# LS SWIR SDK

## User Guide

Version 1.0.0 | Oct. 1, 2025

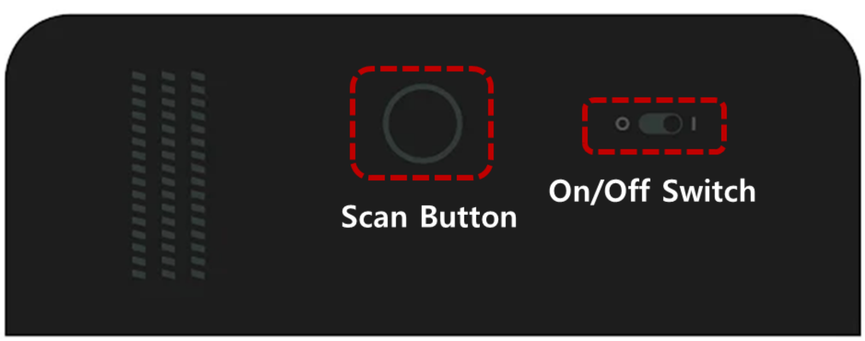
STRATIO, INC. | linksquare.io

# Contents

# 1 Product Overview

## 1.1 Top view


## 1.2 Side view



# 2. Installing Application

## 2.1 System Requirements

The following are the minimum system requirements to use the LS SWIR SDK:

- **Windows**: Windows 10 (64bit) or higher
- **macOS**: macOS Ventura (version 13) or higher
- **Android**: Android 5.0 (API 21) or higher
- **iOS**: iOS 14.0 or higher

## 2.2. Installation

This section explains how to download and install the LS SWIR SDK app.

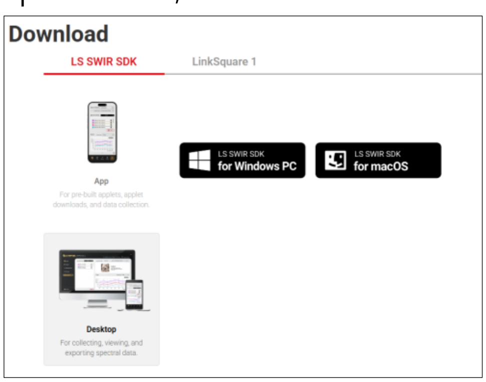
### 2.2.1 Download link

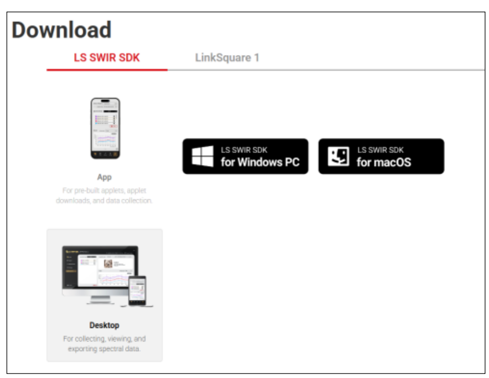
First, access the official download page through the link below.

- **Download Link**: https://linksquare.io/download/

Once you access the page, make sure the '**LS SWIR SDK**' tab is selected. LS SWIR SDK is available in two versions: 'App' for mobile/tablet and 'Desktop' for PC. Select either App or Desktop, then click the button for your operating system to proceed with the download.

- App: App Store (iOS), Google Play Store (Android)
- Desktop: Windows, macOS



### 2.2.2. Installation

#### iOS (App Store)

1. In the 'App' section, click Download on the App Store button.
2. In the App Store, tap 'Get' to proceed with the installation.
3. Once the installation is complete, you can find the app icon on your home screen.

#### Android (Google Play Store)

1. In the 'App' section, click GET IT ON Google Play button.
2. In the Play Store, tap "Install" to proceed.
3. Once the installation is complete, you can find the app icon in your app drawer.

#### Windows

1. In the 'Desktop' section, click LS SWIR SDK for Windows PC button to download the installer file (`.exe`).
2. Run the downloaded file.
3. Follow the on-screen instructions to proceed with the installation. If a "User Account Control" pop-up appears, click 'Yes'.
4. Once installed, you can run the LS SWIR SDK from your desktop or Start Menu.

#### macOS

1. In the 'Desktop' section, click LS SWIR SDK for macOS button to download the disk image file (`.dmg`).
2. Open the downloaded file to show a Finder window.
3. Drag the LS SWIR SDK app icon to the 'Applications' folder to copy it.
4. Once installed, you can run the program from Launchpad or the Applications folder.

### 2.2.3. App Permission Requests

When you first launch the app, it may request permissions required to use LS SWIR SDK. For smooth device connectivity and app usage, please allow the permissions below.

**Android**

- Bluetooth: Required to search for and connect to LS SWIR SDK devices. On Android 12 and higher, a "Nearby devices" permission may be displayed.
- Location (some devices/OS): On Android 11 and below, location permission may be required for BLE scanning.
- Camera: May be required for scanning QR codes when importing a project.

**iOS**

- Bluetooth: Required to search for and connect to LS SWIR SDK devices.
- Camera Access: May be required for scanning QR codes when importing a project.
- Photo Library Access (Optional): Access to photos/files may be needed when adding sample images.

**Windows / macOS (Desktop)**

- Bluetooth: On macOS, you may need to consent to Bluetooth access when using BLE.

Note: **If you deny permissions, some app features may not function correctly.** You can change permission settings later in the app's settings menu or your OS's settings app. In particular, denying Bluetooth permission will prevent the LS SWIR SDK device connection feature from working, so please be sure to allow it.

# 3. Getting Started

## 3.1 Power On

Turn on the power by sliding the power switch from Off to On (O → I).

The green Power LED will blink, and the device initialization process will proceed. Once initialization is complete, the Power LED will remain on.

## 3.2 Charging Battery

Connect the USB cable to the LS SWIR SDK.

When the battery is charging, the charging LED turns on. When charging is complete, the charging LED turns off.

## 3.3 Connecting with the App

### 3.3.1 Device Connection

The LS SWIR SDK device can be connected via Bluetooth Low Energy (BLE) or USB.

- **Bluetooth Connection**: The PC must have built-in Bluetooth functionality, or an external Bluetooth adapter is required if not.

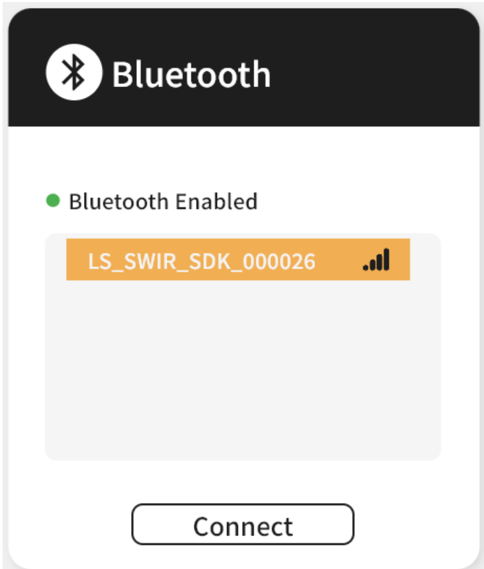
- **USB Connection**: One or more USB ports and a USB-C type data cable are required.

### 3.3.3 Bluetooth Connection (Desktop/Mobile)

**Prerequisites**

The following conditions must be met to connect to the device via Bluetooth.

- The device must be powered on and the initialization process must be complete.
- The Bluetooth function on the desktop or smartphone must be turned on.
- For smartphones, the app's Bluetooth permission request must be approved.




**Connection Procedure**

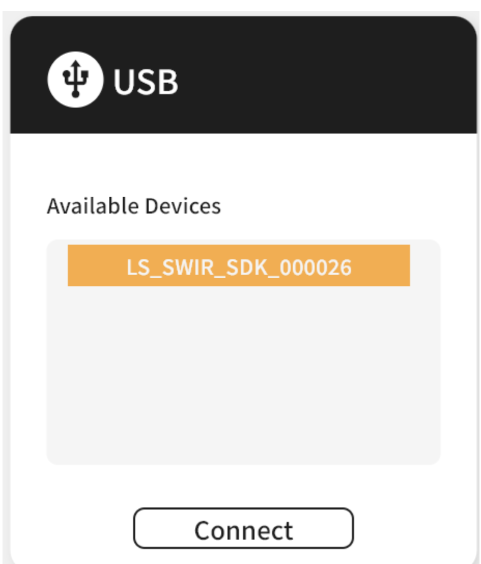
If the Bluetooth function is turned on, connect to the device in the following order:

- When the device is powered on, it becomes discoverable via Bluetooth.
- The discovered device is displayed in the list.
- Select the device to connect to and click the "**Connect**" button.

### 3.3.4 USB Connection

**Prerequisites**

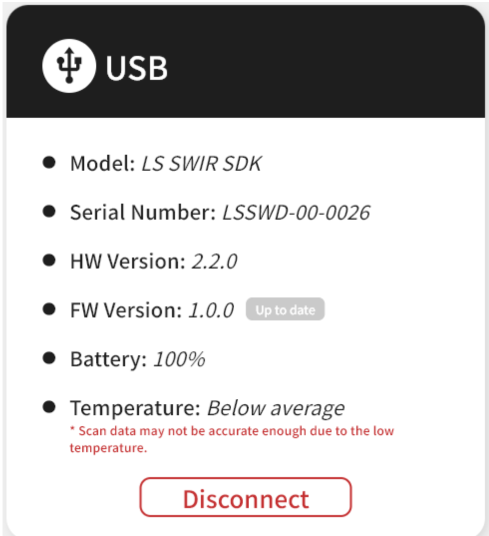
For desktop (Windows, macOS), connection with the device is possible using a USB cable.
Connect the desktop and the device with a USB-C type cable.




**Connection Procedure**

- Connect the device using a USB cable.
- The connected device is displayed in the list.
- Select the device to connect to and click the "**Connect**" button.

*Note: Can only be used on desktop (Windows/MacOS).




**Successful Connection**

Upon successful connection with the device, the device's status LED turns on, and the device information is displayed in the app.

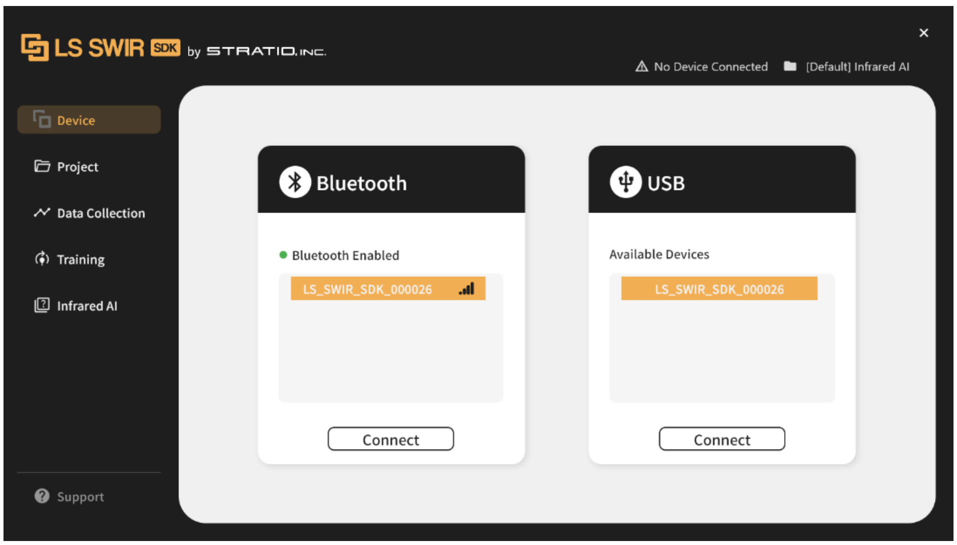
- **Model**: The model name of the device
- **Serial Number**: The serial number of the device
- **HW Version**: The hardware version of the device
- **FW Version**: The firmware version of the device. If a newer firmware version exists than the device's current version, an **Update Available** button is displayed.
- **Battery**: The current battery charge level of the device is displayed.
- **Temperature**: The sensor temperature of the device is displayed.

# 5. App Feature

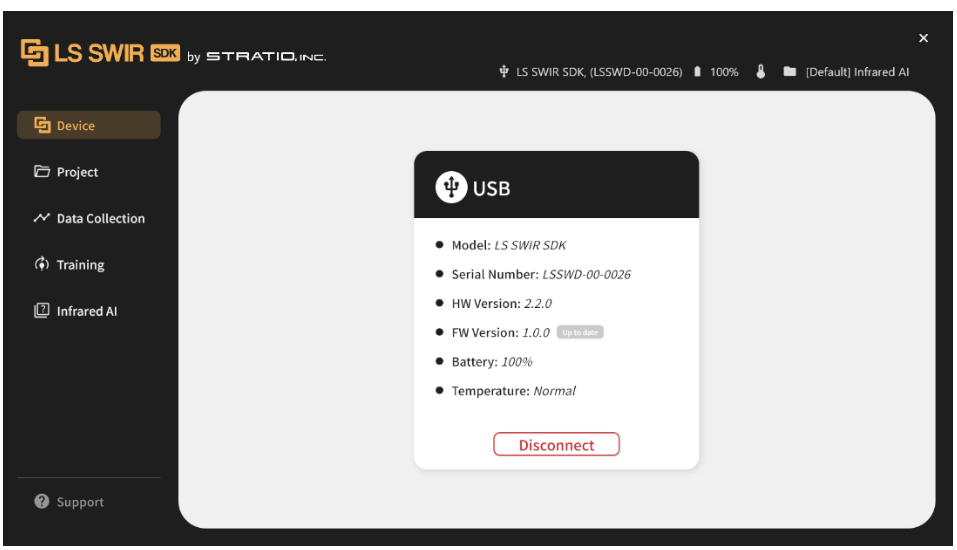
## 5.1 Device

You can search for connectable LS SWIR SDK devices and connect to the discovered device to use it. For **Windows** and **macOS**, both **Bluetooth** and **USB** can be used. **Tablet** and **Mobile** apps can only use **Bluetooth**.

When a device is found, it is displayed in the list. Select the device from the list and press the **Connect** button to connect to the selected device.

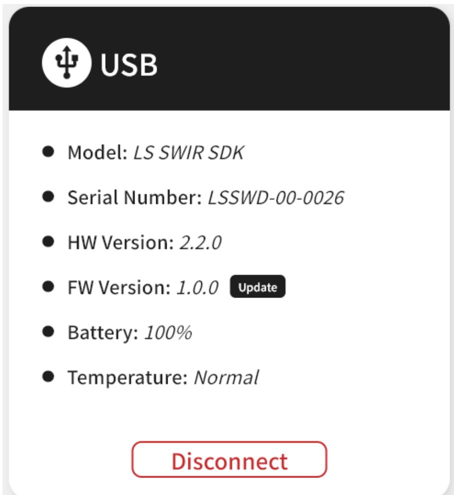



After a successful connection, the device information is displayed.

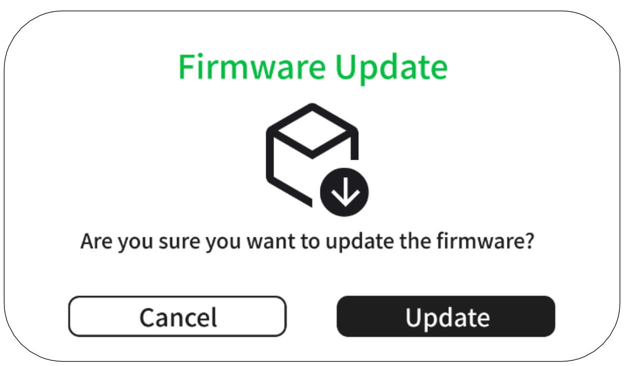


### 5.1.1 Firmware Update

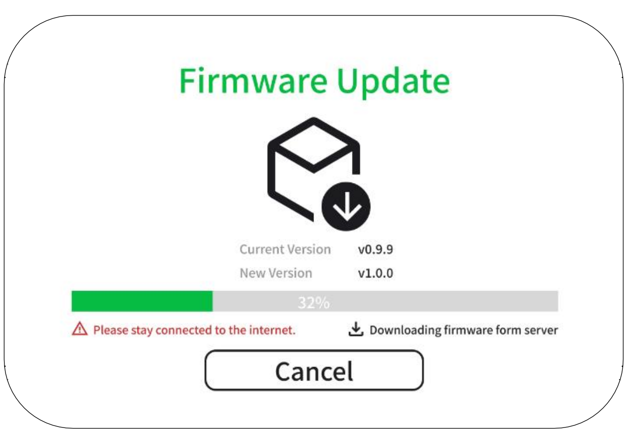
This function updates the device's firmware to the latest version. An **internet connection** is required to proceed with the firmware update. If you disconnect the internet or turn off the device power during the update process, it may cause problems with device operation.




If a newer firmware version exists than the firmware of the USB-connected device, an Update button is displayed next to FW Version.




Clicking the **Update** button displays a pop-up window to confirm if you want to proceed with the firmware update.

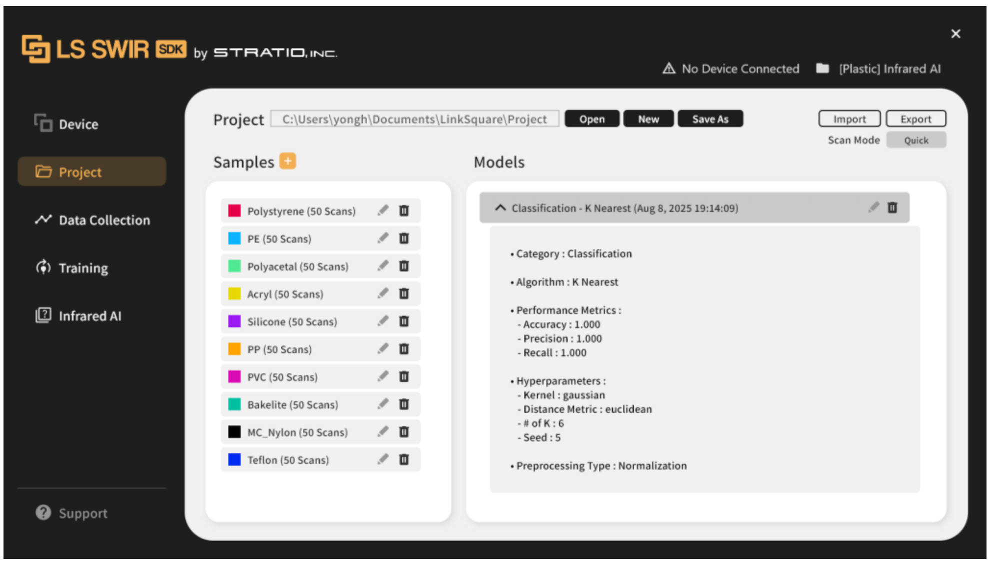



Clicking the **Update** button starts the firmware update, which may take some time to complete.

## 5.2 Project

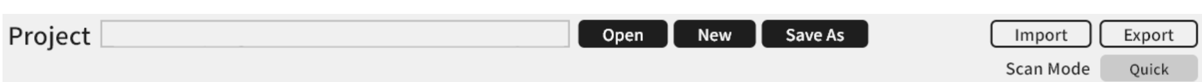
You can manage projects for saving data collected by the LS SWIR SDK.

Projects allow you to create samples and manage the spectral data collected from the LS SWIR SDK device, saving them per sample. You can also check and manage the **Infrared AI Models** trained with the collected data.




### 5.2.1 Project Meu

You can create a new project, open a saved project, and save it under a different name. You can also share a project with other devices by exporting it and then importing it.



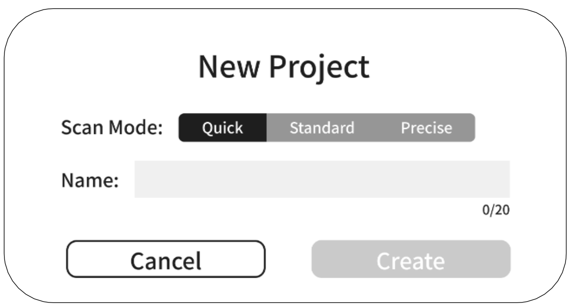
### Open Project

Loads a saved project. For desktops, a file selection window is displayed to select the saved project. You can select a **".proj"** file.

For tablets and smartphones, a list of projects saved in the app is displayed.

### New Project

Allows you to name and create a new project. The project name can have a maximum of **30 characters** and allows English letters (upper/lower case), numbers, '-', and '_'.



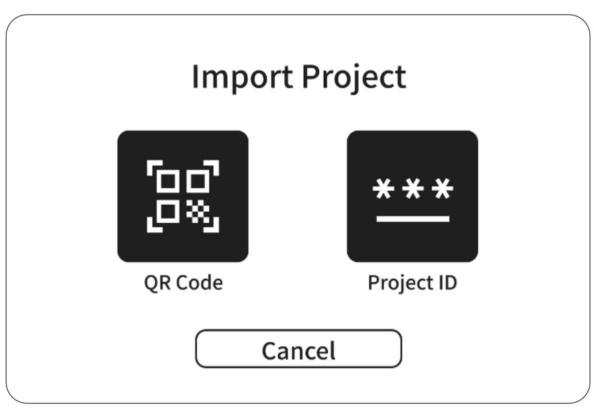

- **Scan Mode**: You can select one of three options, and this setting is permanently applied to the project.
  - **Quick**: Faster scan speed, but slightly lower data accuracy.
  - **Standard**: A general mode that balances scan speed and data accuracy.
  - **Precise**: Slower scan speed, but the highest data accuracy.

### Save As

Saves the current project under a different name. If successful, the currently open project is closed, and the newly saved project is loaded.

### Import

Imports a project that was exported from another device to this device. To import a project, you need the **QR Code** or **Project ID** generated during the export process.

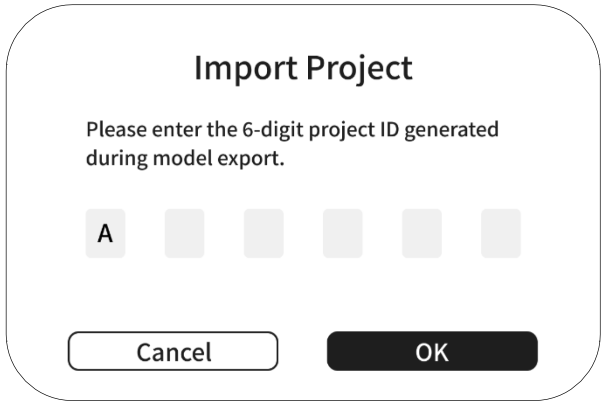


- **QR Code**

Scans the QR code displayed on the Export screen with the camera to import the project.

- **Project ID**

Enters the 6-digit Project ID displayed on the Export result screen to import the project.




**Export**

Exports the current project for easy sharing with other devices or saves the spectral data stored in the project as CSV

- **Project**

Exports the entire project. The project file is uploaded to the server. You can retrieve the project file uploaded to the server by scanning the QR code or entering the 6-digit Project ID in the Import menu.

* Note: The file uploaded to the server is only valid for about **5 minutes**. After 5 minutes, it is automatically deleted from the server, and import is no longer available. Perform the export again if necessary.

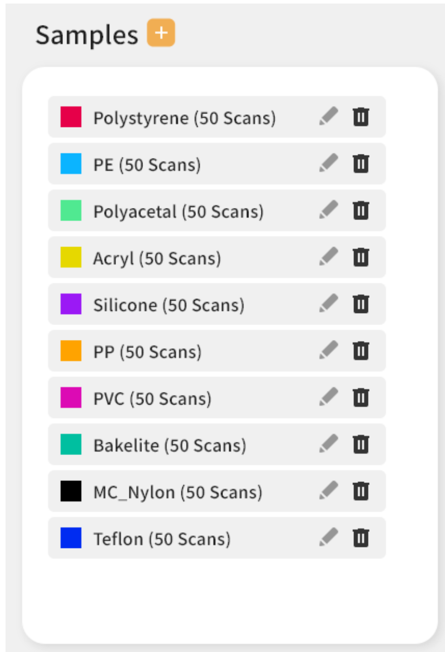

- **CSV**

Saves the spectral data collected in the project as **CSV format** files, categorized by sample. The CSV file is automatically saved to the following path depending on the device used:

- **Windows**: LinkSquare₩Exports (inside the My Documents folder)
- **macOS**: LinkSquare/Exports (inside the Documents folder)
- **Android**: Documents₩LinkSquare₩Exports (inside the internal storage)
- **iOS**: LS SWIR SDK₩Exports (in the Files app's On My iPhone)

### 5.2.2 Samples Menu

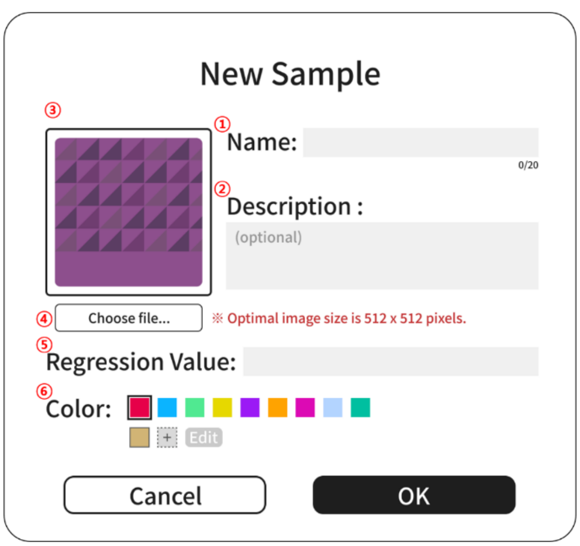
This menu manages the samples included in the project. A list of samples included in the project is displayed.




**Add Sample**

Creates a new sample in the project.

You can enter the detailed information of the sample.




① **Name**: The Sample name (**Required**)

② **Description**: Additional description for the sample (Optional)

③ **Sample Image**

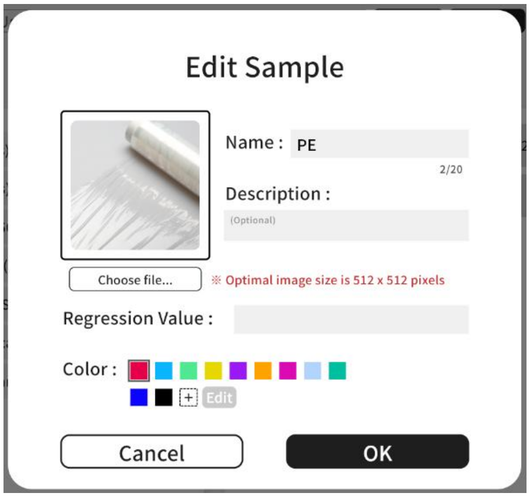
④ **Choose File**: Selects the image of the sample to be displayed on the Infrared AI result view. (Optional)

⑤ **Regression Value**: The value used for regression model training (Optional)

⑥ **Color**: Selects the color to be displayed on the spectral graph (**Required**)

**Edit Sample**

Modifies the information of the selected sample. Press the **OK** button after modification to save the changes. Clicking the **Cancel** button cancels the changes and uses the existing information.

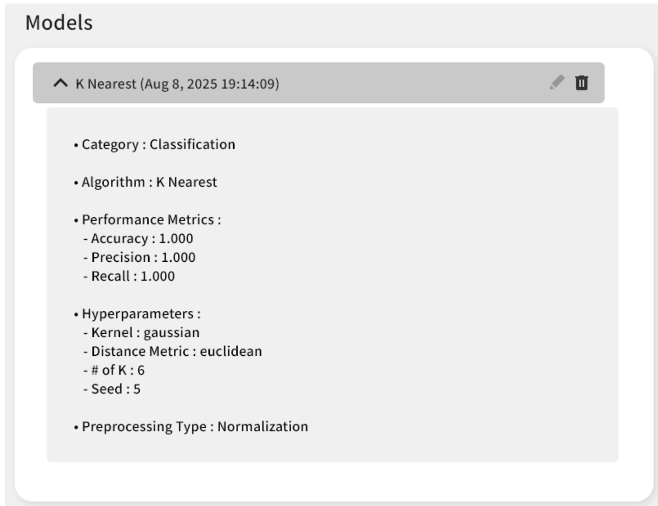



**Delete Sample**

Deletes the selected sample. **The deleted sample cannot be recovered.**

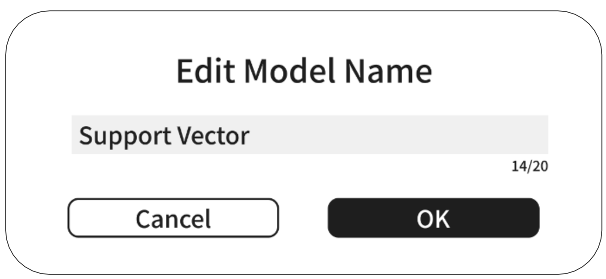
### 5.2.3 Model Menu

A list of Infrared AI Models saved in the project is displayed. Clicking on each model name allows you to view detailed information.



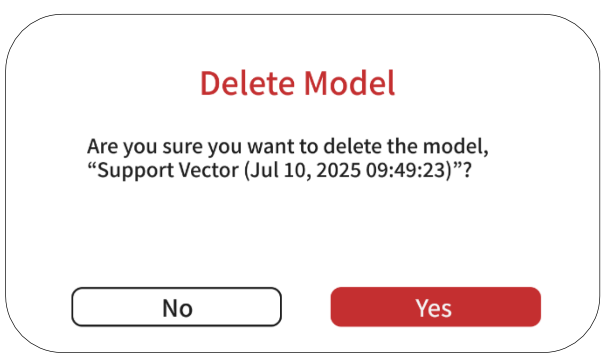

**Edit Model Name**

Change the name of the model.



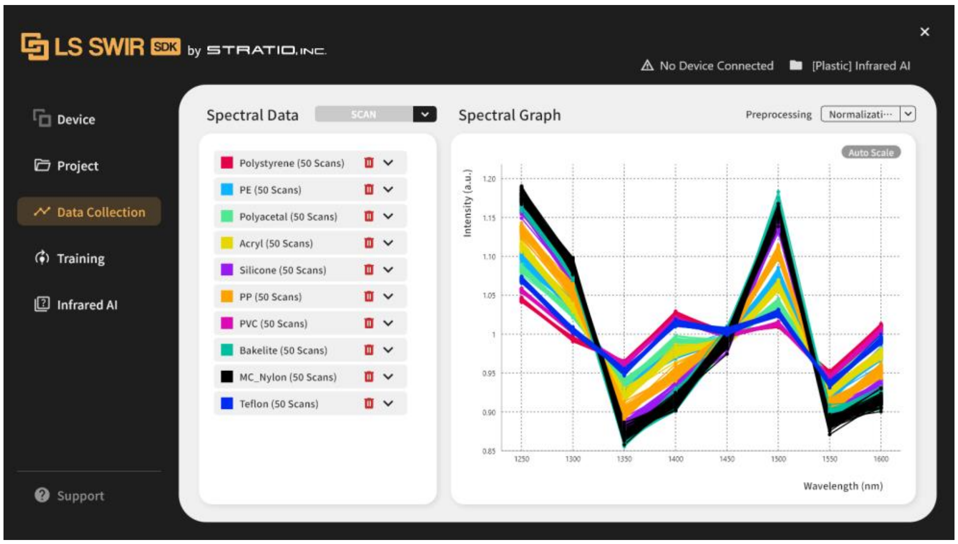

**Delete Model**

Deletes the selected model. **The deleted model cannot be recovered.**



## 5.4. Data Collection

Users can collect spectral data for each sample using the connected LS SWIR SDK device and view it displayed as a graph.



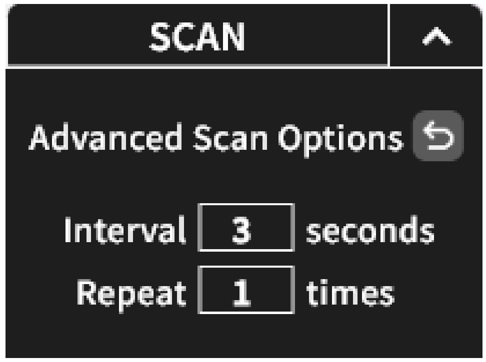

### 5.4.1 Spectral Data Scan

This is the **Scan** button to obtain spectral data from the currently connected device. It is only activated when **1) the app is connected to the device** and **2) a sample for data storage is selected**.

#### Normal Scan


Clicking the **Scan** button executes a single scan on the currently connected device, and the collected spectral data is saved to the selected sample. The collected data is displayed on the graph screen. Pressing the **Scan button on the device** can also execute the same scan.

**Advanced Scan**




Clicking the arrow to the right of the Scan button allows you to set **Advanced Scan Options**. The original Scan button is displayed as the Advanced Scan button, and clicking this button repeatedly executes scans according to the set options.

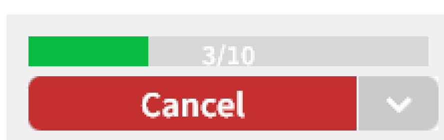
- **Interval**: The waiting time (in seconds) between consecutive scans. After receiving the spectral data of the current scan, the next scan starts after this interval.
- **Repeat**: The number of scans to repeat when the Scan button is pressed once.

*Example*: If **Interval** is set to 3 seconds and **Repeat** is set to 5 times, a single click of the Scan button executes a total of 5 scans with a 3-second wait between each scan.

- Reset ( ): Clicking the reset button **initializes all advanced scan options**.

.

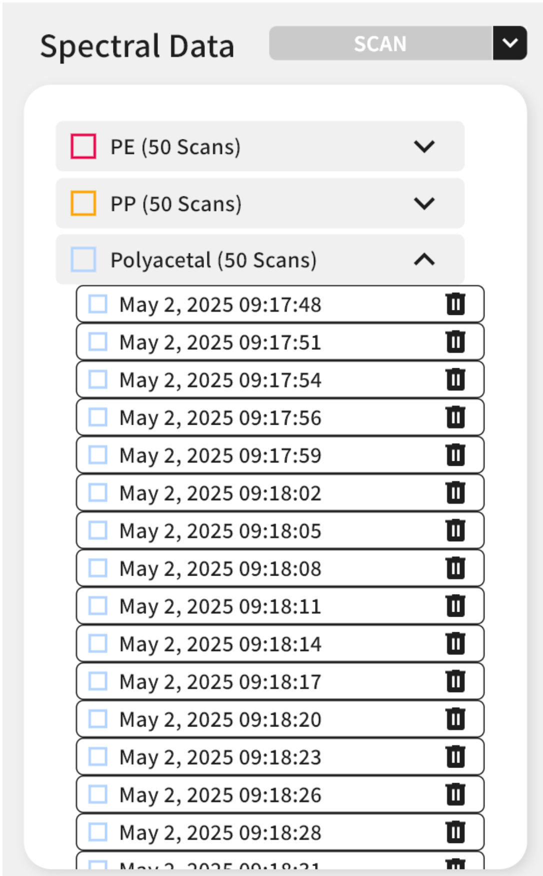
When the advanced scan is in progress, the total number of scans and the number of scans completed so far are displayed.




**Cancel Scan**

Clicking the **Cancel** button during a scan will complete the current scan and stop the repetitive scanning

## 5.4.2 Sample List

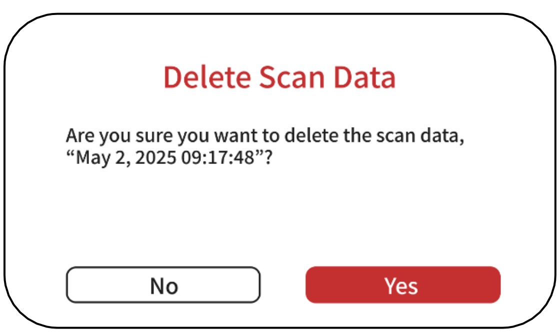



The list of samples included in the project and the spectral data for each sample are displayed. (Refer to the **Project Tab** for adding, editing, or deleting samples).

The list displays the sample name along with the number of spectral data points included. Clicking the checkbox in front of the sample name displays the graph of the spectral data included in that sample. Also, a delete button appears next to the sample name; pressing this button allows you to **delete all spectral data within that sample**

Clicking the arrow to the right of the sample name expands the list of spectral data included in the sample. The spectral data displays the time the scan occurred, and clicking the checkbox in front of the time can display it in the graph area. Additionally, you can delete individual spectral data points by pressing the delete button.

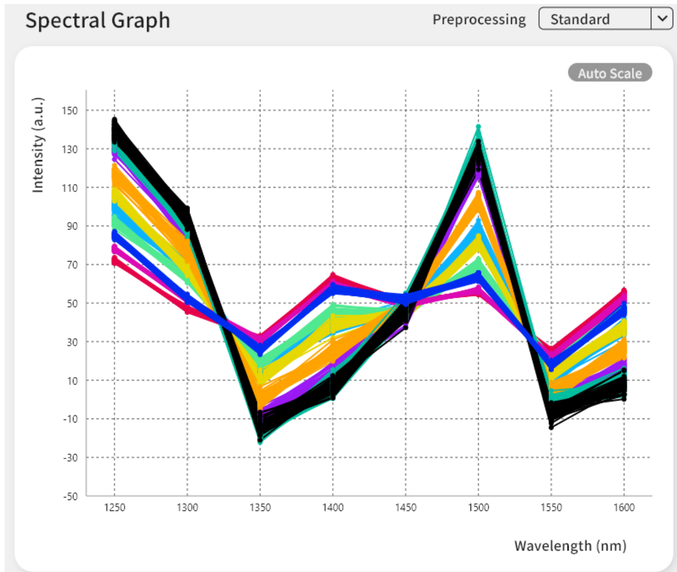
### Delete Spectral Data




Clicking the delete button displayed on the sample allows you to delete all spectral data within the sample.

Clicking the delete button on a spectral data allows you to delete individual spectral data. **<u>Deleted spectral data cannot be recovered.</u>**

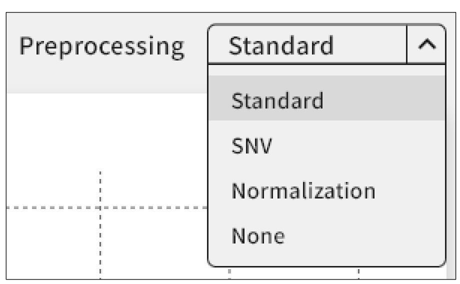
### 5.4.3 Spectral Graph




You can view the selected samples and spectral data as a graph. The spectral data is displayed according to the sample's color. The horizontal axis represents the **Wavelength**, and the vertical axis represents the **Intensity**.

#### Preprocessing

You can select the preprocessing method for the spectral data displayed on the spectral graph.



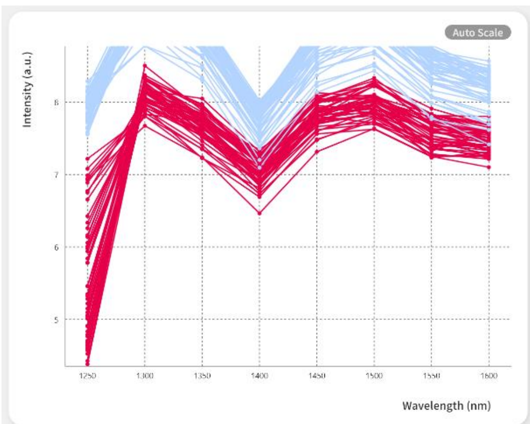

- **Standard**: Preprocesses the spectral data using the **Standard** method and displays it. This is the most basic preprocessing method.
- **SNV**: Preprocesses the spectral data using the **Standard Normal Variate (SNV)** method and displays it.

- **Normalization**: Preprocesses the spectral data using the **Normalization** method and displays it.
- **None**: Displays the collected spectral data as is, **without preprocessing**.

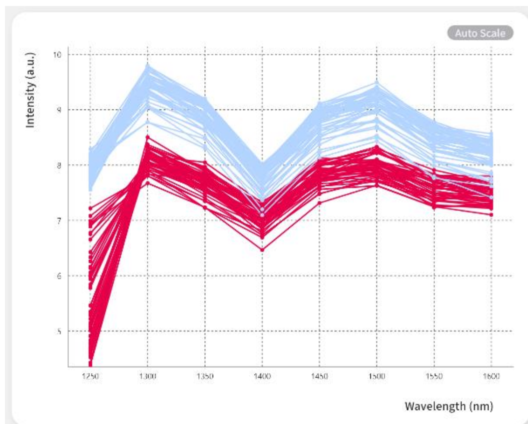
### Auto Scale

If spectral data extends beyond the graph area, clicking the **Auto Scale** button automatically adjusts the graph's vertical axis to match the intensity range of the currently selected data.

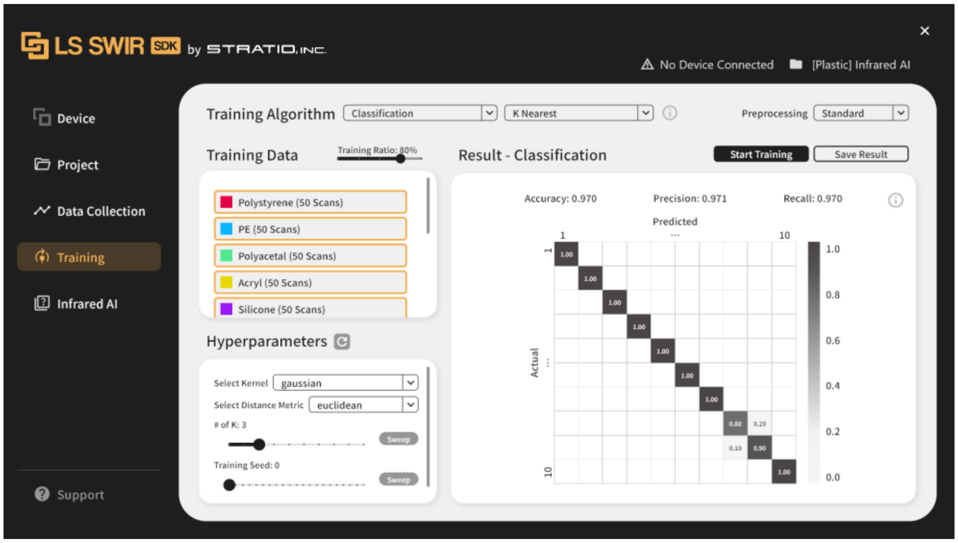
[Before Auto Scale]




[After Auto Scale]



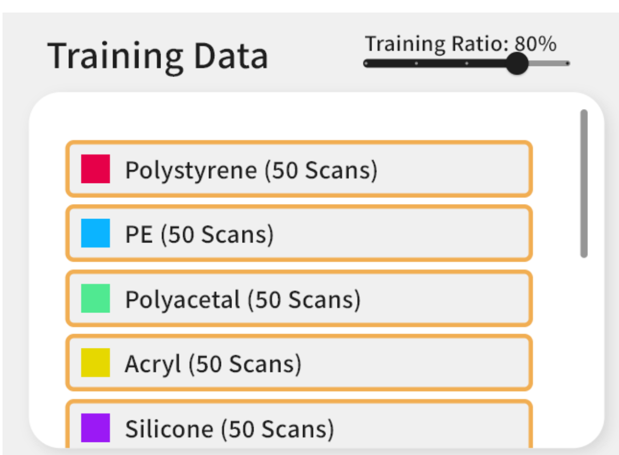
## 5.5 Training




You can train various **Infrared AI models** using the spectral data collected from the LS SWIR SDK device.

### 5.5.1 Training Data

You can select the samples to be used for training from the list of samples included in the project. Selected samples are highlighted, and only the spectral data of those samples will be used for training.




- **Training Ratio**: Sets the ratio for splitting the selected data into training data and validation data. For example, if set to 80%, 80% of the selected data is used for training, and 20% is used for validation to evaluate the model's performance.

### 5.5.2 Training Algorithm

You can select the algorithm for training the model. It is broadly classified into **Classification**, **Regression**, **Clustering**, and **Dimensionality Reduction**, with detailed algorithms available for each category.

**Classification**

Training algorithms for classifying samples containing spectral data. The following algorithms can be used:

- K Nearest
- Support Vector
- Decision Tree
- Logistic

**Regression**

Training algorithms for regression analysis. You must pre-set the **Regression Value** for each sample in the **Project Tab** for training. The following algorithms can be used:

- Linear
- KNN

**Clustering**

Training algorithms for cluster analysis. The following algorithms can be used:

- K Means

**Dimensionality Reduction**

Algorithms for visualizing spectral data in a 2D plane through dimensionality reduction. The following algorithm can be used:

- TSNE (t-distributed stochastic neighbor embedding)

### 5.5.3 Hyperparameter

You can set hyperparameters for the selected training algorithm. You can try various hyperparameter combinations to improve performance.

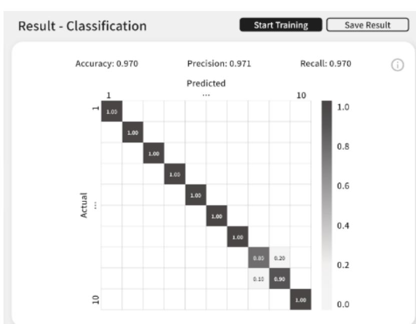
#### Hyperparameter Sweep

You can check the model's performance metrics for a selectable range of hyper-parameters. You can refer to the performance metric results to determine effective hyperparameter values

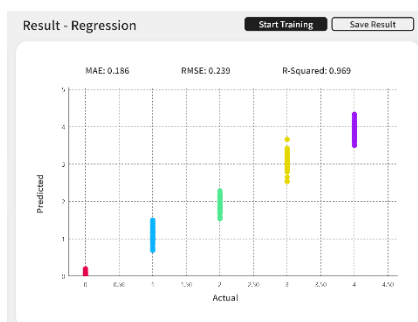
### 5.5.4 Start Training

After completing the settings for training data, training algorithm, and hyperparameters, click the 'Start Training' button to begin training. Upon successful completion of training, the results screen for each classification can be viewed.

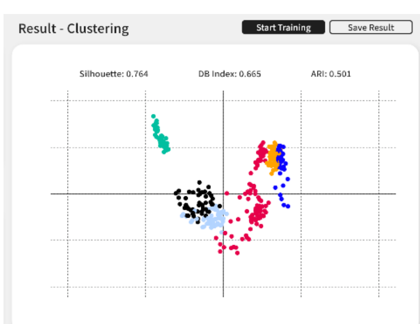
**Classification**



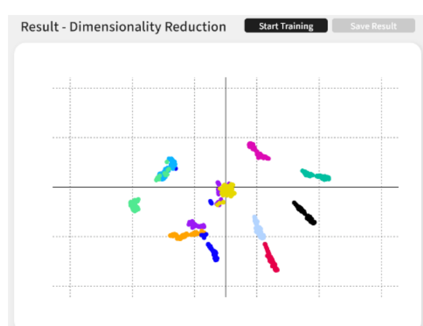

**Regression**




**Clustering**




**TSNE**

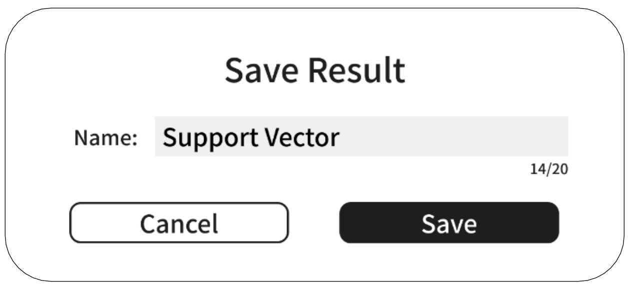


### Performance Metrics by Training Algorithm

| Classification | Regression | Clustering |
|---|---|---|
| Accuracy | MAE | Silhouette |
| Precision | RMSE | DB Index |
| Recall | R-Squared | ARI |

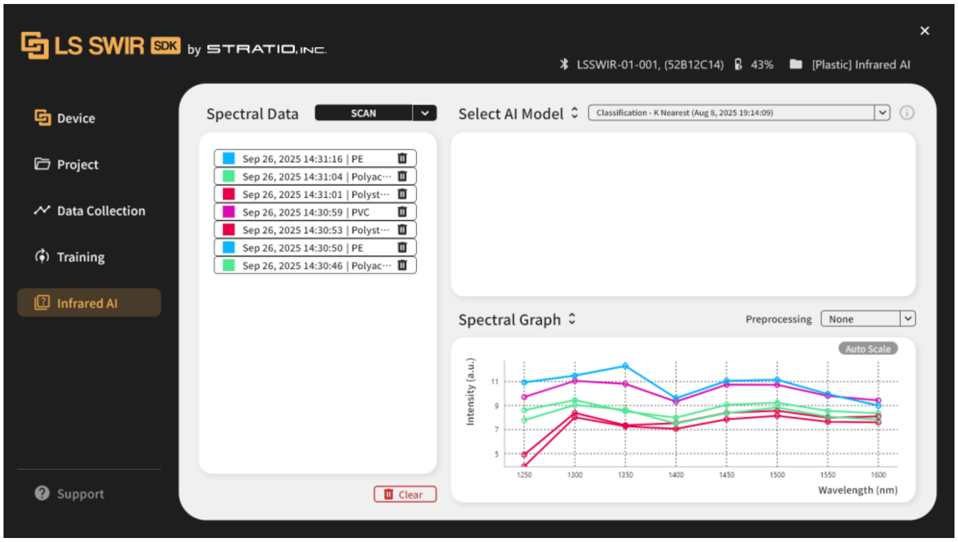
### Save Result

The completed model can be saved to the project using the **'Save Result'** button. Enter the name of the model and click the **'Save'** button to save the trained model to the current project. The list of saved models can be checked in the **Project Tab.**




* Note: **<u>Dimensionality Reduction results cannot be saved.</u>**

## 5.6 Infrared AI

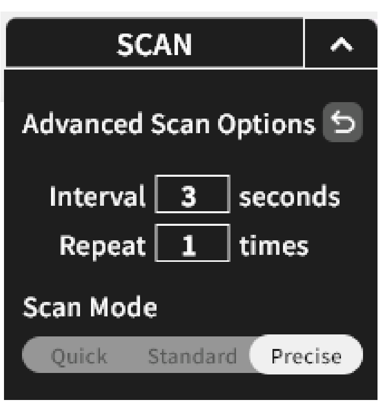



You can **test** the models created in the **Training Tab** with spectral data collected from the connected device.

### 5.6.1 Spectral Data Scan

Executes a scan to obtain data from the currently connected device. The Scan button is only activated when the device is connected. Spectral data collected in the Infrared AI Tab **is not saved** within the project. The list is cleared by clicking the **'Clear'** button or upon app termination.

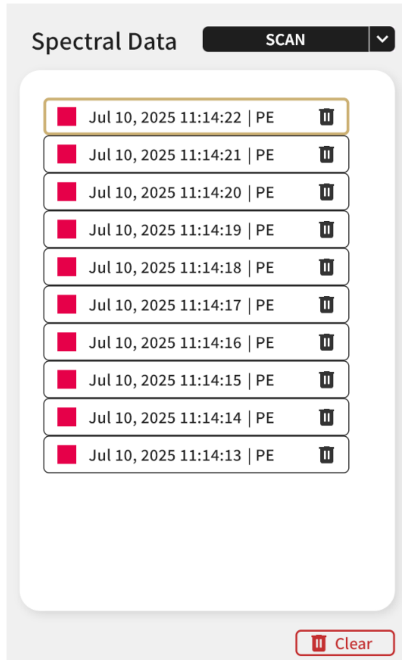
#### Advanced Scan



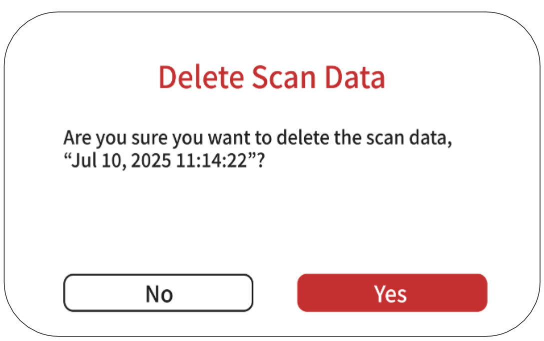

Similar to the Advanced Scan function in the Data Collection Tab. Additionally, **Scan Mode selection** is available. You can select a Scan Mode that is the **same as or faster** than the one selected during project creation. (Slower Scan Modes are disabled)

### 5.6.2 Spectral Data List

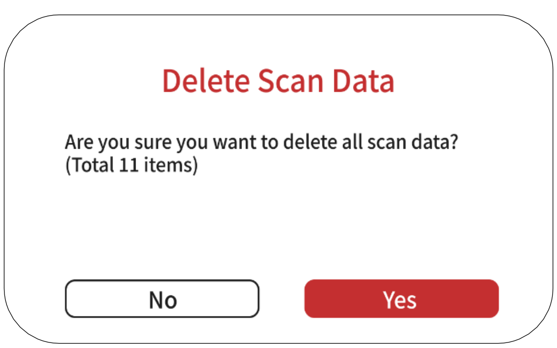
The list of collected spectral data is displayed




**Delete Spectra Data**

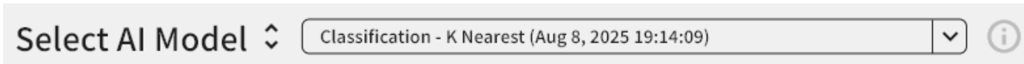



You can delete a specific spectral data point by clicking the delete button on the right of the spectral data.




Clicking the **'Clear'** button at the bottom of the screen **deletes all spectral data** collected in the Infrared AI Tab and clears the list. (This does not affect the scan data collected in the Data Collection Tab)

### 5.6.3 Model Selection

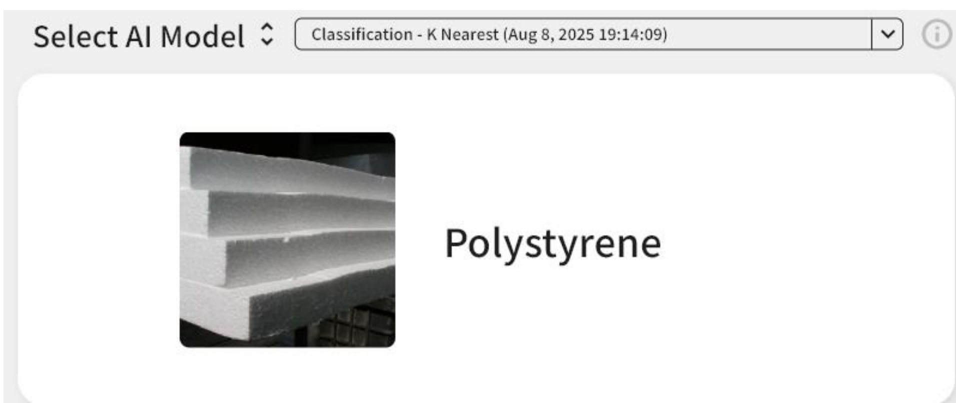



You can select an Infrared AI model saved in the current project. Detailed information about the model can be checked in the **Project Tab.**

### 5.6.4 Model Test Result

When data is selected from the spectral data list, the results from the selected Infrared AI model can be checked.

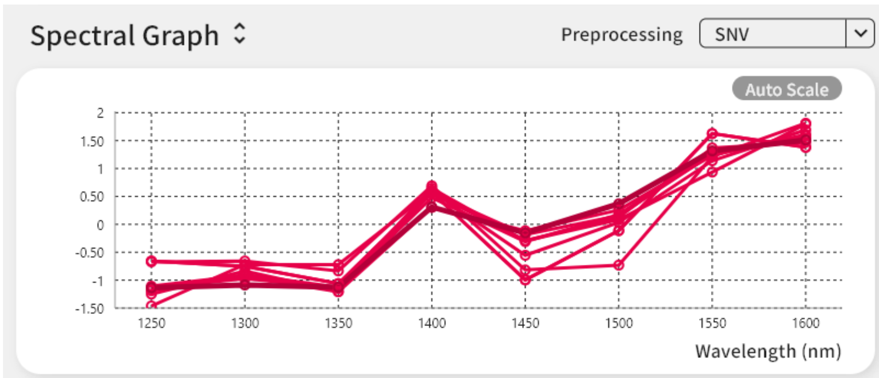
- **Classification**: Displays the class information predicted by the model.
- **Regression**: Displays the regression prediction value predicted by the model.
- **Clustering**: Displays the clustering coordinates predicted by the model.




If a new Infrared AI model is selected while a specific spectral data is selected, the new prediction results are shown using the selected AI model and spectral data.

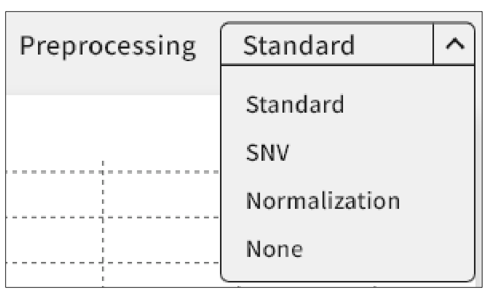
### 5.6.5 Spectral Graph

The graph of the collected spectral data is displayed.




**Preprocessing**

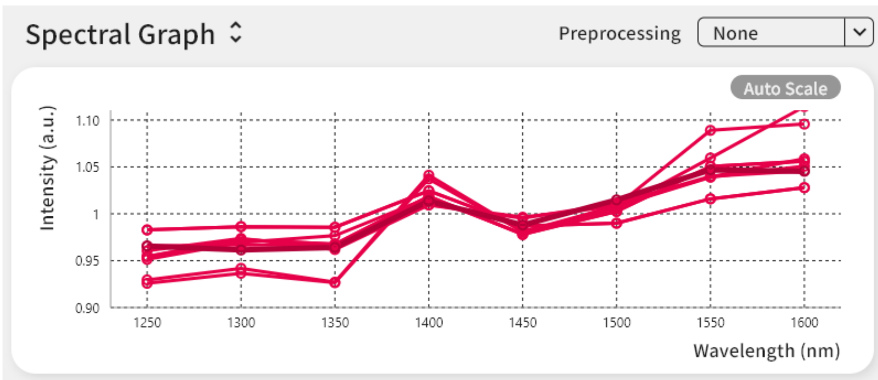
You can select the preprocessing method for the spectral data displayed on the graph. The spectral data input to the Infrared AI model is processed using the preprocessing method selected during model training. The preprocessing item selected here **only applies to the data displayed on the graph** and **does not affect** the preprocessing method applied during model training.



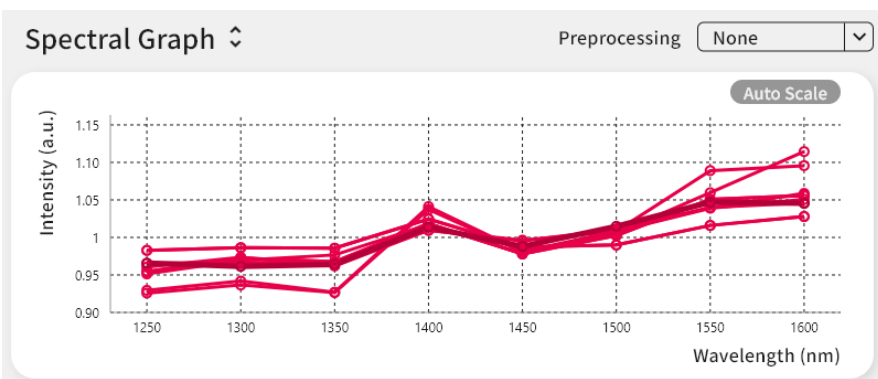

- **Standard**: Preprocesses the spectral data using the **Standard** method and displays it. This is the most basic preprocessing method.
- **SNV**: Preprocesses the spectral data using the **Standard Normal Variate (SNV)** method and displays it.
- **Normalization**: Preprocesses the spectral data using the **Normalization** method and displays it.
- **None**: Displays the collected spectral data as is, **without preprocessing**.

### 5.6.6 Auto Scale

If spectral data extends beyond the graph area, clicking the **Auto Scale** button automatically adjusts the graph's vertical axis to match the intensity range of the currently selected data.



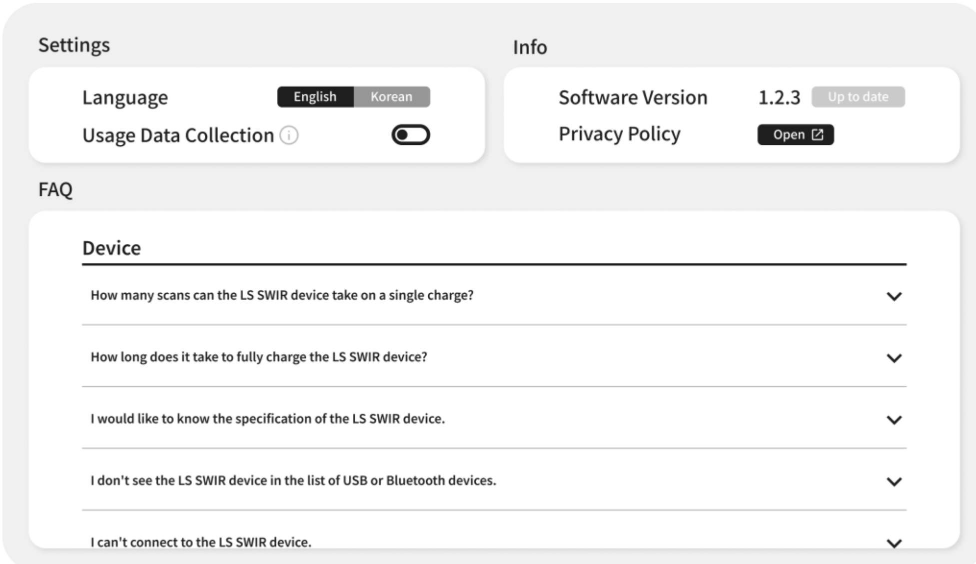

[Before Auto Scale]




[After Auto Scale]

## 5.7. Support

You can manage app settings, view information, or check frequently asked questions (FAQ).




### 5.7.1 Settings

- **Language**: Selects the app language. Korean and English are supported.
- **Usage Data Collection**: Sets whether to collect usage data.

### 5.7.2 Info

- **Software Version**: Displays the currently running app version. It automatically checks for the latest version and requires an internet connection. An **Update** button is activated if an update is available.

- **Privacy Policy**: Directs you to the page where you can check the privacy policy (https://linksquare.io/legal.html)

### 5.7.3 FAQ

- A list of frequently asked questions for each tab..
- Clicking a question displays the answer.

# 6. Troubleshooting

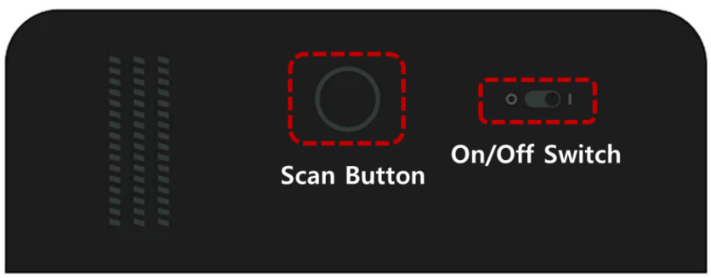
## 6.1 Safe Mode

If a notification window prompts you that Safe Mode operation is required during app operation, or if the device's status LED operation indicates a device error, you can restart the device in **Safe Mode** to proceed with a **device software update**.

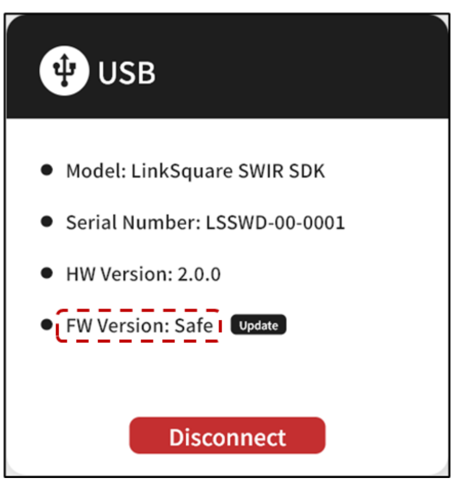
If the problem persists even after the device software update, you can contact the customer support center (linksquare@stratiotechnology.com) to inquire about resolving the device error.

### 6.1.1 Operating the Device in Safe Mode

It operates when the **power switch is turned on while the SCAN button** of the LS SWIR SDK **is pressed**.




In Safe Mode:




① Bluetooth operation stops, so connection to the device is **only possible via a USB cable on a desktop**.
② Only **firmware download operation** is possible in the device tab of the app.

When connected to a device operating in Safe Mode, the **FW Version** value is displayed as **"Safe"** in the Device Tab, as shown on the left.

## 6.2 Device Status via LED Operation

Before connecting with the app, the device's status and the type of error can be determined through the LED operation. If an unresolvable error persists, you can contact the customer support center (linksquare@stratiotechnology.com) to inquire about resolving the device error.

### 6.2.1 During Safe Mode Operation

Safe Mode booting has proceeded normally. Please proceed with the firmware update.


| LED | LED Behavior |
|---|---|
| **Scan LED** | ON |
| **Power LED** | ON |
| **Status LED** | OFF |

### 6.2.2 Device Startup Failure

The device has failed to start normally. Please contact customer support


| LED | LED Behavior |
|---|---|
| **Scan LED** | ON |
| **Power LED** | OFF |
| **Status LED** | OFF |

### 6.2.3 Abnormal Operation Occurred (Initialization)

The initialization process of the LS SWIR SDK device did not proceed normally· Please turn the power switch off and then on again to perform the initialization process. If the same symptom persists, please contact customer support.


| LED | LED Behavior |
|---|---|
| **Scan LED** | OFF |
| **Power LED** | OFF |
| **Status LED** | Quickly Blinking (0.2 sec.) |

## 6.4 Communication Error

A BLE or USB communication error has occurred. Please check if the problem is resolved by turning the power switch off and then on again. If the same symptom persists, please contact customer support. Providing the duration for which the Status LED is on can help with the response


| LED | LED Behavior |
|---|---|
| **Scan LED** | OFF |
| **Power LED** | OFF |
| **Status LED** | Slowly Blinking (Repetition of N sec. ON + 1 sec. OFF) |