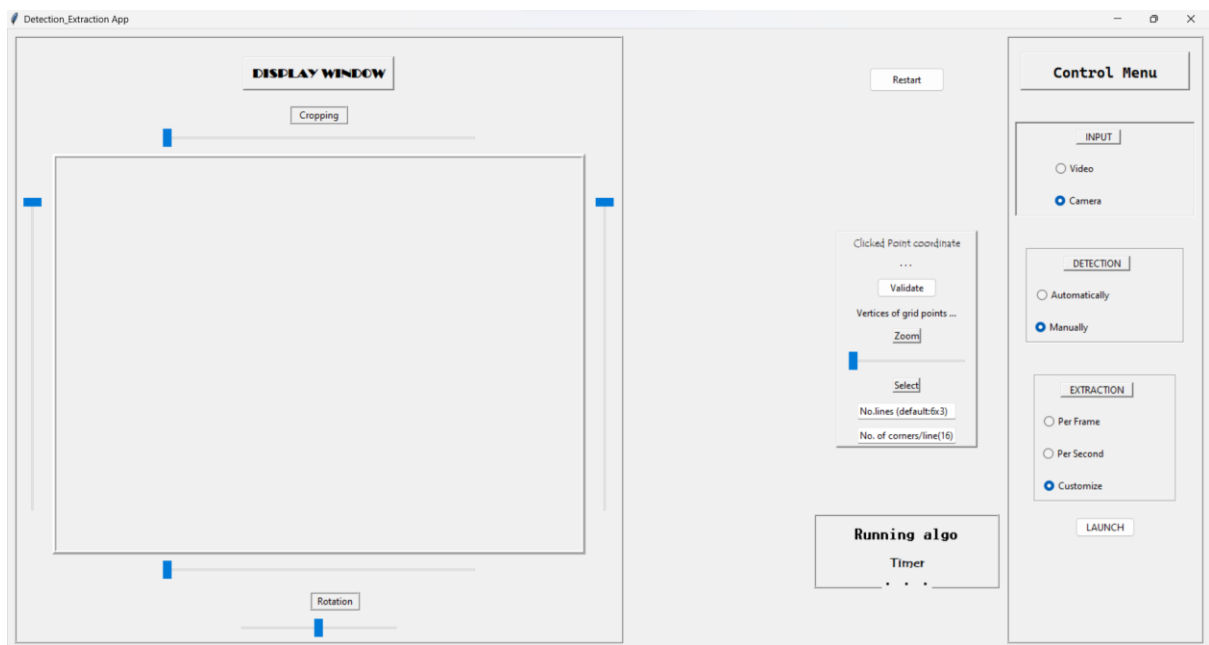# Instruction manual

1. Introduction

Welcome to the Sensor Data Extraction Application user manual. This application is designed to help you extract data for sensors and save them into CSV files. The extracted data consists of average pixel variations for four bands: Red, Green, Blue, and Gray. These data are crucial for analysing, detecting, and classifying gases based on their presence and classification.

The application provides two modes of sensor detection: automatic and manual. In automatic mode, the application can detect sensors automatically from video input or directly from a webcam feed. In manual mode, you have the flexibility to manually select and define sensor points. The application employs multi-threading to ensure smooth performance and responsiveness during sensor detection and data extraction processes.

In this manual, we will guide you through the various features and functionalities of the Sensor Data Extraction Application. Let's get started!

Note: Before using the application, please ensure that you have the necessary video input or webcam connected to your system.

2. Installation

There are two methods to install the Sensor Data Extraction Application. You can choose the method that suits you best.

Method 1: Installation via PyInstaller (From Project Folder)

- Ensure that you have the project folder of the application.
- Open your command prompt or terminal.
- Navigate to the project folder using the cd command.
- Run the following command to install the application using Pyinstaller (install python and Pyinstaller before):

Windows:

```
pyinstaller --onefile --add-data TKinter_pygubu2.ui --add-data
"function;function" --icon "logo.ico" -w App.py
```

mac:

```
pyinstaller --onefile --add-data TKinter_pygubu2.ui:, --add-data
"function:./function" --icon "logo.ico" -w App.py
```

This command will create a standalone executable file for the application.

Method 2: Installation via USB Key

- Contact the application provider to obtain the installation files on a USB key.
- Insert the USB key into your computer.
- Copy the application from the USB key to a desired location on your system.
- You can now launch the application by double-clicking the executable file.

Note: The installation process may vary depending on your operating system. Make sure to follow the appropriate steps for your system.

3. Launching the application

- To launch the Sensor Data Extraction Application, simply follow these steps:
- Navigate to the directory containing the application files.
- Double-click on the executable file (with the application's icon) to launch the application.
- Upon launching, the application will start, and the main window will appear on your screen. You are now ready to use the Sensor Data Extraction Application to extract data from sensors.

Note: The application does not require any additional configuration or logging in. Simply double-clicking on the executable file will initiate the application.

4. Main interface

The Sensor Data Extraction Application features a user-friendly interface with three main frames (containers) that serve different purposes. Let's explore each of these frames in detail:

- **Display Window**: This frame provides a visual display of the input video feed or webcam stream. Here, you can see the live feed from the selected video source. Additionally, the frame also displays the vertices of the detected sensors, allowing you to visualize the positioning and boundaries of each sensor.

  Within the Display Window, you have the option to adjust the cropping and rotation of the frame. These features enable you to fine-tune the frame to capture the desired area and ensure accurate sensor detection and data extraction.

- **Control Menu**: The Control Menu frame offers a set of options and settings that allow you to configure the application according to your requirements. Here, you can define the input source for the video feed, whether it's a video file or the webcam. You can also select the

method of sensor detection, choosing between automatic detection or manual detection using predefined points.

Additionally, the Control Menu frame provides options for selecting the type of data extraction you wish to perform. Once you have defined all the necessary settings, you can launch the extraction process by clicking the appropriate button.

- **Third Frame**: The Third Frame serves various functions within the application. It provides a restart button that allows you to reset the application to its initial state. Additionally, this frame displays the points used for manual detection, helping you visualize the selected points and their arrangement.

  The Third Frame also features a timer that indicates the duration of the extraction process. This is useful for monitoring the progress of the extraction and estimating the time required for completion.

The main interface of the Sensor Data Extraction Application is designed to be intuitive and user-friendly, providing easy access to essential features and controls. With these frames at your disposal, you can efficiently manage the detection and extraction of sensor data.
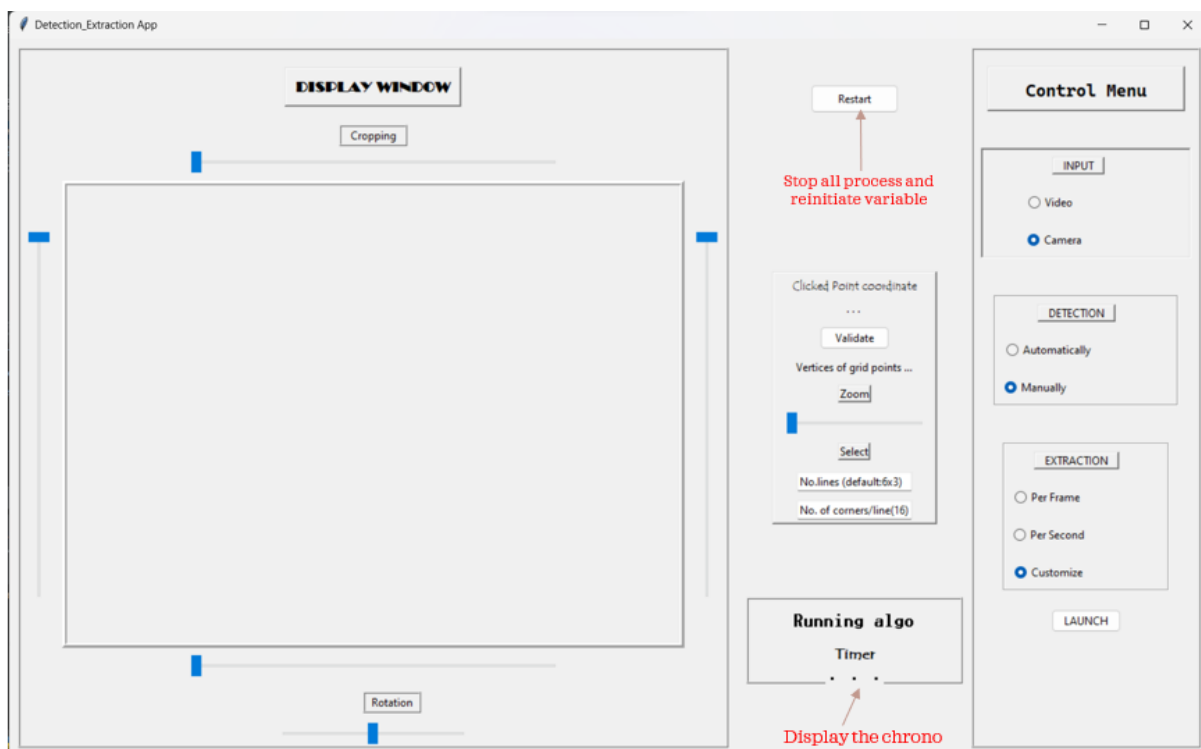
5. Importation video or Using webcam

The Sensor Data Extraction Application provides two options for input sources: importing a video file or using the webcam. Let's explore each of these options in detail:

Importing Video: To import a video file for processing, follow these steps:

- Click on the "Video" button in the Control Menu frame.
- A file selection window will open, allowing you to browse and select an MP4 video file from anywhere on your computer.
- Once you have selected the desired video file, click "Open" to load it into the application.

The application will then start processing the video, detecting sensors, and extracting the required data.

Using Webcam: If you prefer to use a webcam as the input source, follow these steps:

- Click on the "Camera" button in the Control Menu frame.
- The application will search for available webcams from index 0 to 2.

If a webcam is found and successfully opened, the live feed from the webcam will be displayed in the Display Window frame.

The application will then proceed to detect sensors and extract data from the webcam feed.

Note: In case the application fails to open the webcam or does not find any connected and activated webcam, a message box will appear, indicating that the webcam could not be accessed. Please ensure that your webcam is properly connected and activated before attempting to use it with the application.

The ability to import video files or use a webcam as the input source provides flexibility and convenience in capturing the necessary data for sensor detection and extraction. Choose the option that suits your needs and proceed with the data extraction process.
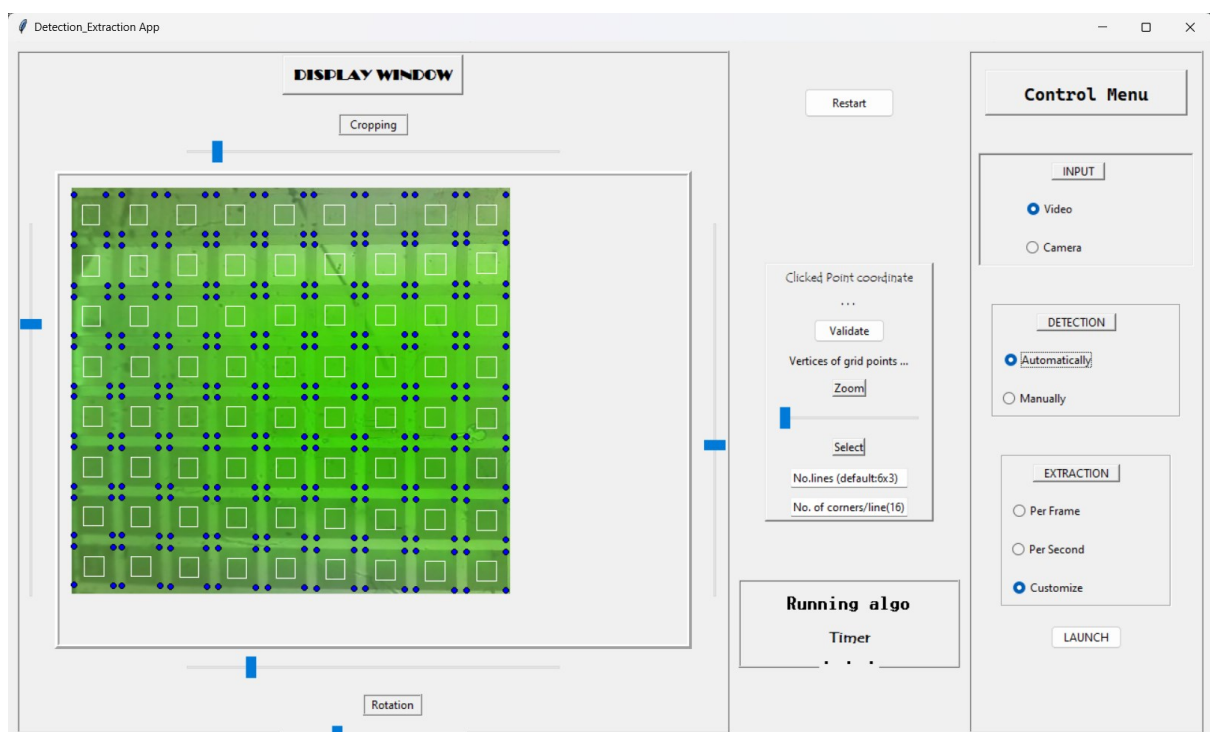
6. Select detection method

The Sensor Data Extraction Application offers two methods for sensor detection: Auto Detection and Manual Detection. Let's explore each method in detail:

- Auto Detection:

 The Auto Detection method is a convenient option that automatically detects the sensors in the frame. To use Auto Detection, follow these steps:

- Ensure that the frame is properly cropped and rotated to focus on the matrix of sensors. It is recommended to keep only the matrix of sensors with 9 rows and 8 columns.
- Click on the "Auto Detection" button in the Control Menu frame.
- The application will analyse the frame and detect the vertices of the sensors.
- Once the detection is complete, a message box will appear, indicating that the detection is successful.
- The grid of corners representing the sensors will be displayed on the frame in the Display Window.

Advice: The Auto Detection method can be sensitive to variations in the frame. To achieve accurate detection, ensure proper cropping and rotation of the frame. In some cases, the detection may capture unintended elements. If this happens, it is recommended to use the Manual Detection method for precise sensor detection.


- Manual Detection:

The Manual Detection method allows you to manually select three points to define the sensor matrix. Here's how to use Manual Detection:

- Click on the "Manual Detection" button in the Control Menu frame.
- Select the first corner of the first row, the first corner of the 7th row, and the first corner of the 13th row of the sensor matrix. These points will define the grid of sensors.

Advice: Before selecting the points, it is recommended to rotate the frame for better alignment. You can also perform cropping to focus on the desired area of the frame.

After selecting the three points, the grid of corners representing the sensors will be displayed on the frame in the canvas. You can visualize the sensor vertices and make any necessary adjustments, such as rotating or cropping the frame, to fine-tune the detection.

If you are not satisfied with the initial grid, you have the option to redefine the three points and update the grid accordingly.
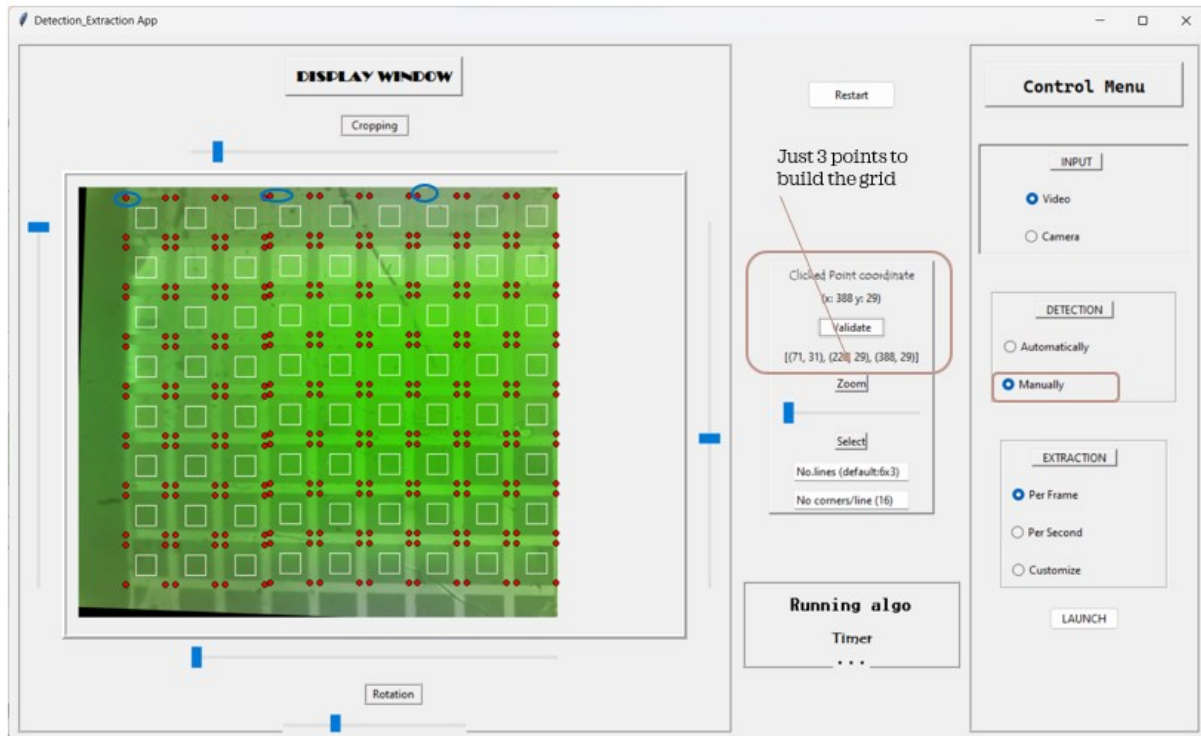
7. Selecting extraction method

The Application offers different methods for extracting sensor data. You can choose the extraction method that best suits your needs. Here are the available options:

- **Per Frame:** The "Per Frame" extraction method calculates the average pixel value for each sensor on the four-color bands (Red, Green, Blue, Gray) for every frame in the input. This method provides data for each frame individually.
- **Per Second**: The "Per Second" extraction method computes the sensor data every second. It calculates the average pixel value for each sensor on the four-color bands for every second of the input video or webcam feed. This method aggregates the data at a regular time interval of one second.
- **Custom:** The "Custom" extraction method allows you to customize the sample rate at which the sensor data is computed. You can specify a custom sample rate using a dialog box. Enter the desired rate (an integer value) in the dialog box, and the application will calculate the average pixel value for each sensor on the four-color bands at the specified rate.

If you do not specify the extraction method, the default method of "Per Frame" will be applied. This means that the application will calculate the sensor data for each frame in the input.

Choose the extraction method that aligns with your data analysis requirements. Keep in mind that selecting a higher sample rate (Per frame) may result in more detailed data but could also increase the processing time and resource usage.

8. Launching the extraction

Once you have set up the grid and specified the type of data extraction, you are ready to launch the extraction process. Simply click on the "**Launch**" button to initiate the data extraction.

The application will start collecting the sensor data according to the selected extraction method (per frame, per second, or custom). A timer will automatically start, indicating the duration of the data collection process. The timer will stop once the data collection is complete.

All recorded data will be saved in a folder called "Data files" on your desktop. If the folder does not exist, the application will create it for you. Each data set will be saved in a separate CSV file for easy access and analysis.

You can launch the extraction process as many times as you need to collect the desired data. Each extraction will generate a new set of data files, allowing you to compare and analyse different data sets.

9. Restarting the Application

If you encounter any issues or need to make changes to the application settings, you can use the "Restart" button to restart the application. This will stop all ongoing processes and reinitialize the application to its default state.

To restart the application, simply click on the "Restart" button. This will ensure that any previous settings or processes are cleared, allowing you to start fresh.

If you need to change the input source (e.g., switch from video to webcam or vice versa), it is recommended to restart the application before making the change. This will ensure that the new input source is properly detected and initialized.

If you encounter any complicated problems or errors, you can exit the application completely and relaunch it. This will provide a clean start and may help resolve any issues you are facing.

Feel free to restart the application whenever necessary to ensure smooth operation and to apply any desired changes.

10. Conclusion

In conclusion, the application provides a user-friendly interface for extracting data from sensors and saving them into CSV files. It offers two methods of detection - auto detection and manual detection allowing you to choose the most suitable approach for your needs. The extraction can be performed per frame, per second, or with a custom sample rate.

While using the application, it is important to keep in mind that it is designed specifically for detecting sensors arranged in a matrix. If you input any other form or layout, the automatic detection may not work correctly. Therefore, it is advised to ensure that the input aligns with the expected matrix configuration.

As with any software, there may be some bugs or issues that could arise. Please note that this is the first version of the application, and further improvements and updates may be implemented in the future to address any reported problems.

It is recommended to avoid relocating the application window while using it, as it may lead to unexpected behaviour or malfunctions. Keeping the application window in its original position will help ensure a smooth and optimal user experience.

If you encounter any difficulties or have any suggestions for improvement, please don't hesitate to provide feedback. Your input is valuable in enhancing the functionality and usability of the application.

Thank you for using our application, and we hope it serves you well in your data extraction and analysis tasks.