network diagram

[1] The current version supports connection of 1 Canon PTZ Camera and 1 ceiling microphone. The microphone can be either a Sennheiser TeamConnect 2 Ceiling microphone or a Shure MX920 Ceiling Array microphone.

1.5 Governance

This document is subject to version control.

The content remains the property of Canon Europe.

This document does not require localization.

2 Installation

2.1 The Installer Package

The PTZ Camera Audio Tracker application is shipped as a package, containing licenses, documentation, and the installer TrackingEngineTrayApplication.exe. This will allow a user to install the application under the hosting computer's Program Files\Canon\PTZ Camera Audio Tracker folder by default and allow the configuration of HTTP and HTTPS access. Any configuration files associated with the use of the application will be placed under ProgramData\Canon\PTZ Camera Audio Tracker.

.Net 6 libraries as mentioned earlier must be installed, otherwise an error screen like the following will be shown when attempting to install:

Figure 2 Warning message for missing .Net framework

Before the installer can continue with the installation process, the EULA must be accepted:

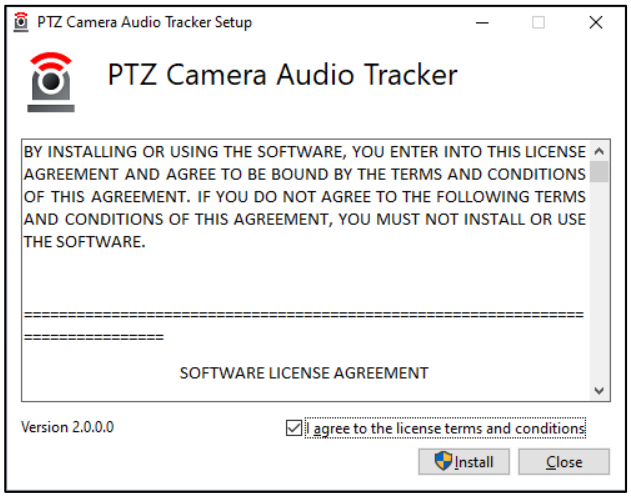


Figure 3 EULA page in the installation wizard

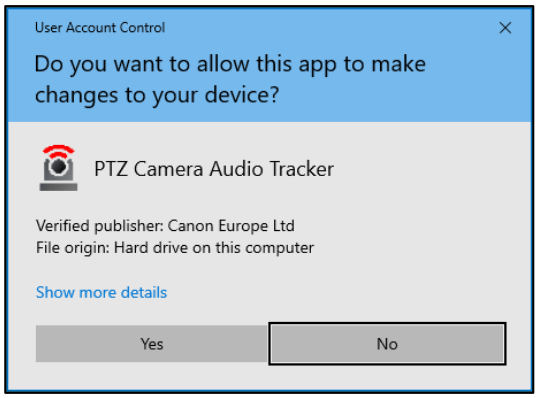


Figure 4 Windows User Account Control consent prompt

Figure 5 Installation wizard

The application supports HTTP and HTTPS. It may be necessary to change the default ports allocated depending upon other apps that may be already running on the computer, e.g. if the default ports are already in use by another app, then alternative ports will need to be used. If a firewall is in use then the ports must be permitted access through the firewall.

See Key Files and their function for changing ports after installation.

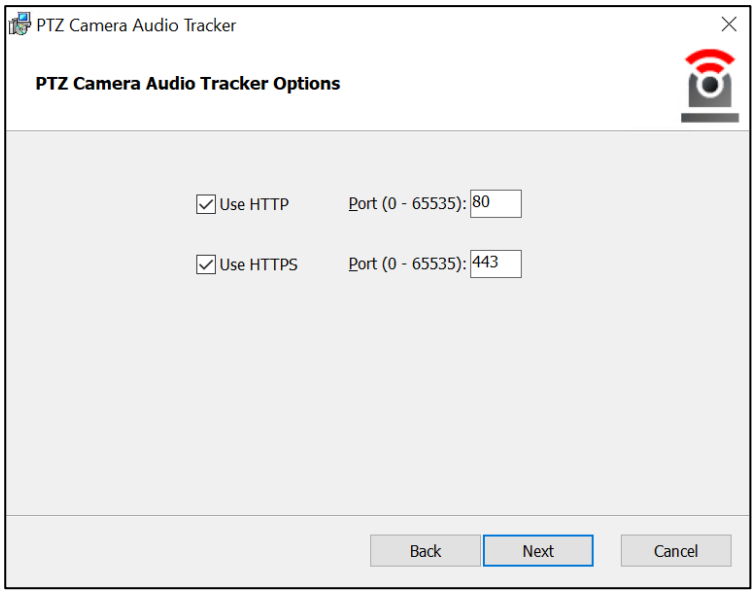


Figure 6 HTTP and HTTPS port selection

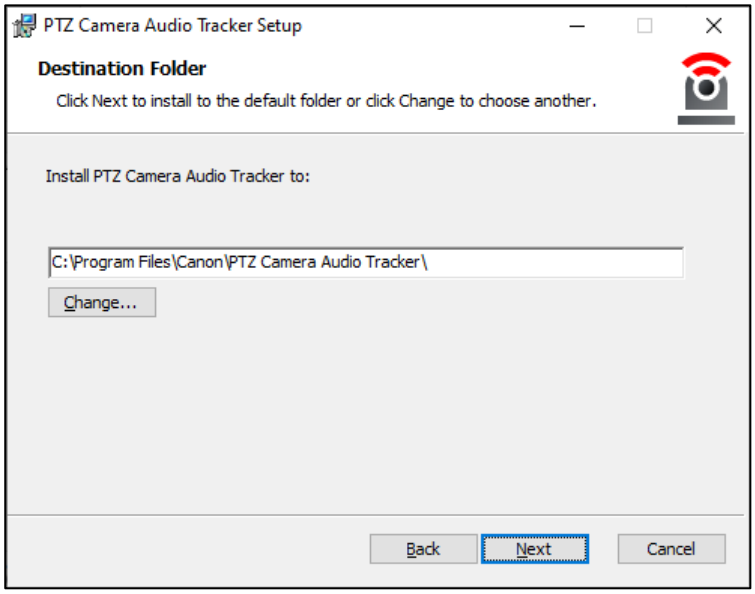


Figure 7 Destination folder preference

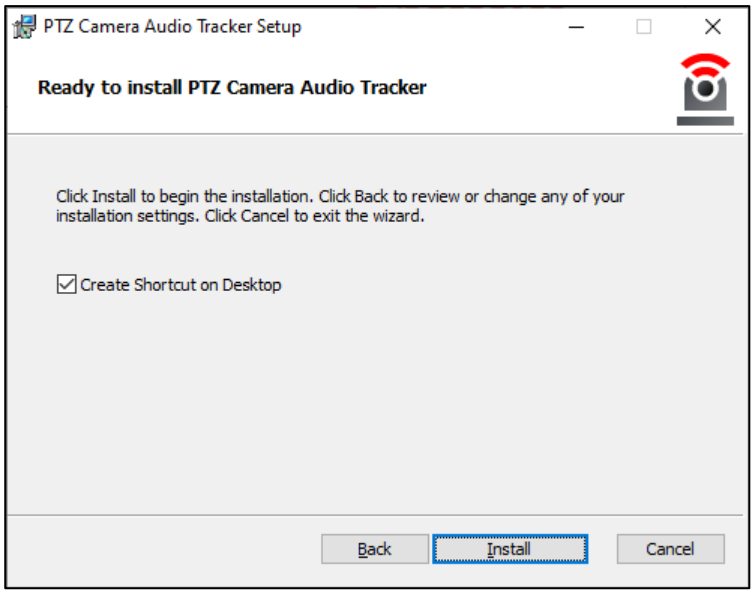


Figure 8 Add shortcut on Desktop option

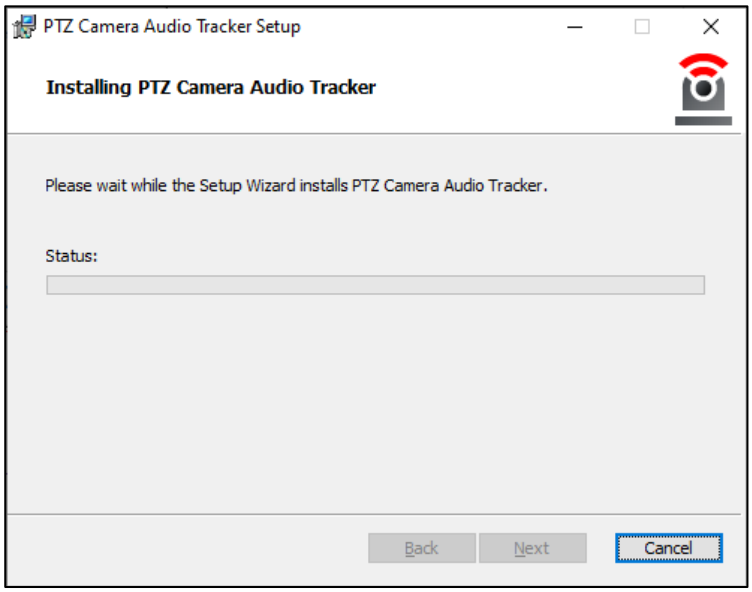


Figure 9 Installation progress

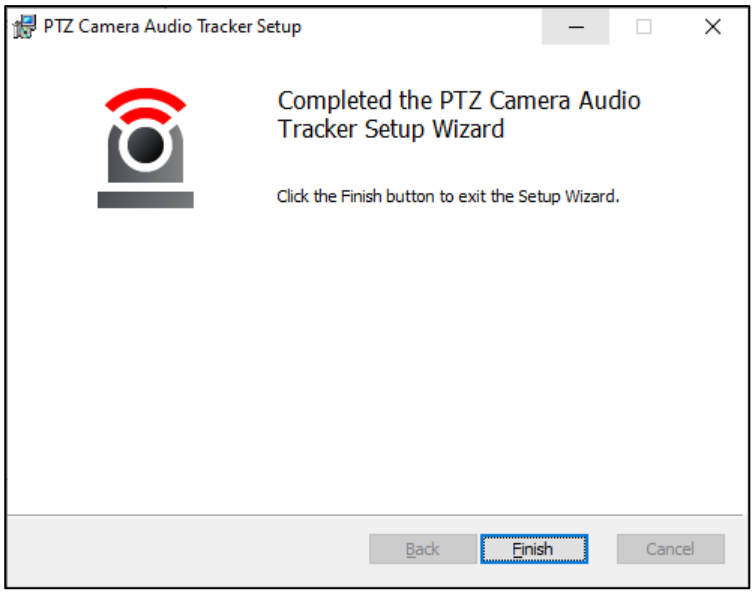


Figure 10 Finished installation

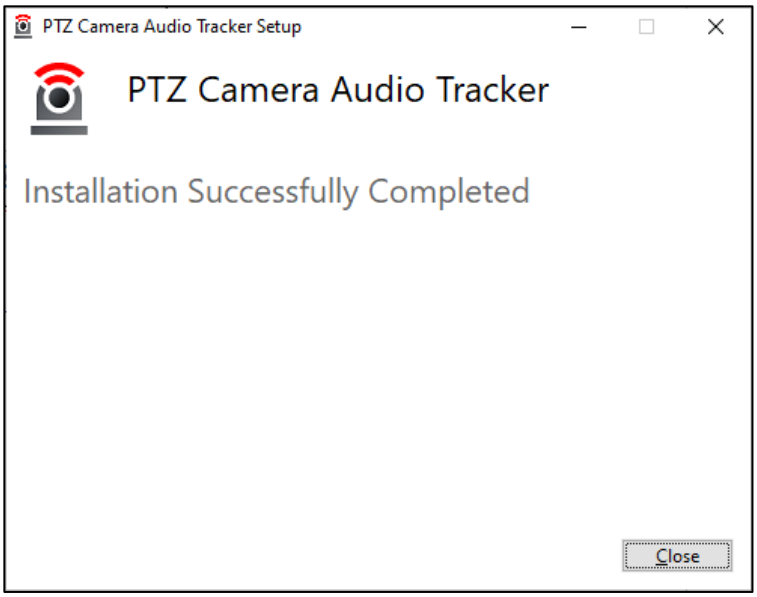


Figure 11 Notification on successful installation

Upgrading the application from an older version will follow a similar process. If the application is still running when the installer upgrade starts, the installer will indicate that application files are in use:

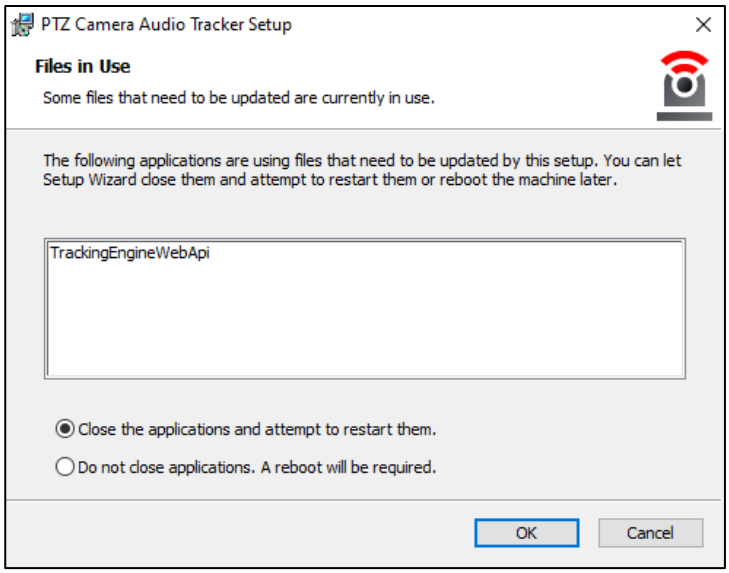


Figure 12 Closing application during installer upgrade

If a later version of the application is already installed the installer will halt and warn that a newer version has already been installed.

Figure 13 Warning message when installing an older version of the application

The user may repair or uninstall the application by launching the installer with the same version number with the currently installed application.

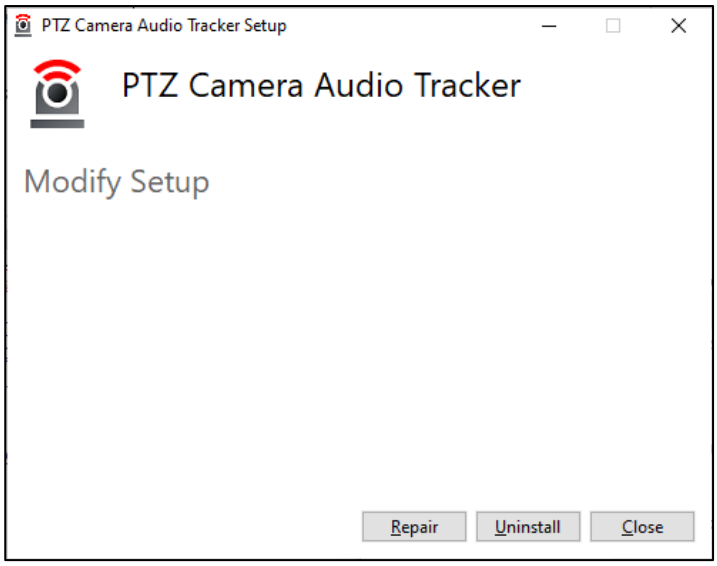


Figure 14 Repair or remove application using the installer

After an upgrade from v1.0 to v2.0 of the application, any previous application settings and calibration data will be migrated to a default room profile "Default Profile.json" file, which will be created and available to use upon first time launching the upgrade application. See Room Profile Files for more details.

For any issues related to installing or upgrading the application, please refer to the Troubleshooting section.

2.2 HTTPS

To support the use of HTTPS, the application installer will automatically create a self-signed certificate during the installation process. This certificate will be created in the Local Computer/Personal store with the Issuer field set to "PTZ Camera Audio Tracker Application" and with the expiry date set to two years from the date of installation. It will also appear in the Intermediate Certification Authorities list of certificates.

The self-signed certificate will be removed if the application is uninstalled, except in the following circumstances:

- User cancels Installation
  - the self-signed certificate may already be installed. If this is the case and the user no longer wishes to install the application, the certificate should be removed manually
- User cancels Uninstallation
  - The self-signed certificate may already be removed. If this is the case and the user still wishes to use the application, they should restore the certificate, i.e. by re-installing the application

Use of alternative certificates is not currently supported.

2.3 Key Files and their function

Under ProgramData\Canon\PTZ Camera Audio Tracker, there are a number of files that hold important settings and data related to the application. It is not recommended to edit these files directly, but experienced users can access, modify or backup these files if required.

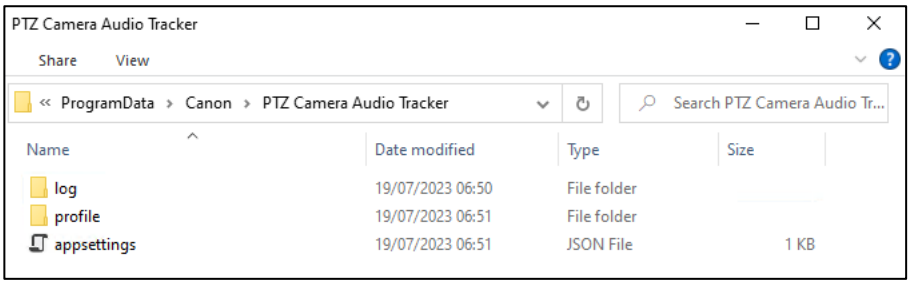


Figure 15 Key files related to application settings and data

2.3.1 Logs

After the first time the application is run, a log folder will be created where information about the applications activities is stored. When raising a support call, it is usually beneficial to attach the log file(s) after an issue has occurred.

There is typically one file created per day with data being appended to the bottom of the log if the app is restarted on the same day.

2.3.2 Application Configuration (appsettings.json)

This file contains settings for logging level, HTTP and HTTPS ports, file path for camera preset calibration, and the list of application users.

Note that the appsettings.json file format must be preserved during editing, otherwise the application will not be able to run.

2.3.3 Room Profile Files (<room profile name>.json)

These files store the room profile configurations that includes the room profile name, microphone model, microphone IP address, camera IP address, camera and microphone tracking configurations, and calibration mapping data between camera presets and the microphone. Calibration can be done from the Calibrate tab of the web interface. See Calibration section for more details.

These files will not be deleted or overwritten if the application is uninstalled or reinstalled. An experienced user can back up these files, switch between different copies, or modify the calibrated presets by modifying the "MinAzimuthBoundary" and "MaxAzimuthBoundary" values as required. Caution is advised if a user manually edit the room profile files, as a file with corrupted format cannot be read or used by the application.

For more information on room profiles, please refer to Setup Connections.

3 First Use and Setup

This function is only available to the administrator.

3.1 Application Start-up

After installation is completed, the PTZ Camera Audio Tracker application can be launched from the Start Menu.

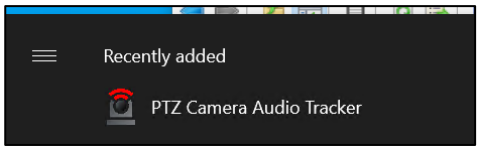


Figure 16 Application icon in Start Menu

When launched, the application will be minimized to the System Tray. Right clicking on the application icon will display options to open the application in a browser window or to exit the application.

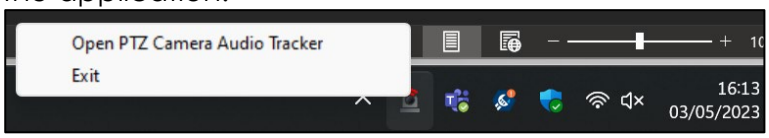


Figure 17 Application tray options

Clicking "Open PTZ Camera Audio Tracker" will open a browser window and navigate to the application. The application can be found at http://localhost:port (or http://<ip-address>:port), where <ip-address> is the IP address of the PC that hosts the tracking application, and port is the port that was configured during installation. If HTTPS was selected during installation then the application can be accessed from https://localhost:port or https://<ip-address>:port. Given that Firewall settings have been configured appropriately, this web page can also be accessed from other devices on the same network via the IP address. The web interface should be appear as shown below:

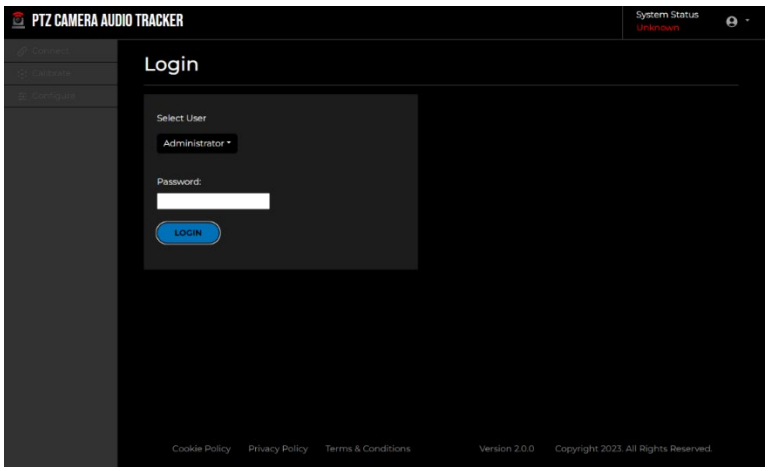


Figure 18 PTZ Camera Audio Tracker login page

3.2 Account and Security

The following pre-defined user credentials can be used to log into the application:

Administrator	password0
Operator (limited access)	password1

There are 2 users: Administrator and Operator. The **Administrator** can access "Connect", "Calibrate" and "Configure" pages, and can perform initial setup. The **Operator** can access the "Connect" page only to switch between existing Room Profiles, and "Configure" page for camera tracking.

Only one user can log in at a time. If the Administrator logs in while another user is already logged, then a prompt will be shown (see Figure 19 Force login prompt). Continuing to log in will cause the previous user's session to expire. The Operator cannot log in while the Administrator is logged in. A user session will automatically expire after 2 hours of inactivity .

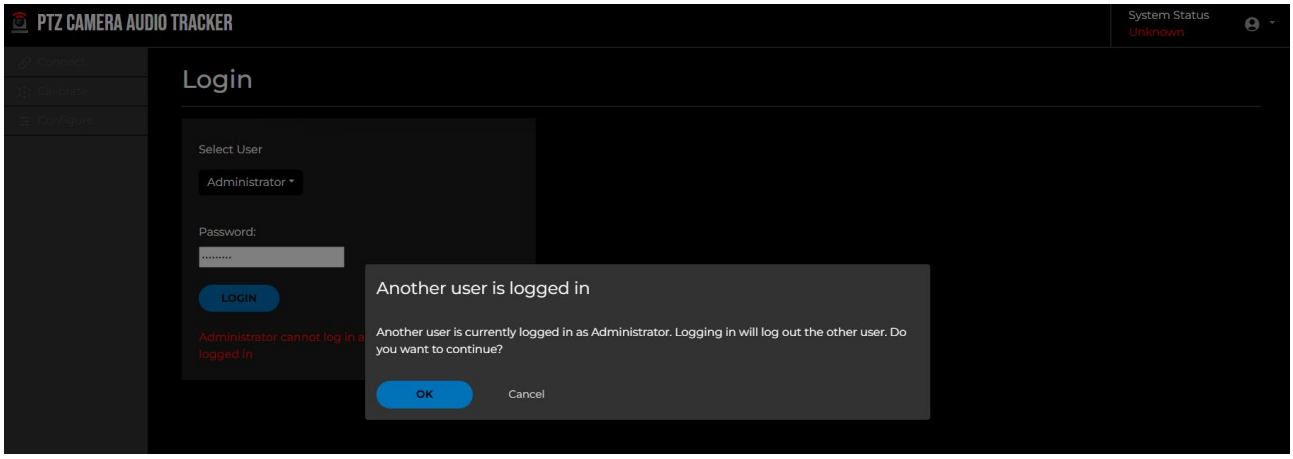


Figure 19 Force login prompt

3.2.1 Change Password

Once logged in, the user can change the default password by clicking the top right dropdown menu → Change Password.

The Administrator can change their own password as well as the Operator's password by selecting the user to change password for in the dropdown menu. The Operator can only change their own password.

There is currently no mechanism to create new users.

Note that if HTTP is used, the user credentials will be sent in plain text. Please take this into consideration while setting up the credentials. It is recommended that the application is configured on an isolated network and/or using HTTPS.

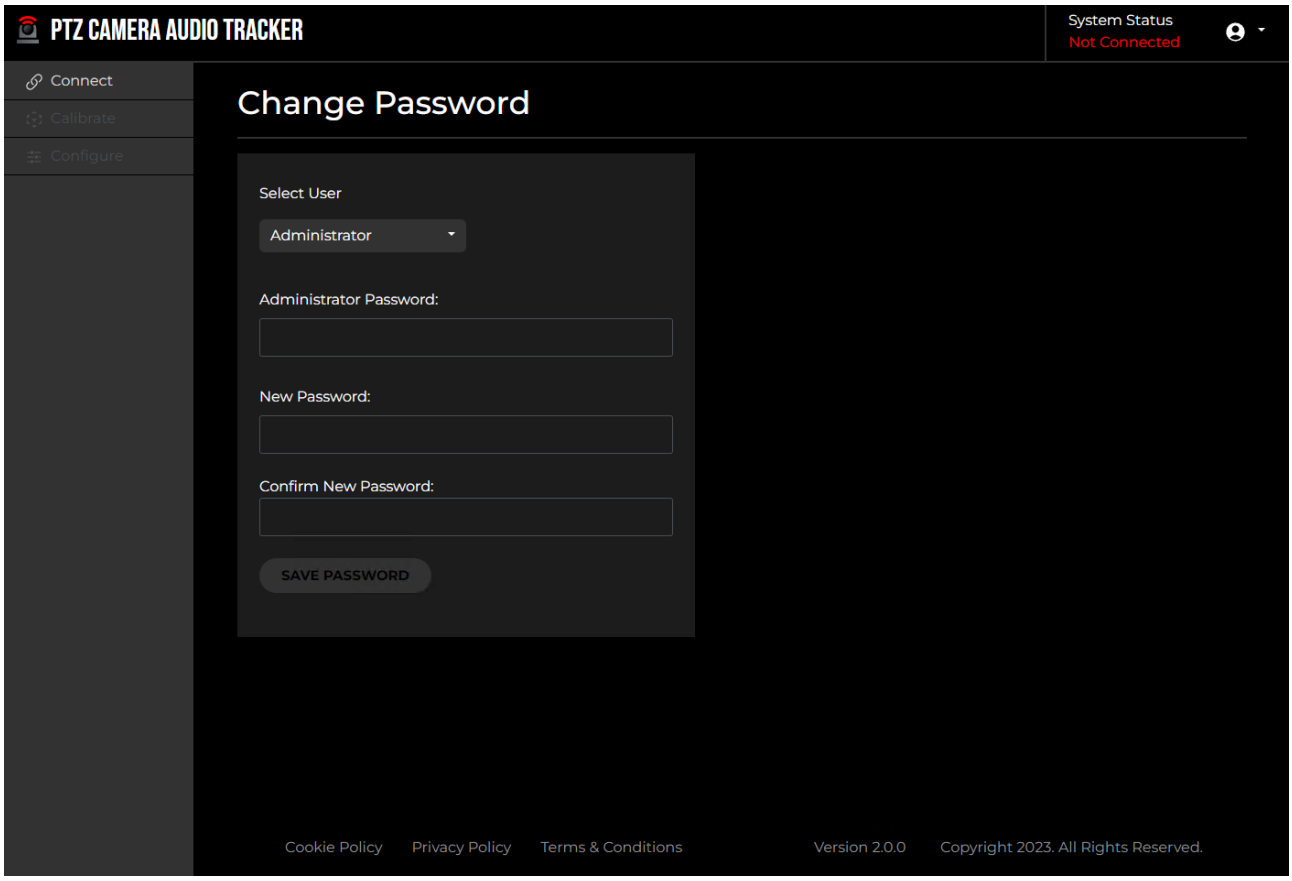


Figure 20 Change Password page for Administrator

3.3 Setup Connections

Login as Administrator to configure connection settings with the use of room profiles. On first login after a fresh installation, there will be no connection or calibration data and therefore the Connect page will be shown.

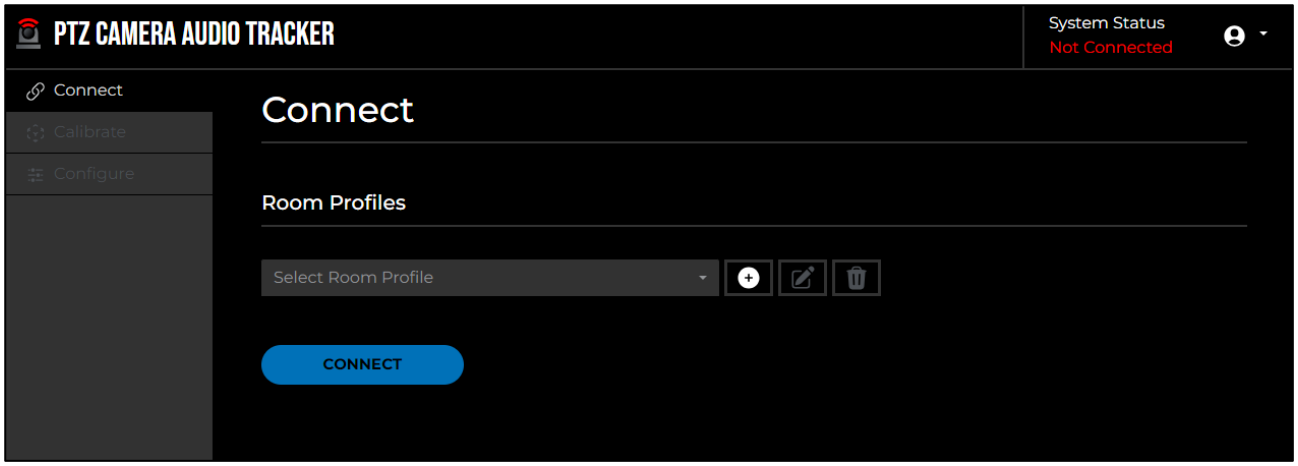


Figure 21 Connect page after logging-in from fresh installation or upgrade

After upgrading the application from v1.0 to v2.0 and upon the user starting the application, the camera and microphone connection details from the appsettings.json file and the calibration data from the mapping file will then be migrated to a new room profile file called "Default Profile", which is automatically generated by the application. After login, the user must manually select the "Default Profile" from the list of available room profiles and click Connect to be able to use the previous calibrations for camera tracking.

If there are multiple room profiles and the application has been restarted, the application will default to connecting to the last connected room profile after the user logs in. If a room profile exists but the application is not connected to it prior restarting the application, it will not automatically connect to any pre-existing profile after the user logs-in.

Note: if PTZ Camera Audio Tracker v2.0 has been installed but the older version of the Connect page from v1.0 is displayed, please refer to the Troubleshooting section to resolve the issue.

3.3.1 Create Room Profile

This function is only available to the Administrator.

Figure 22 Create Room Profile icon

This function allows you to create one or more room profiles. Pressing the icon launches the Create Room Profile modal dialog that contains the following fields:

- Room Profile Name allows only a maximum of 60 characters. The name must not contain leading or trailing whitespaces, nor the special characters: <, >, :, ", /, \, |, ?, *, as this will be used as the filename for the Room Profile file.
- Select Microphone Model allows the user to select the microphone type that the camera will be paired to. The application currently supports 2 microphone models: Sennheiser TeamConnect Ceiling 2 and Shure MXA920.
- Camera IP Address/Hostname reflects the IP address for the camera. It also allows a camera's fully qualified domain name (FQDN) as input.
- Microphone IP address reflects the IP address of the camera set in Microphone Model field. An error will be displayed if the microphone's IP address does not match with the selected Microphone Model

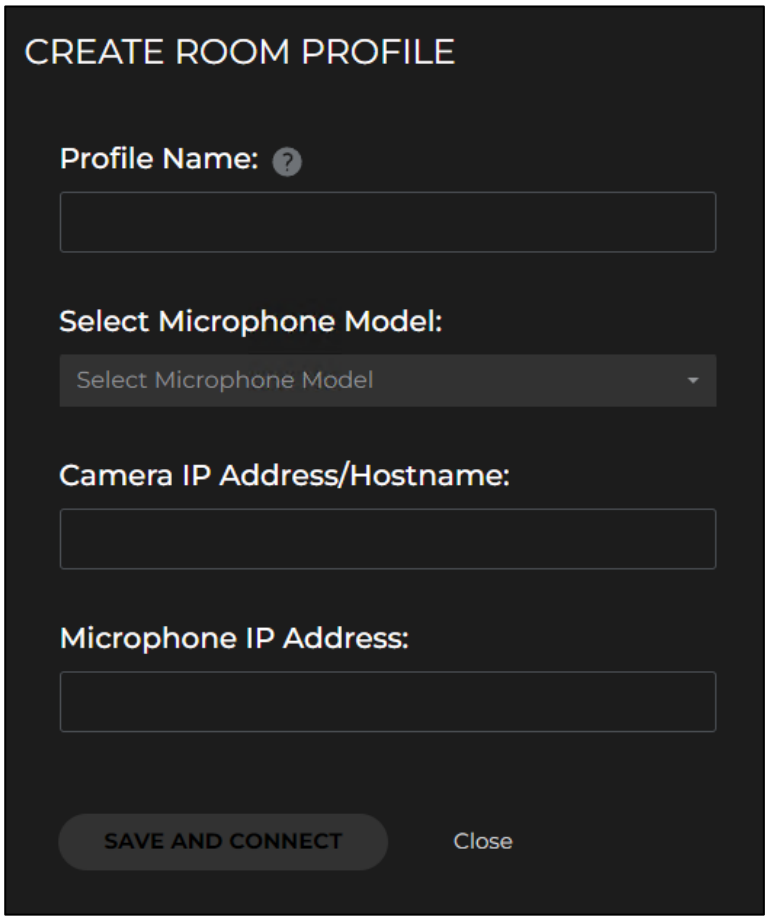


Figure 23 Create Room Profile modal dialog

Once all the fields have been filled in and "Save and Connect" has been clicked, a message will confirm successful creation and connection to the newly created room profile.

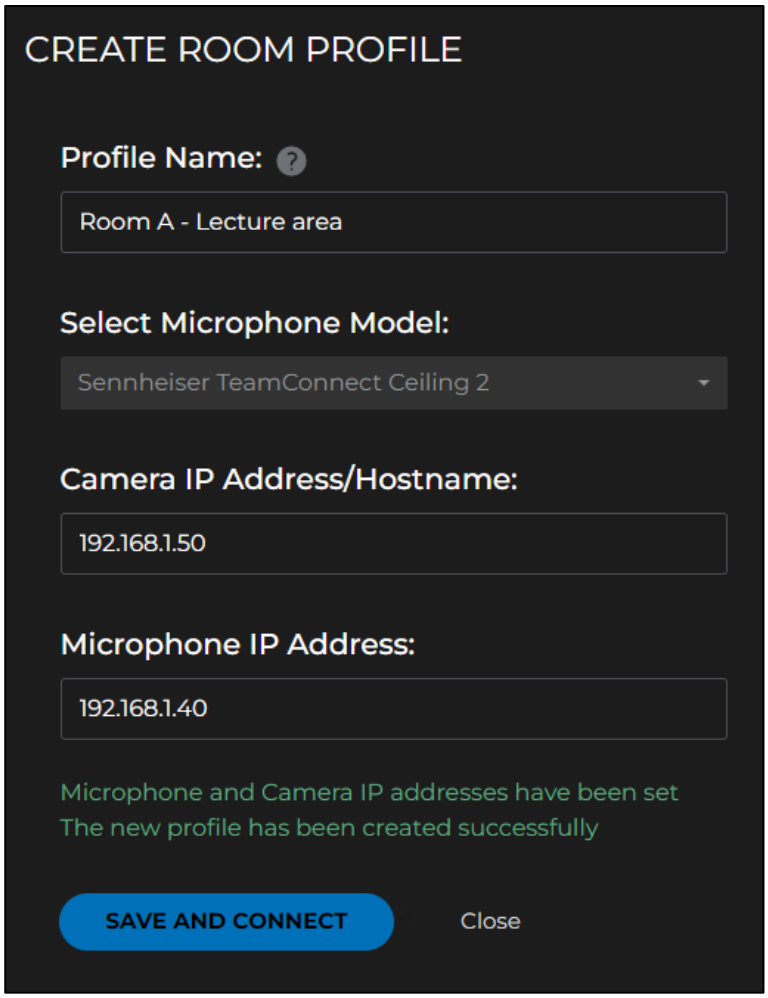


Figure 24 IP addresses setup successful

After a room profile has been created, the user should proceed to Calibration.

3.3.2 Edit Room Profile

This function is only available to the administrator.

To edit a room profile, select the room profile from the list of available room profiles, then click the edit room profile icon.

Figure 25 Edit Room profile icon

Only the following details can be changed:

- Room Profile name
- Camera IP address/Hostname
- Microphone IP address

If there are no modifications made to these fields, the "Save" button will remain disabled. It will only be enabled when at least one field has been modified. Clicking "Save" checks the validity of the room profile, tests the connectivity of IP addresses and microphone model, and applies modifications to the application. Note that executing "Save" does not connect to the modified room profile, thus retains connection with the currently connected room profile. Clicking "Close" exits the Edit Profile pop-up window and returns focus to the Connect page.

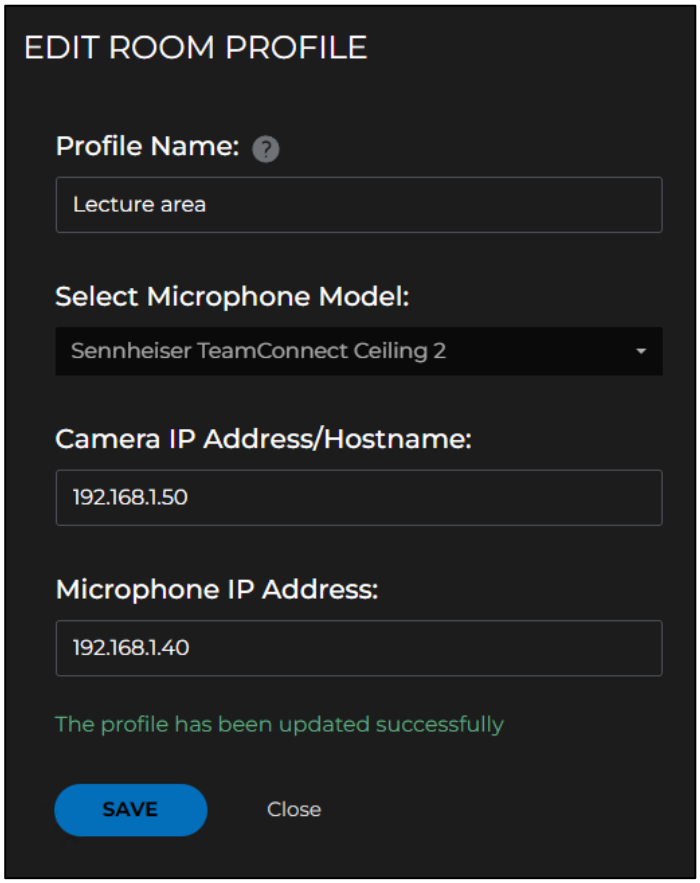


Figure 26 Edit Room Profile modal dialog

3.3.3 Delete Room Profile

This function is only available to the administrator.

To delete a room profile, select the room profile from the list of available room profiles, then click the delete room profile icon. All room profiles can be deleted including the currently connected profile or the migrated default room profile.

Figure 27 Delete Room Profile icon

Upon clicking the delete icon, a delete confirmation prompt will be shown before deletion of the room profile.

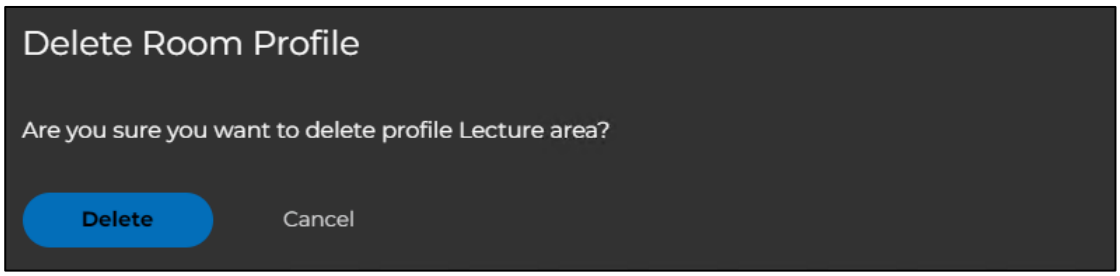


Figure 28 Delete Room Profile confirmation dialog

If the currently connected room profile has been deleted, the application will require the user to select a room profile to connect to. Note that it will not automatically select and connect to the next available room profile. Otherwise, the application will retain connection to its currently connected profile.

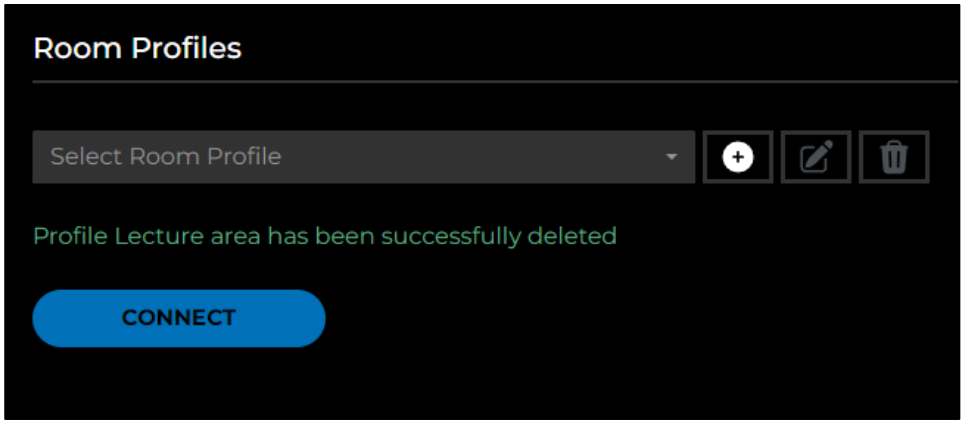


Figure 29After deleting the currently connected room profile

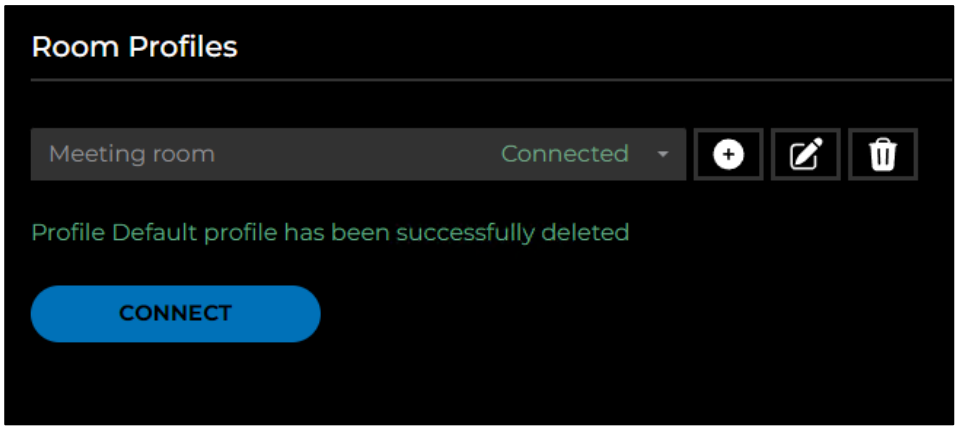


Figure 30 After deleting other room profiles

3.3.4 Connecting to Another Room Profile

This functionality allows a user to switch and connect to another room profile by selecting a profile from the list of available room profiles and then clicking Connect. All calibration and configuration settings of the selected room profile will be loaded once the connection is successful.

After connecting to a room profile, a "Connected" tag will be displayed beside the room profile name. The room profile name will also be displayed in the application's header and will be visible in all pages of the application.

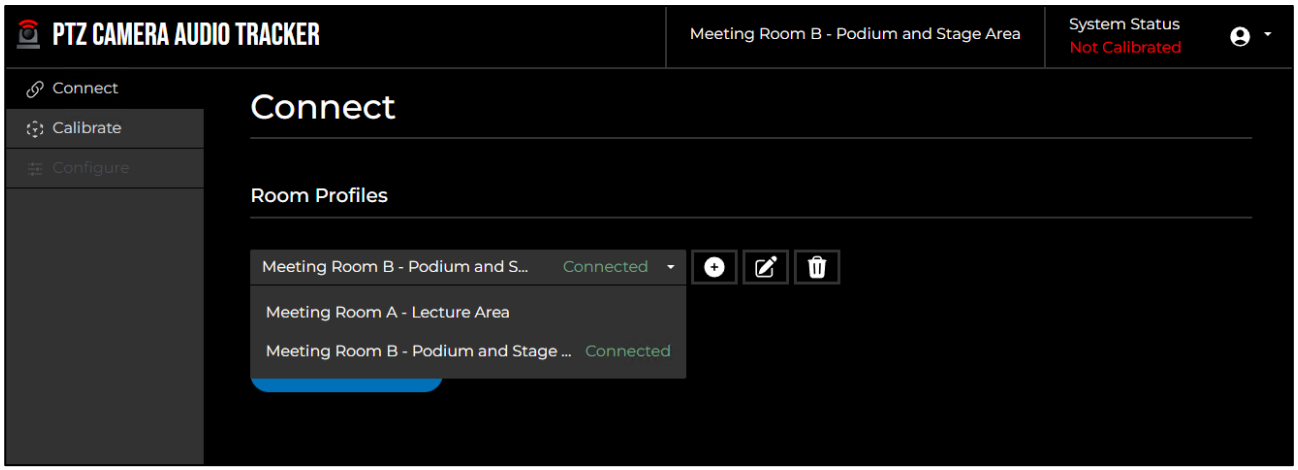


Figure 31 List of available room profiles

The complete room profile name can be viewed by hovering the mouse pointer on top of the room profile name.

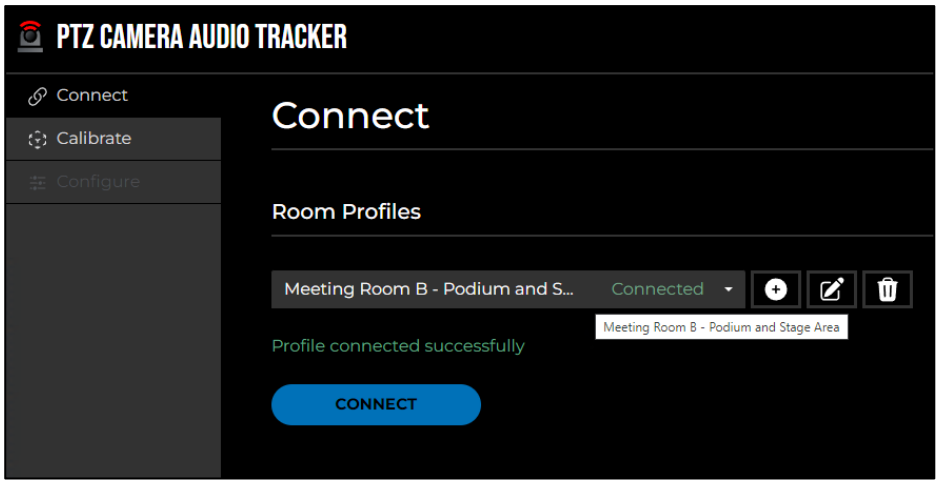


Figure 32 Truncated room profile name when mouse-hovered

3.4 Calibration

This function is only available to the Administrator.

The purpose of calibration is to establish relationships between the predefined camera presets and the microphone beam position ranges. Please ensure that the microphone exclusion zone setting is not excluding camera preset areas which will be calibrated for as microphone pickup will be restricted thus impacting the process.

If calibration data is not created after setting up connections, camera tracking will be in a "Not Calibrated" status, and the Configure page will be disabled, which will prevent camera tracking from being started.

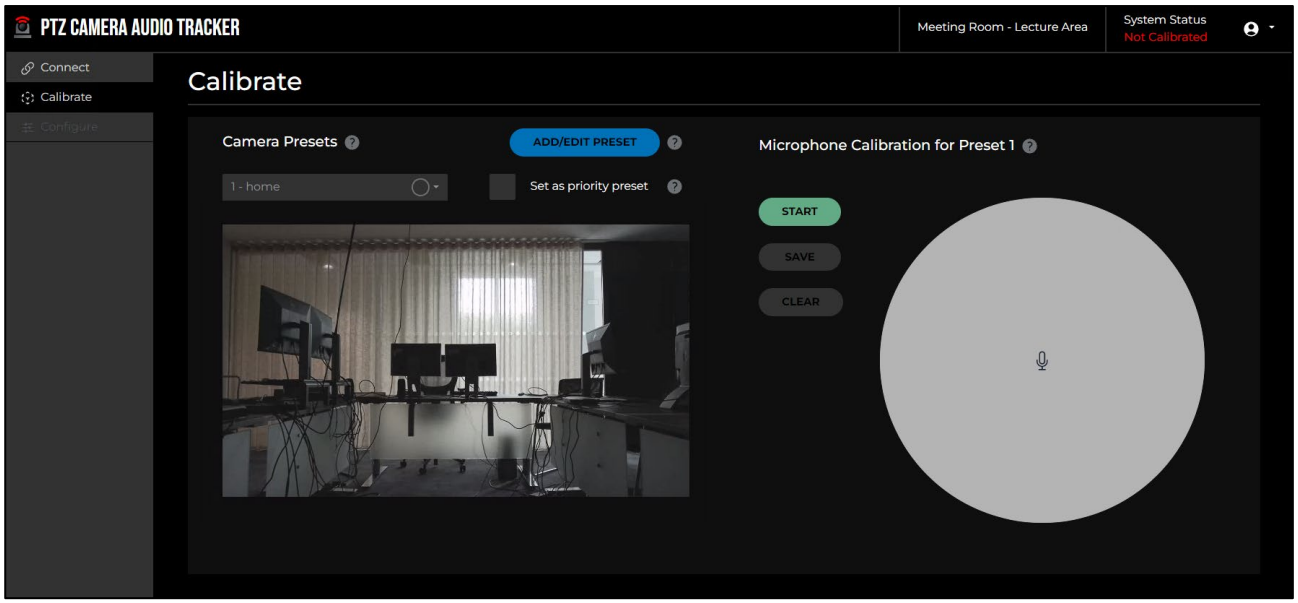


Figure 33 Calibrate page with no calibrated presets

3.4.1 Calibration Requirements

Calibration should be performed on all active presets that camera may move to.

The application can still control the camera tracking of a speaker even if some presets are not calibrated. The camera will never move to a preset unless it is calibrated. Once calibrated, the camera preset will be associated with a microphone azimuth range.

The tracking operation will only start if at least one non-home preset is calibrated.

If the home preset is not calibrated, the camera will only move to the home preset after a period of silence (default 10 seconds), or if no one was speaking at any of the calibrated preset during that period.

3.4.2 Camera Preset Configuration

Please use the Camera Remote Control Software or the web interface for the Canon PTZ Camera to configure presets appropriate for the room being setup for.

There is no limit to the number of camera presets that can be used for the tracking application. There must be one or more active presets, in addition to the home preset (preset #1). Please see the Known Issues and Limitations section for limitation on naming camera presets.

Ideally there should not be significant overlapping among camera presets that are to be calibrated for tracking.

Note that the camera will return to the home preset after a period of silence (or sounds outside any of the targeted areas). Additionally, the home preset does not have to be calibrated for tracking. If the home preset is not calibrated, then the camera will only move to the home preset when there is a period of silence (up to 10 seconds). This preset is commonly set as a wide shot overlooking the entire room.

3.4.3 Calibrating a Camera Preset

To calibrate a camera preset, select the preset from the dropdown list at the left side. The right panel will show calibrated data of the selected preset.

Follow the steps below to calibrate:

- Press the green **Start** button to start recording azimuth data from microphone. The green Start button will turn into a red **Stop** button.
- The user (or an assistant) should speak from several positions while keeping within the camera picture. There should be no other sounds in the room. The recorded azimuth should show in the chart as green dots. Ideally those green dots should form a cluster covering the whole intended area.
- Press the red **Stop** button to stop recording azimuth data. A sector will show on the chart to illustrate the azimuth range for the selected preset.

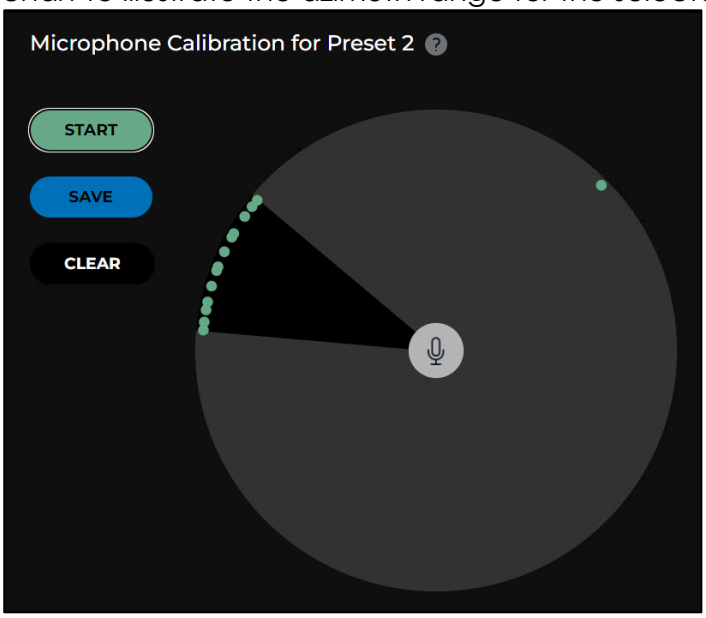


Figure 34 Example calibrating a preset (Preset 2)

- If the data is unsatisfactory (e.g., someone in a different position makes a noise), press the **Clear** button to remove all data for the current present, and repeat the steps above.
- Once satisfactory calibration data has been acquired, press **Save** button to save calibration data.

Note: During calibration, if only one azimuth data was recorded (one green dot) and the calibration was stopped, the sector in the chart will display -3 degrees as minimum boundary and +3 degrees maximum boundary from the original beam position.

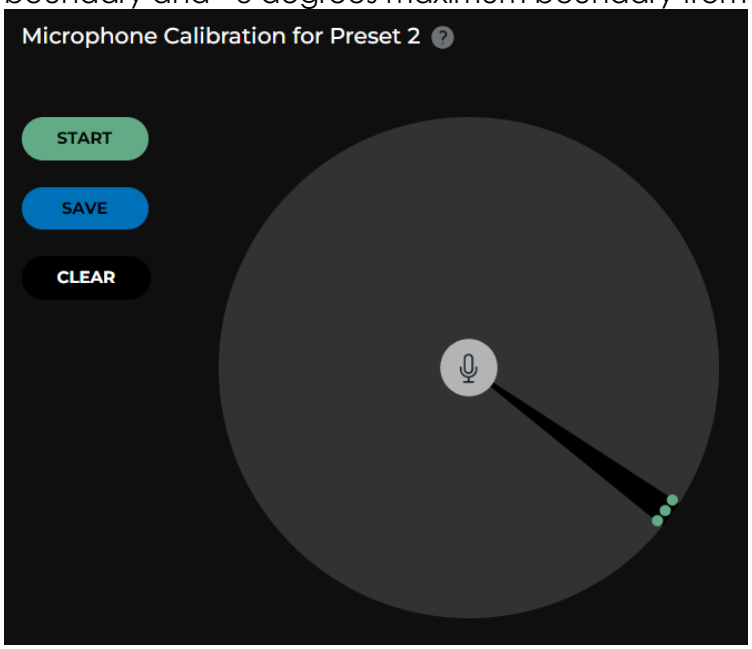


Figure 35 Calibration sector if only one azimuth was recorded

Once a preset is calibrated, use the dropdown menu at the left side to choose another preset to calibrate. The previously recorded calibration data will show as a coloured arc marked with preset number.

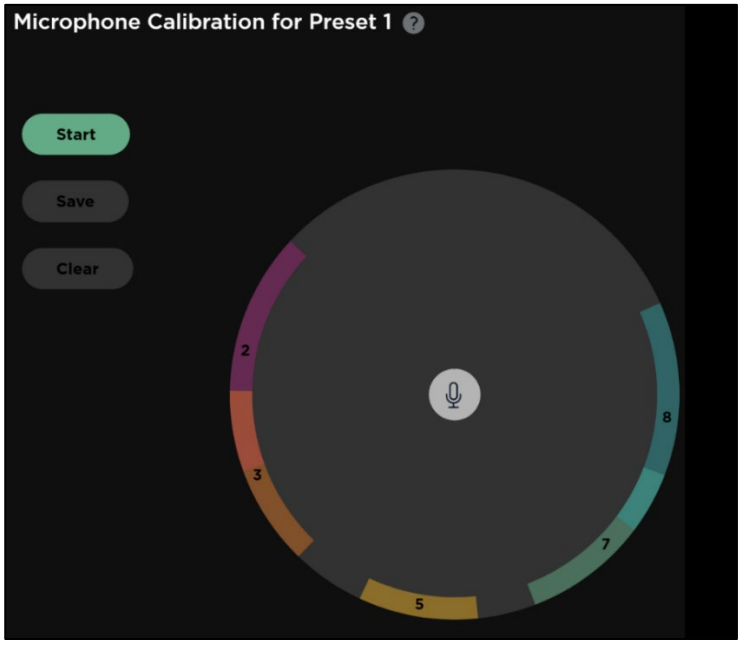


Figure 36 Calibration chart showing 5 calibrated presets

3.4.4 Preset with Poor Quality Data

During the calibration process, you may see this warning for poor quality data.

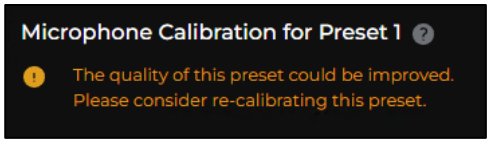


Figure 37 Warning message for calibrated preset with poor quality data

The warning icon is displayed on the preset with poor quality data:

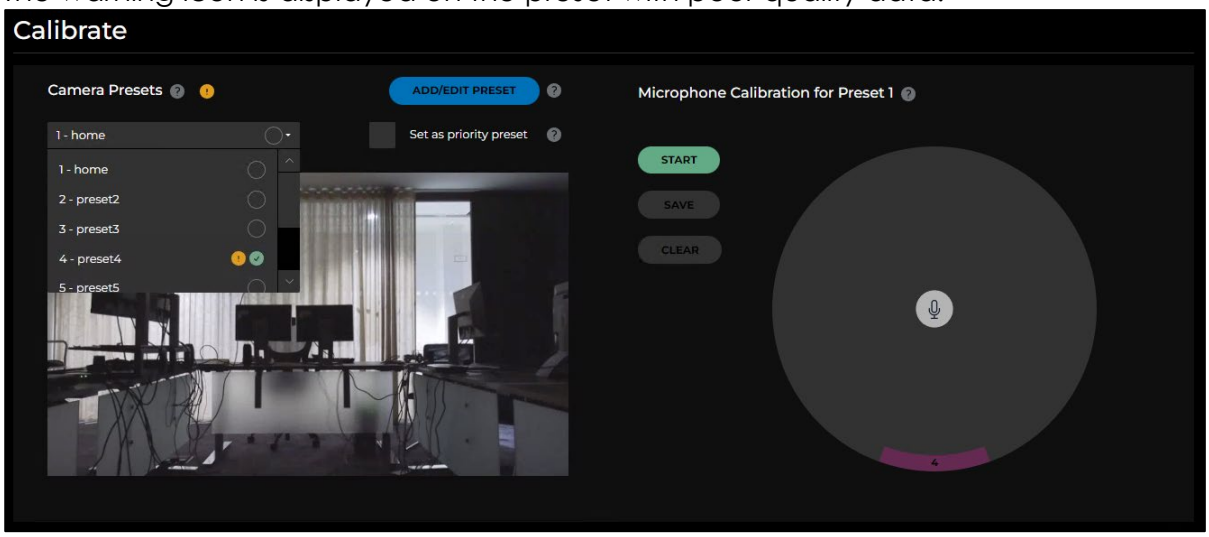


Figure 38 Warning icon displayed when there are poor calibration data

The warning icon tooltip will be displayed if one of the presets was calibrated with poor quality data. This icon is not displayed if there are no calibrated preset or if all presets are calibrated with good quality data:

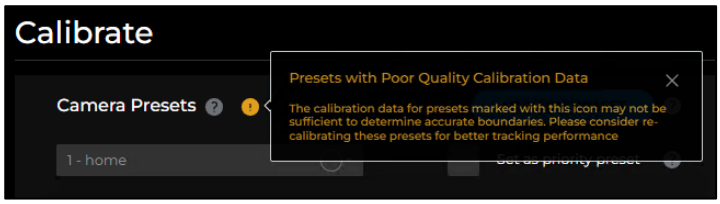


Figure 39 Poor quality calibration data tooltip

Calibration data for a preset is considered as poor quality if:

a. The azimuth data are too dispersed around the circle, therefore no meaningful boundary can be determined, OR
b. The percentage of outlier azimuths is too large (>30%).

This is often caused by unintended background noise during calibration, so it is recommend to clear the azimuth data for this preset, and re-calibrating when the background noise is eliminated.

However, if the preset boundaries are satisfactory despite this warning, the warning can be ignored without impacting camera tracking.

Some examples of presets with poor quality data are given below:

1. In this case, there are two areas with people talking during calibration, and the application cannot determine which is the intended area:

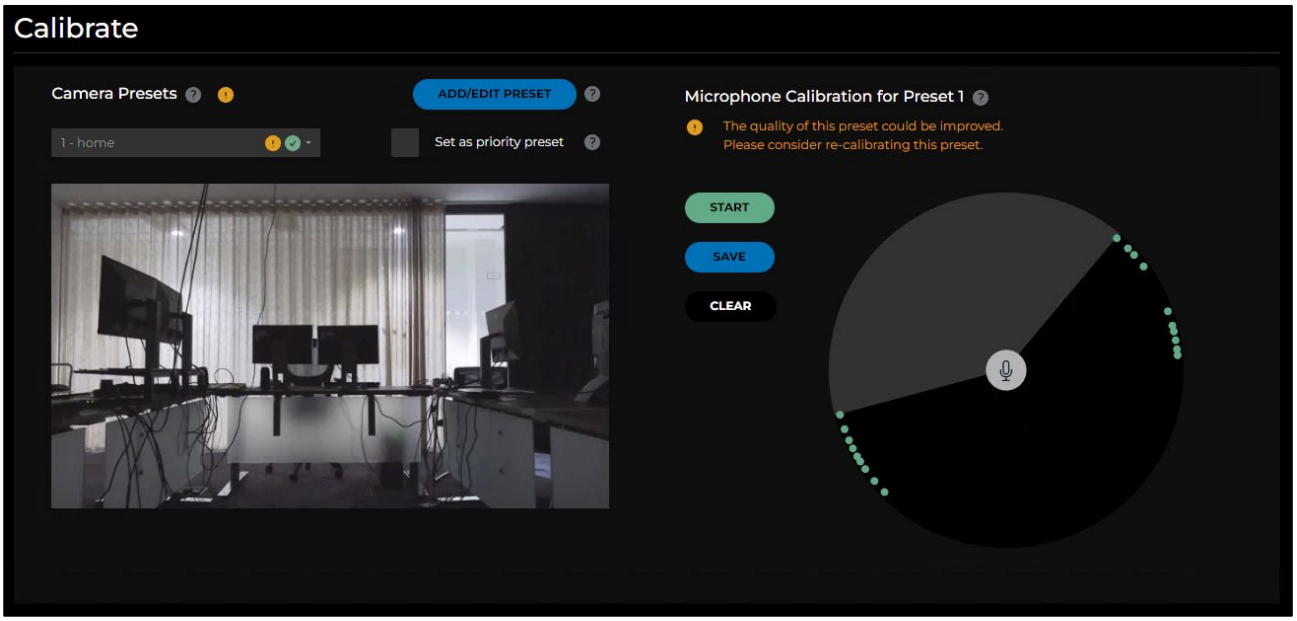


Figure 40 Poor quality data Example 1

2. The azimuth data is too dispersed around the circle to give meaningful boundaries. In general it is not recommended for a preset to cover a very large area:

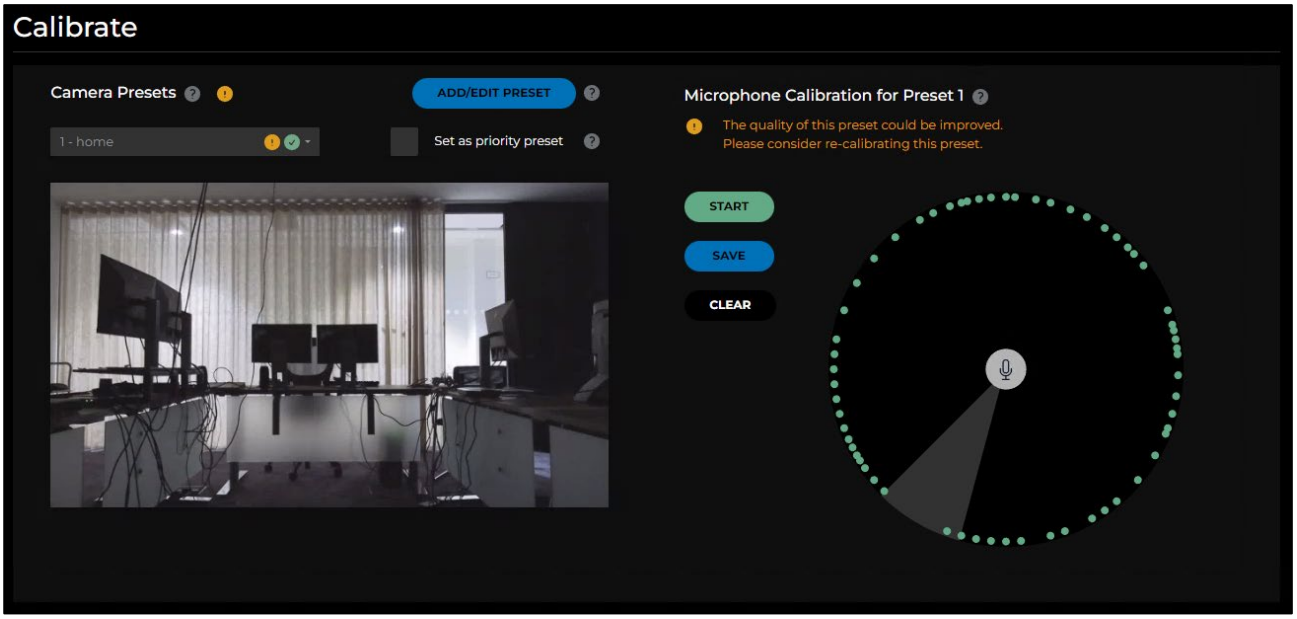


Figure 41 Poor quality data Example 2

3. In this case even though boundaries for the lower half can be determined, the percentage of outliers in the azimuth data is too large (>30%), therefore a warning is given

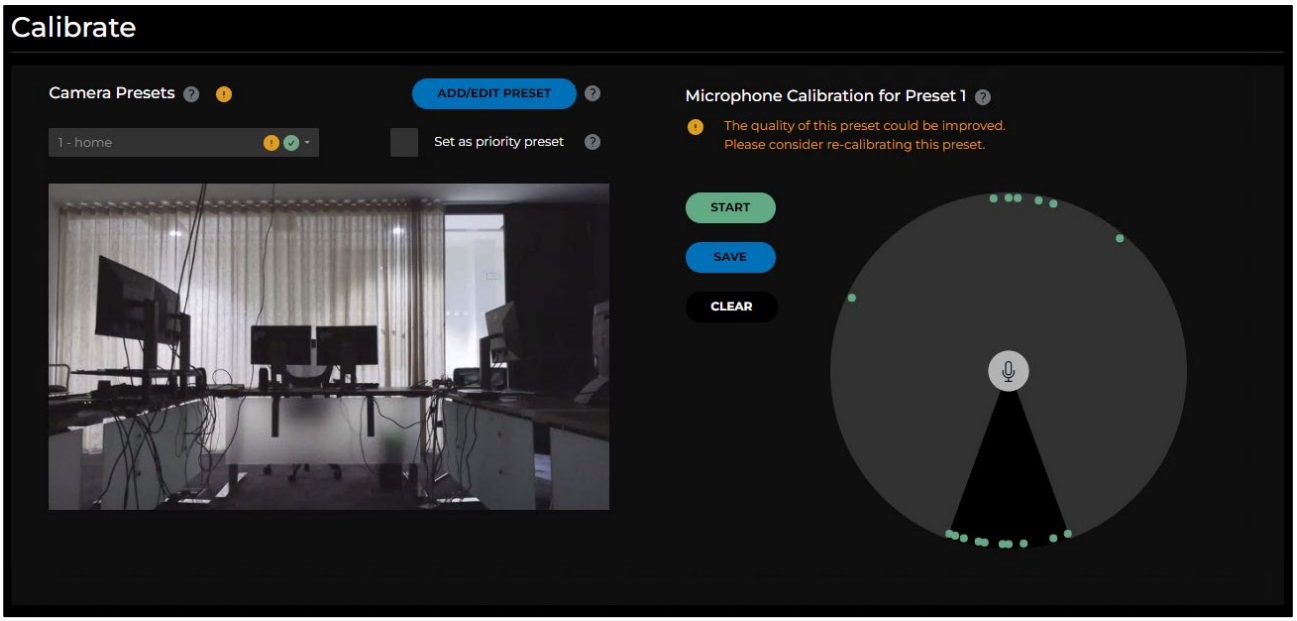


Figure 42 Poor quality data Example 3

3.4.5 Priority Preset

During calibration, a camera priority preset can be optionally selected to be given higher priority during camera tracking, such as a lecturer's stand, or a guest speaker's podium. There can be a maximum of one priority preset. To select a priority preset, choose the preset in the dropdown menu, and tick the checkbox next to it marked with "Set as priority preset".

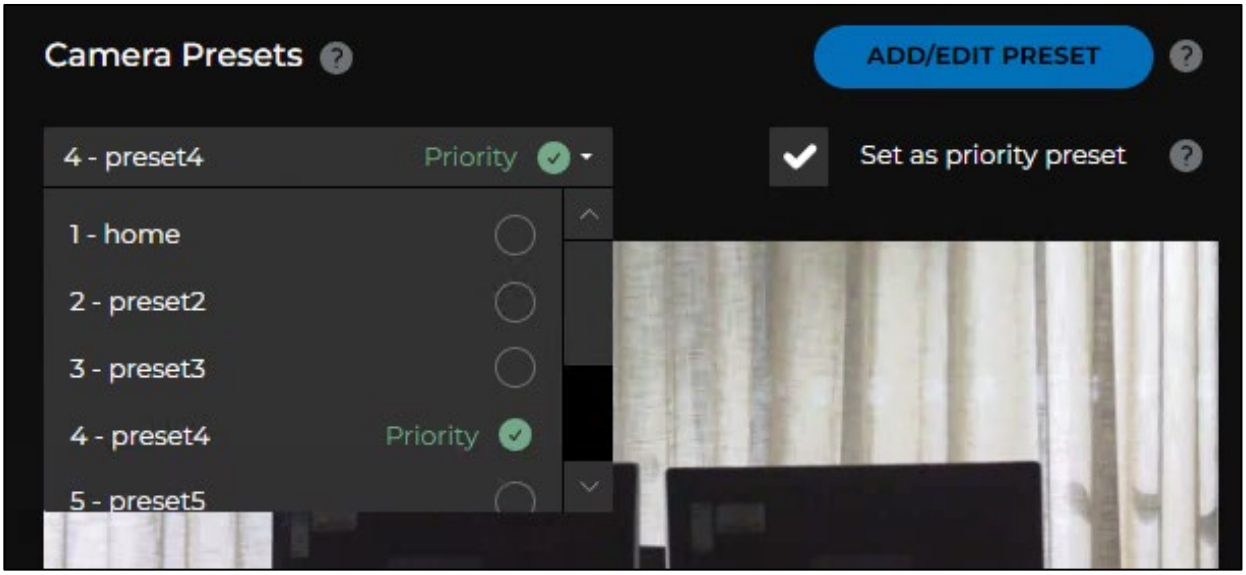


Figure 43 Setting a preset (preset2) as a priority preset

3.4.6 Calibration Data for Obsolete Camera Presets

If the saved calibration file contains data for camera presets that have since been deleted, the "Calibrate" page will prompt the user to delete them.

In the following example, there are saved calibration data for preset 98 and preset 99, however these presets no longer exist within the camera. Clicking "Delete" will delete the saved data for these two presets. If you wish to keep the data despite this, click "Cancel". The saved calibration data will then be preserved.

If the user chooses to keep the calibration data for deleted presets, the obsolete data will not be used during camera tracking. They will also not be displayed on the calibration chart on the "Calibrate" page, to minimise confusion.

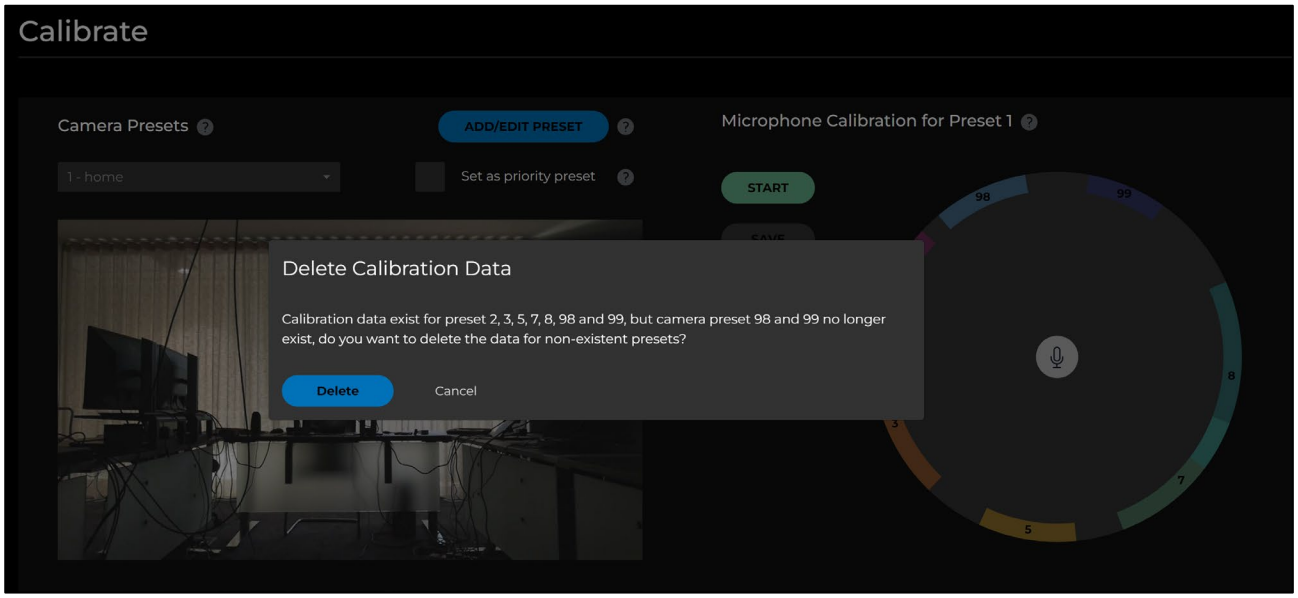


Figure 44 Prompt to delete (or keep) calibration data for non-existent camera presets

3.5 System Status Explained

- **Not Connected**: camera / microphone IP address not set or cannot be connected.
- **Not Calibrated**: requires microphone calibration with camera presets. In order to enable camera tracking, at least one preset that is not the home preset (preset 1) needs to be calibrated.
- **Inactive**: there are enough calibrated presets. Camera audio tracking is available but is currently off.
- **Active**: camera audio tracking is on.
- **Unknown**: If this is seen while logged in, an application error or a communications error has occurred. Close and restart the application, then refresh the web page.

3.6 Microphone Specific Notes and Best Practices

3.6.1 Sennheiser TeamConnect Ceiling 2

Here are some suggestions to configure the Sennheiser TeamConnect Ceiling 2 microphone to improve camera tracking performance.

Room Size: Based on our observations and testing, the camera tracking performs reliably if speaker talks within the maximum distance recommended in the manufacture's manual.

Microphone Settings to Improve Tracking:

- If there are certain areas in the room that background noises are likely to be generated (i.e. AC unit, doorway), the user can configure Exclusion Zones in the microphone's settings for these regions
- Depending on the level of noise in the room, the user can configure the Sensitivity Threshold of the microphone (this is available both in the PTZ Camera Audio Tracker's web UI, or through the microphone's settings)

Limitation: the microphone's Priority Zone should not be used in conjunction with camera tracking. See Known Issues and Limitations for more details.

3.6.2 Shure MXA920

Here are some suggestions to configure the Shure MXA920 microphone to improve camera tracking performance.

Room Size: The microphone should be fitted to the recommendations of the manufacture's manual. Based on our observations and testing, for the camera tracking to perform reliably, the speaker should be within 3.5 meters (11.5 feet) distance away in any direction from the microphone. Therefore, during microphone installation, preset configuration and calibration, it is best to take into consideration of the intended speakers' distance from the microphone.

Coverage Areas Best Practices: Camera tracking works with both Automatic coverage ON and OFF. If the user configures Automatic coverage to ON, some recommendation to improve camera tracking are:

- Configure Coverage Area(s) to closely match the size, shape and usage of the room. An overly large coverage area will reduce effectiveness of talker position pickup.
- If an area in the room is intended to be tracked with camera tracking, it should be covered within a Dynamic Coverage Area.
- If multiple Room Profiles with the same Shure MXA920 microphone are configured, the user may need to update the Coverage Area(s) in the microphone when they change between profiles, if the areas covered are markedly different. The Shure MXA920 microphone also offers saving up to 10 presets, which can be helpful.

Microphone Settings to Improve Tracking:

- Adjust Automatic gain control (AGC) if volume of the speaker is too low to be picked up consistently.
- If the room has very high or low frequency ambient noises, adjust Parametric EQ (PEQ) and configure Low Cut and/or High Cut filters as required
- If there are certain areas in the room that background noises are likely to be generated (i.e. AC unit, doorway), the microphone's Coverage Area should be configured to not include these regions.

Limitation: Please note that camera tracking cannot be used in Dedicated Coverage areas of the microphone. See Known Issues and Limitations for more details.

4 Tracking Operation

This function is available to both Administrator and Operator.

If an Operator is logged in while the application's System Status is "Not Connected" or "Not Calibrated", they will see the following message. An Administrator needs to setup the application before an Operator can use camera tracking.

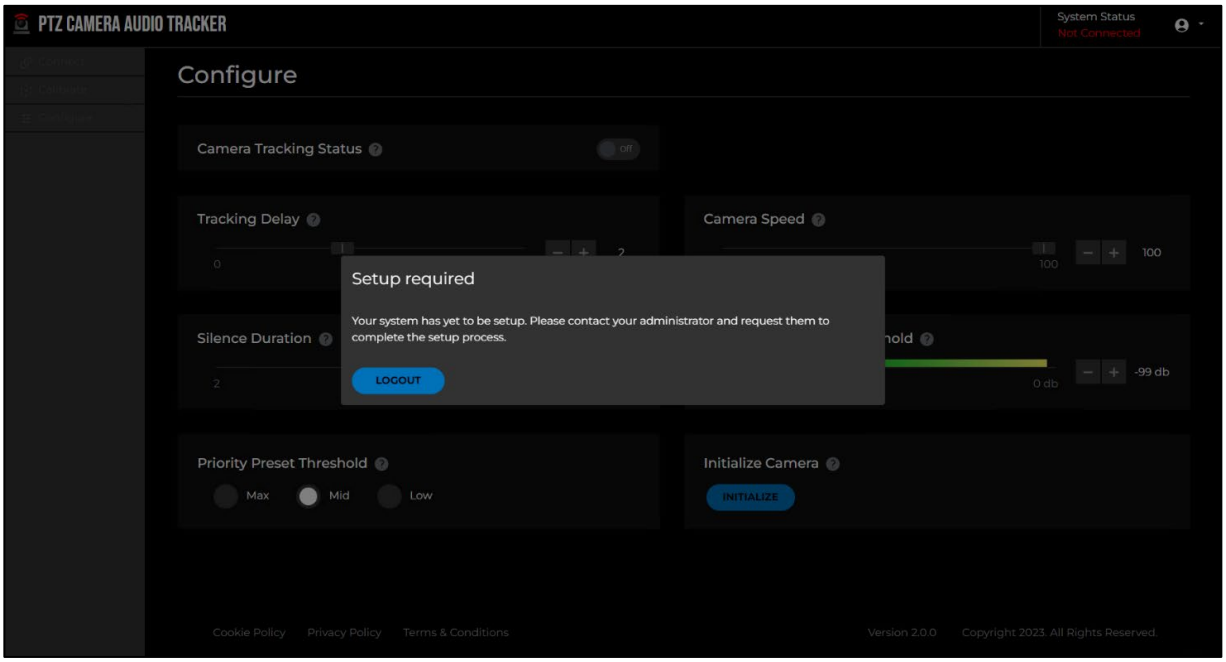


Figure 45 System Setup prompt for Operator

Once there is adequate calibration data, camera tracking automatically starts when the PTZ Camera Audio Tracker application is started.

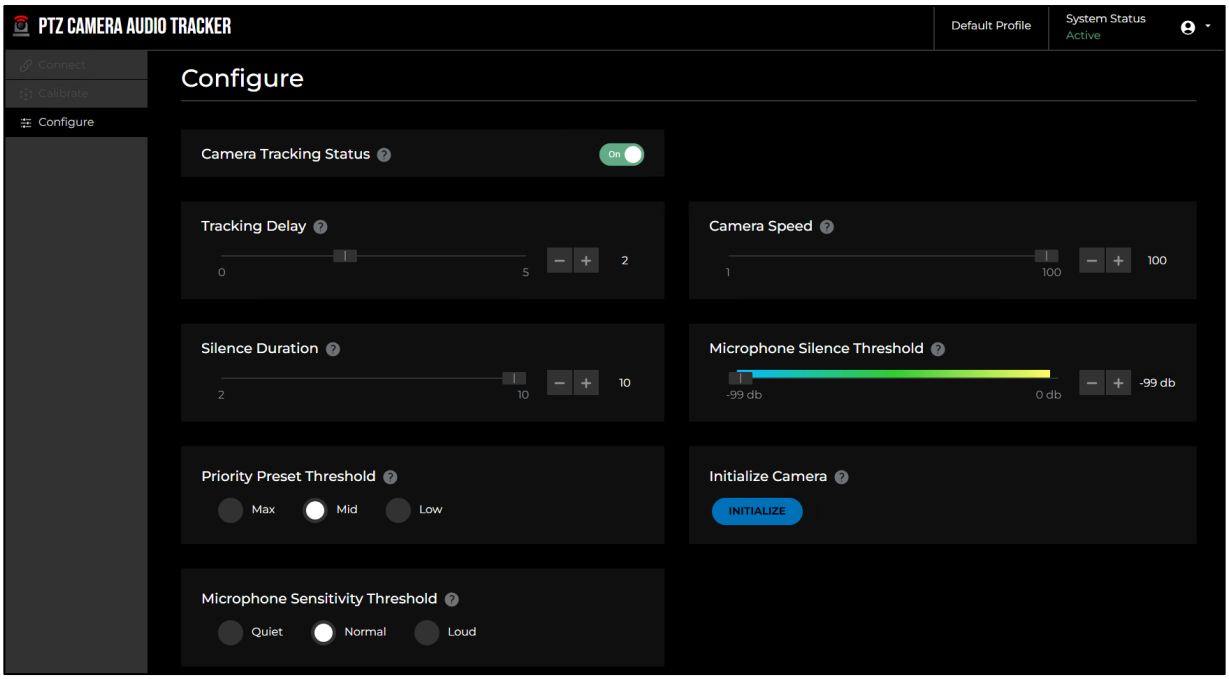


Figure 46 The Configure page for Sennheiser microphone

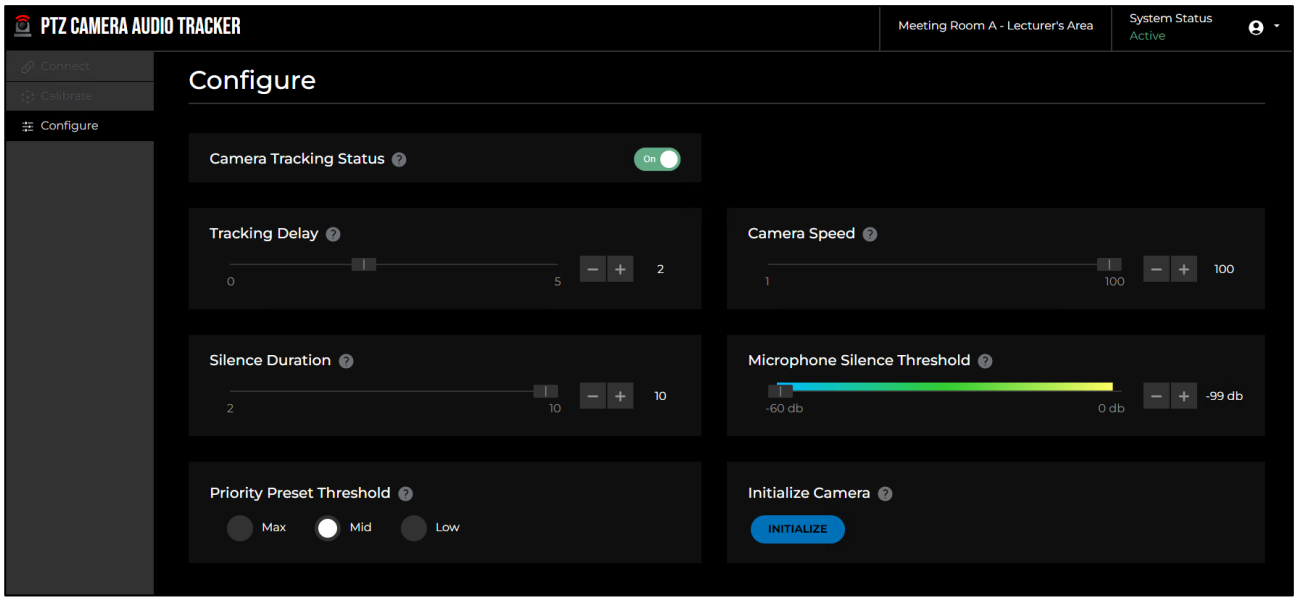


Figure 47 The Configure page for Shure microphone

Note: the camera will automatically start tracking audio even without the user accessing the application web interface. Closing the web page or logging out does not stop camera tracking.

When the user log into the tracking application web page, the system status at the top of the page will show 'Active'.

The On/Off toggle can only be used in the "Configure" page, and while tracking is on, "Connect" and "Calibrate" tabs will be disabled and the user cannot navigate to these pages, to minimise interference with tracking.

4.1 List of Camera Tracking Features and Configurations

Whilst the camera is tracking audio, a user can adjust tracking configuration options if desired. Any change will take effect immediately.

Table 2 Camera Tracking Features

Feature	Explanation and Example Use Cases
Camera Tracking Status	The On/Off toggle used to turn camera tracking on or off.
Tracking Delay	The delay is the time window the application uses to evaluate the microphone beam signal. The default delay is 2 seconds. It can be set to any value between 0 and 5 seconds. When the delay is small, the camera will become very responsive, but this may be undesirable if it changes position too frequently. When the delay is longer, the camera will take longer to change position to the current speaker but will give more accuracy tracking the main speaker / priority speaker when multiple speakers are talking at the same time. **Case 1:** If speaker A is the main speaker, while speaker B occasionally interrupts, the camera will stay with speaker A. **Case 2:** Start with speaker A being the main speaker, B occasionally interrupts. After a while, B becomes the main speaker, then camera moves to B **Case 3:** Start with speaker A being the main speaker and the camera is focused on A. Speakers B, C, D start talking over A simultaneously, so no main speaker exists anymore. The camera will stay in its original position (with A). This scenario works better with a longer delay period.
Silence Duration	The duration (seconds) in which the room should be silent before the camera returns to home preset. **Case 1:** No one in the room speaks and the room is silent for greater than 10 seconds. The camera will return to the home preset (preset 1), which can be set to a wide shot of the whole room. **Case 2:** Speaker A is talking, but outside of any defined camera preset. The camera regards this as silence and will return to the home preset after 10 seconds Note: there is a known issue with this feature, which may not work consistently. See Known Issues and Limitations section for more details.
Priority Preset Threshold	If required, one preset can be selected to be the Priority Preset. When a preset (X) is set as the Priority Preset, the camera will go to preset X whenever a speaker in that preset is talking for more than the Priority Preset Threshold level, even if there are simultaneous speakers in other presets. **To set up a priority preset**: → Login as Administrator and go to the "Calibrate" page → Select a desired preset from the dropdown list

Feature	Explanation and Example Use Cases
	→ Tick the "Set as Priority Preset" check box → Untick the check box will disable the priority preset **Priority Preset Threshold levels:** **Max**: the camera will immediately move to the priority preset if a speaker is within it. Camera will continue to focus on the priority preset as long as the speaker is making some sound within the delay period. **Mid** (default): The camera will track and stay on the priority preset if the speaker is talking at least 20% during the delay period. **Low**: The camera will track and stay on the priority preset if the speaker is talking at least 40% during the delay period. **Case 1:** Preset 2 is set as Priority Preset with Max level. A lecturer is giving a speech. There are some students talking in preset 3, 4. The camera will give priority to preset 2, provided the lecturer is talking for some of the time. **Case 2:** Preset 2 is set as Priority Preset with Max level, but there is no one speaking from within this preset. Two Speakers are having a conversation in presets 3 and 4 respectively. The camera will track as normal between presets 3 and 4 without giving priority to either preset.
Camera Speed	The speed at which the camera will move to a new preset. The range of values is between 1 and 100, with 1 = slowest, 100 = fastest. The default value is 100.
Microphone Sensitivity Threshold	The threshold level the microphone uses to detect sound. This also refers to the background noise level at the room. Permitted values are Quiet, Normal or Loud. The default value is Normal. **Quiet**: microphone will pick up small background noises **Normal** (default): sufficient for a typical conference room **Loud**: microphone will filter out small background noises Note that this feature is only available for *Sennheiser TeamConnect Ceiling 2* microphone
Microphone Silence Threshold	The audio peak range at which the application treats a room as silent. This is used to block background noises so that camera tracking to the intended audio source is not interfered. Set the slider to a higher value if the room is noisy or lower if the room is silent so the camera will only move if the application receives an audio peak greater than the set microphone silence threshold. The plus and minus buttons can also be used to adjust the range. By default, -99 dB is set for Sennheiser TeamConnect Ceiling 2 microphone and -60 dB for Shure MXA920 microphone. **Case 1**: In a classroom setup with the students having a normal conversation, you can set the Microphone Silence Threshold around the range of -45 to -50 dB (for Sennheiser microphone) so that the camera will not move or track to the position of the students.

Feature	Explanation and Example Use Cases
Initialize Camera	Used to re-initialise the camera. This need only be performed if manual initialization is required, e.g., if someone has accidentally knocked the camera resulting in a loss of position.

5 Known Issues and Limitations

Here is a list of known issues and limitations in the PTZ Camera Audio Tracker application. User feedback is welcomed and will aid in the further improvement of this application.

Table 3 Known Issues of the Application

Known Issues of the Application	Notes
Camera does not consistently return to home preset after 10 seconds	There is an issue with the microphone not being reliably detecting silence, and not returning to home preset after 10s consistently
Calibration chart preset label in wrong place and won't show boundaries when there is only 1 azimuth data in a preset	This issue will be addressed in a later version of the application
If camera presets in the PTZ camera have special characters (e.g. space or underscore) in preset name, the preset does not appear in the PTZ Camera Audio Tracker's list of presets	Avoid using space or special characters when creating camera presets
Obsolete preset returns on calibration chart after further calibration	This issue will be addressed in a later version of the application. It will not affect camera tracking.

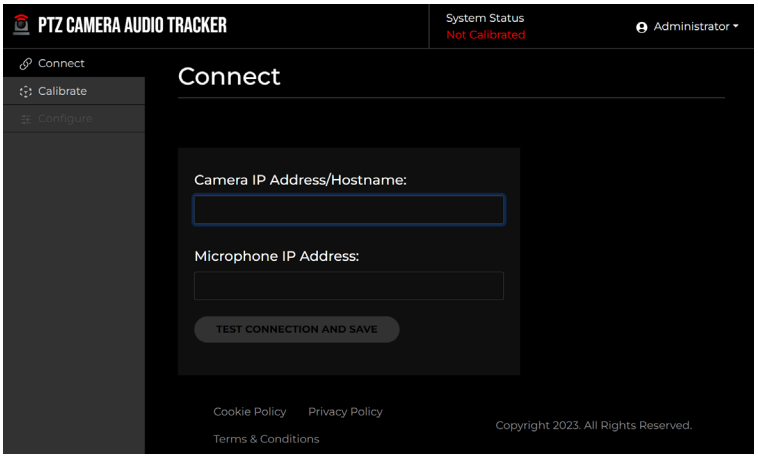
Table 4 Current Limitations of the Application

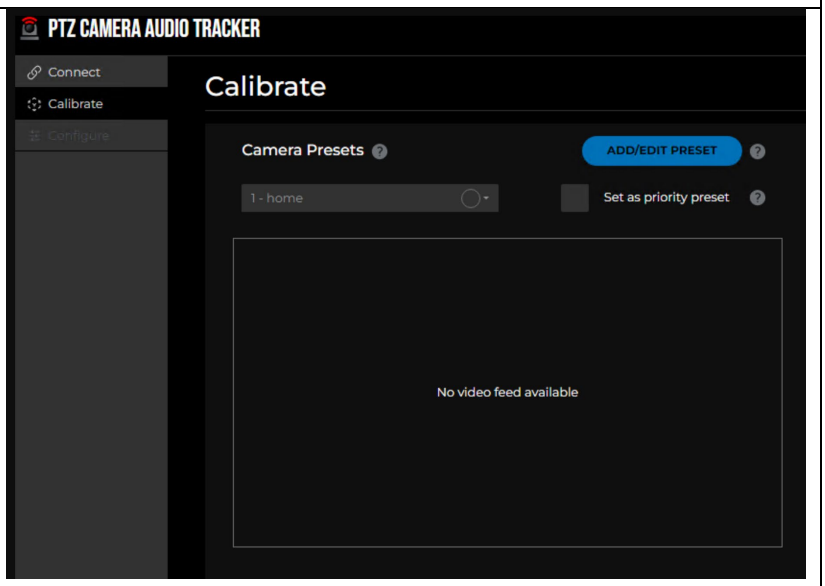
Current Limitations of the Application	Notes
Web interface is not optimised for small screen display such as phones	Recommended to use a Windows PC, or a tablet such as iPad
If camera preset PTZ values are changed, tracker app will not be able to detect the change	If the PTZ value for a camera preset is changed, please also clear the calibration data, and recalibrate for the preset in the PTZ Camera Audio Tracker web interface
Refreshing page will lose session and user has to login again	This issue will be addressed in a later version of the application
Cannot configure the application to use alternative certificates with HTTPS	This issue will be addressed in a later version of the application
(Shure MXA920) Cannot track speakers in a Dedicated Coverage area	With Shure MXA920 automatic coverage on, camera can only track speakers within Dynamic Coverage areas. If the microphone is configured with Dedicated Coverage area(s), speaker positions cannot be detected within those areas, therefore they cannot be used for camera tracking.

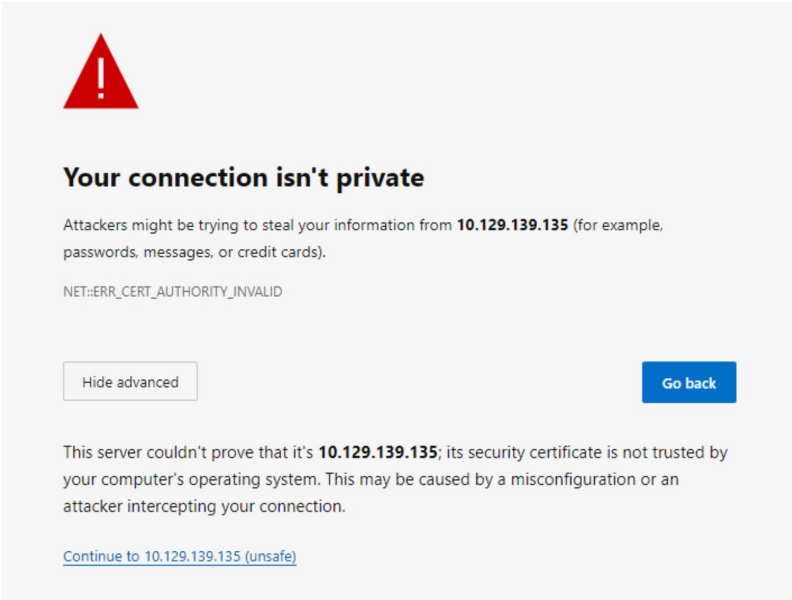
Current Limitations of the Application	Notes
On iPad, if background refresh is off, when minimising or switching between apps will cause the camera video streaming on the Calibrate page to stop	• Turn on background refresh on the iPad will resolve this issue (Settings > General > Background Refresh) • Otherwise, refreshing the webpage will allow the camera video stream to start again

6 Troubleshooting

Table 5 Troubleshooting Guide

Area	Problem	Options
Hardware & Network	The "Status" light on the Camera is flashing orange	The camera requires re-initialization. • Go to the web interface → "Configure" → click "Initialize Camera". The camera will reinitialize and be ready to use in ~1 minute • Alternatively, go to the PTZ camera's setting page → menu on top right → System → Maintenance → General → Pan/Tilt Initialization → click "Execute"
	Cannot connect to the tracking web page from the same or another device	• Check the tracking app is running on the hosting PC (the console needs to remain open) • Check the device is on the correct network • Check the ports are not blocked by a firewall or in use by other applications
	Cannot connect to a room profile, with error message "Camera has an invalid SSL certificate"	• Check if the camera has a valid SSL certificate setup. A valid camera SSL certificate will resolve this issue • Alternatively, go to the camera's settings page → menu on top right → Security → SSL/TLS, and check if the "HTTPS Connection Policy" is set to "HTTPS" only. Change this setting to "HTTP and HTTPS" or "HTTP" will resolve this issue even if the camera still has an invalid SSL certificate
	Video image is lost in Calibrate page	• Check connection with the camera. If the camera is accessible using the PTZ camera's setting page, return to PTZ Camera Audio Tracker application and navigate to other pages and back to "Calibrate" page.
Installation, Upgrade & First Use	PTZ Camera Audio Tracker v2.0 is installed, but the v1.0 Connect page is displayed	If v1.0 of the application was previously installed before upgrading to v2.0, this is caused by browser loading the cache of the older page.  *Figure 48 v1.0 Connect page* To resolve the problem, try: • Hard refresh the page: Ctrl + Shift + R, or Ctrl + F5

Area	Problem	Options
		• If there was a bookmark to the web page of the application, instead of using the bookmark, navigate manually to http(s)://<application-ip-addr>/index.html • Clearing the cache in the browser's settings if none of the above resolves the issue
	Installation or upgrade to v2.0 is unsuccessful, or the application does not work as intended	• If another instance of the application has been installed, uninstall it before running the latest installer • If installation is still unsuccessful, delete ProgramData\Canon\PTZ Camera Audio Tracker before re-installation. Note deleting this folder will remove settings and calibration data from the previously installed application
	On the Calibrate page, "no video feed available" is shown	 *Figure 49 No video feed available* • Check if the PTZ camera is online, connected, and available. Sometimes video feed is not available during camera initializing or rebooting • If the application is installed with HTTPS and this is the first use, it may be caused by the self-signed certificate prompting the insecure content warning message in browser. A workaround is to navigate to the camera's setting's page (https://<camera-ip>), and accept risk:

Area	Problem	Options
		 *Figure 50 Workaround with self-signed certificate*
Shure MXA920 Specific issues	Camera tracking does not work or track as intended	Check the talker is not too far away from the microphone (< 3.5 meters for best tracking performance) In the microphone's settings, check that: • If Automatic Coverage is ON, that the regions intended to be tracked is covered by a Dynamic Coverage Area (and **not** Dedicated Coverage Area) • If Automatic Coverage is OFF, that the lobes are configured corresponding to the intended locations of the speakers • If there are multiple Room Profiles, check that the Coverage Areas configuration in the microphone correspond to the currently selected Room Profile
Camera Tracking	System Status shows "Unknown"	• The application has encountered an error. Close the tracking application (console) and restart it • If the error persists, please submit a report with log files
	Cannot turn on camera tracking by clicking the On/Off toggle	• Check the "System Status" is "Inactive" • The On/Off toggle can only be used in the "Configure" page • If the "System Status" is "Not Connected" or "Not Calibrated", the application needs to be connected or calibrated first
	Camera tracking is picking up unwanted background noise	• In "Configure" → "Microphone Sensitivity Threshold", select "Loud" to filter out background noise • If there is a specific area that continuously generates unwanted noise (e.g. a door or an A/C unit), an exclusion

Area	Problem	Options
		zone can be configured for that area using the microphone's software
	Camera tracking does not pick up sound from desired speaker	• Speaker needs to talk facing the ceiling microphone, and within the microphone's operational range • In "Configure" → "Microphone Sensitivity Threshold", select "Quiet" to increase sound sensitivity. Note that this can pick up unwanted background noise.
	Camera tracking moves too fast between speakers	• In "Configure" → "Delay", change the delay to a longer period (default is 2s)
	Camera tracking is moving the camera, but not to desired preset location	• Reinitialize camera • Check microphone orientation is correct (see "Hardware & Network" above) • Check microphone exclusion zones are correct • In "Calibrate", check preset calibration matches up with the general area of the camera presets • Re-calibrate if required

7 References, Legal and Compliance

- Microsoft .Net: https://dotnet.microsoft.com/en-us/download/dotnet/6.0
- Sennheiser TeamConnect Ceiling 2: Ceiling microphone TeamConnect Ceiling 2 | Sennheiser
- Shure MXA920: MXA920 - Ceiling Array Microphone - Shure USA
- Canon PTZ: PTZ Cameras & Remote Network Cameras – Canon Europe (canon-europe.com)
- Canon CR-N300: Canon CR-N300 PTZ Camera – Canon Europe (canon-europe.com)
- Canon Remote Camera Control: https://www.canon-europe.com/support/consumer_products/products/remote-camera-system/cr-n300.html
- Open-Source Software Usage for PTZ Camera Audio Tracker Development for Released Products: This is contained in the released software under Licenses. Also refer to the Terms & Conditions on the PTZ Camera Audio Tracker web page