Project Report

YOLO8 ANNOTATION TOOL

Master's in computer science

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Contents

1. PROJECT OVERVIEW

The **Yolo8 Annotation Tool** is an intuitive Python-based application created to streamline the process of building annotated datasets for object detection models, specifically those that utilize the YOLOv8 framework. In the realm of object detection, having accurately labeled training data is paramount, yet achieving this can often be a daunting task filled with challenges such as time constraints and the potential for human error. This is where our tool steps in, offering a user-friendly solution that simplifies image annotation.

Built with **PyQt6**, the tool features a graphical interface designed for users of all backgrounds—from those just starting their journey in machine learning to seasoned data scientists. It allows users to easily annotate images by drawing bounding boxes around objects. This capability is crucial for defining regions of interest (ROI) in object detection workflows, as these bounding boxes are integral to training machine learning models to recognize and localize various objects in images.

To enhance the annotation process, the Yolo8 Annotation Tool includes a variety of features aimed at improving efficiency. Users can take advantage of batch processing, undo/redo options, and automatic dataset splitting, all of which significantly reduce the time and effort required for dataset preparation. Moreover, the tool incorporates data augmentation techniques, such as resizing and adjusting brightness/contrast, to increase the diversity of the training dataset—an essential factor for improving model performance.

Additionally, the tool provides built-in options for converting image formats, ensuring consistency throughout the annotation process. While the current version supports only single-category annotations and is specifically optimized for YOLOv8, its solid foundation allows for potential future enhancements, which could expand its capabilities to meet more complex annotation needs and accommodate additional machine learning frameworks.

2. PROJECT GOALS

The primary goals of the Yolo8 Annotation Tool are:

- **User-Friendly Annotation:** To provide an easy-to-use platform that enhances productivity while minimizing errors during the dataset preparation process.
- **High-Quality Data Production:** To ensure the generation of high-quality annotated datasets that can significantly improve the performance of machine learning models, particularly for object detection tasks.
- **Simplified Dataset Management:** To offer features that streamline the image annotation process and facilitate efficient management of datasets.

3. FEATURES

3.1. Image Loading and Navigation

The Yolo8 Annotation Tool allows users to easily manage and navigate their image datasets:

- **Load Images:** Users can select a directory containing their image files, allowing the tool to load these images for annotation. This feature enables quick access to large datasets without the need to open each image manually.
- **Navigate Images:** Navigation controls like "Previous" and "Next" buttons help users move seamlessly between loaded images, making it easy to browse the dataset and concentrate on specific images without interruptions.

3.2. Bounding Box Drawing

Creating bounding boxes around objects is a core functionality of the tool:

- **Drawing:** Users can annotate objects in images through a simple click-and-drag action. This intuitive functionality makes it accessible for both beginners and experienced annotators.
- **Bounding Box Details:** After drawing a bounding box, users receive detailed information about its dimensions and coordinates, which is crucial for maintaining accuracy in the annotation process.

3.3. Annotation Management

Managing annotations is straightforward with the Yolo8 Annotation Tool:

- **Save Annotations:** Users can save their drawn bounding boxes in a YOLO-compatible format, ensuring the dataset is ready for training without requiring additional formatting steps.
- **Load Annotations:** Previously saved annotations can be loaded, which will automatically display on the corresponding image, making it easy to review or modify existing work.
- **Delete Annotations:** Users have the option to delete an image’s annotations if necessary, offering flexibility in dataset management.
- **Validate Annotations:** The tool can check if each image has a corresponding annotation file, alerting users to any missing annotations, thus ensuring data integrity.

3.4. Image Settings

The tool provides several image manipulation options to optimize images for annotation:

- **Adjust Dimensions:** Users can modify image width and height, allowing for customization according to annotation requirements.
- **Rotate Image:** The rotation slider enables users to rotate images at any desired angle, facilitating annotation from different perspectives.
- **Adjust Brightness and Contrast:** Sliders for brightness and contrast adjustments help ensure that objects are clearly visible, regardless of lighting conditions.

3.5. Annotation Conversion

The tool includes a feature for converting annotation formats:

- **Convert to VOC XML:** Users can convert YOLO format annotations to PASCAL VOC XML format. This flexibility is valuable for users transitioning between different machine learning models.

3.6. Dataset Splitting

Splitting datasets becomes a breeze with this tool:

- **Split Dataset:** Users can divide their datasets into training, validation, and test sets based on specified ratios. This automated process ensures proper organization for model training.

3.7. PNG Conversion

Consistency in image format is crucial, and the tool offers conversion functionality:

- **Convert to PNG:** Users can convert images from various formats into PNG format, simplifying preprocessing steps for machine learning projects.

3.8. Logging

To enhance user experience, the tool includes a logging system:

- **Log Messages:** A dedicated log window provides real-time feedback, keeping users informed of actions taken and any issues that may arise during the annotation process.

4. TECHNOLOGICAL STACK

The Yolo8 Annotation Tool leverages a robust technological stack:

4.1. Programming Language: Python

Chosen for its simplicity and strong compatibility with machine learning libraries, Python facilitates ease of development and integration with YOLOv8 models. (python , n.d.)

4.2. GUI Framework: PyQt6

PyQt6 allows for the creation of a cross-platform, user-friendly interface. Its extensive set of widgets enables smooth navigation and customization. (ultralytics , n.d.)

4.3. Image Processing Libraries: OpenCV or PIL

- **OpenCV:** Offers fast image manipulation functions ideal for large datasets. (opencv, n.d.)
- **PIL:** Provides a simpler alternative for basic image processing and format conversion tasks. (python-pillow, n.d.)

5. ANNOTATION FORMAT: YOLOV8-COMPATIBLE

Annotations are stored in a format optimized for object detection tasks, ensuring smooth integration with YOLOv8 models for training.

YOLO (You Only Look Once) and Pascal VOC (Visual Object Classes) are widely used annotation formats in the field of computer vision, specifically for object detection tasks. Each format has its unique structure and use cases. Below is a detailed explanation of both formats.

5.1. YOLO Format

The YOLO format is used primarily for training models in the YOLO object detection framework. This format is characterized by its simplicity and efficiency in representing bounding boxes for detected objects.

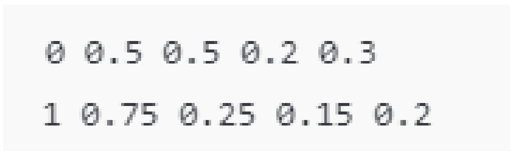
5.1.1. Structure of YOLO Format

1. **Annotation File**: Each image has a corresponding text file with the same name as the image but with a .txt extension. For example, for an image named image1.jpg, the annotation file would be image1.txt.
2. **Line Format**: Each line in the text file represents one annotated object and contains the following information:

- **class_id**: An integer that denotes the category of the object. The class IDs start from 0.
- **x_center**: The X coordinate of the center of the bounding box, normalized by the width of the image (a value between 0 and 1).
- **y_center**: The Y coordinate of the center of the bounding box, normalized by the height of the image (a value between 0 and 1).
- **width**: The width of the bounding box, normalized by the width of the image (a value between 0 and 1).
- **height**: The height of the bounding box, normalized by the height of the image (a value between 0 and 1).

5.1.2. Example of YOLO Format

For an image image1.jpg, the corresponding annotation file image1.txt may look like this:



```
0 0.5 0.5 0.2 0.3
1 0.75 0.25 0.15 0.2
```

Fig 5.1. Annotation data

In this example:

- The first line indicates an object of class ID 0 (the first category) centered at (0.5, 0.5) with a width of 0.2 and a height of 0.3 of the image dimensions.
- The second line indicates an object of class ID 1, centered at (0.75, 0.25) with a width of 0.15 and a height of 0.2.

5.1.2. Advantages of YOLO Format

- **Efficiency**: The format is compact and easy to parse, making it efficient for model training.
- **Real-Time Processing**: YOLO is designed for real-time object detection, and the format aligns well with this goal by providing quick access to bounding box information.
- **Normalization**: Using normalized coordinates makes the annotations independent of image size, simplifying the training process with images of varying dimensions.

5.2. Pascal VOC Format

The Pascal VOC format is an older but still widely used annotation format for object detection tasks. It was originally developed for the Pascal Visual Object Classes Challenge, which aimed to evaluate and benchmark the performance of object detection algorithms.

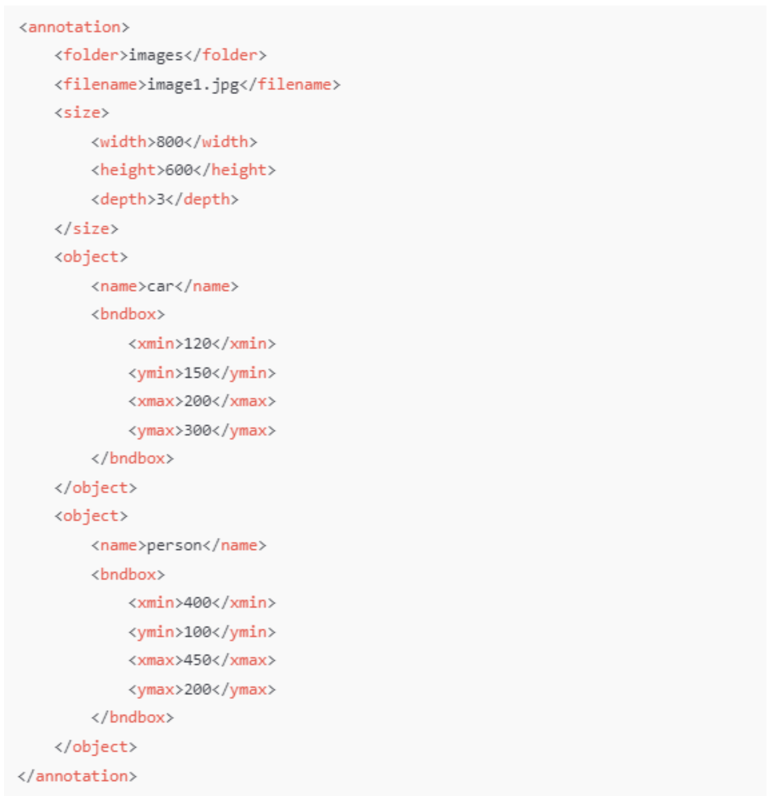
5.2.1. Structure of Pascal VOC Format

1. **Annotation Files**: Each image has a corresponding XML file that contains detailed information about the objects present in the image. The naming convention is similar to YOLO, with the XML file sharing the same name as the image but with an .xml extension (e.g., image1.xml for image1.jpg).

2. **XML Structure**: The XML file contains several key elements:
    - **filename**: The name of the image file.
    - **size**: Dimensions of the image, including width, height, and depth (number of channels).
    - **object**: Each object is represented within its own <object> tag, which contains:
        - **name**: The class label of the object.
        - **bndbox**: The bounding box coordinates, including:
            - **xmin**: The x-coordinate of the top-left corner of the bounding box.
            - **ymin**: The y-coordinate of the top-left corner of the bounding box.
            - **xmax**: The x-coordinate of the bottom-right corner of the bounding box.
            - **ymax**: The y-coordinate of the bottom-right corner of the bounding box.

5.2.2. Example of Pascal VOC Format

Here’s an example of how an XML file (image1.xml) may look:



```
<annotation>
    <folder>images</folder>
    <filename>image1.jpg</filename>
    <size>
        <width>800</width>
        <height>600</height>
        <depth>3</depth>
    </size>
    <object>
        <name>car</name>
        <bndbox>
            <xmin>120</xmin>
            <ymin>150</ymin>
            <xmax>200</xmax>
            <ymax>300</ymax>
        </bndbox>
    </object>
    <object>
        <name>person</name>
        <bndbox>
            <xmin>400</xmin>
            <ymin>100</ymin>
            <xmax>450</xmax>
            <ymax>200</ymax>
        </bndbox>
    </object>
</annotation>
```

Fig 5.2. Pascal VOC format

In this example:

- The image is named image1.jpg and has a size of 800x600.
- There are two objects: a "car" and a "person," each with specified bounding boxes defined by their corners.

5.2.3. Advantages of Pascal VOC Format

- **Rich Metadata**: The XML structure allows for additional metadata to be included, such as image dimensions and depth.
- **Multi-Class Support**: Each XML file can contain multiple objects of different classes, making it suitable for complex datasets.
- **Standardized**: Being a widely used format, it is supported by many libraries and frameworks, making it easier to integrate into different workflows.

5.3. Key Differences Between YOLO and Pascal VOC Formats

Feature	YOLO Format	Pascal VOC Format
File Type	.txt files for each image	.xml files for each image
Bounding Box Representation	Normalized coordinates (center x, center y, width, height)	Absolute pixel coordinates (xmin, ymin, xmax, ymax)
Class ID	Integer values starting from 0	Class names (strings)
Multi-Class Support	Each image file can contain multiple annotations	Supports multiple objects per image in one file
Efficiency	More compact and faster to process	More verbose due to XML structure
Image Size Independence	Yes, annotations are normalized	No, annotations are absolute coordinates

6. TARGET USERS

The Yolo8 Annotation Tool is tailored for three main user groups:

6.1. Data Scientists:

Data scientists require high-quality datasets for model training. The tool provides:

- **Streamlined Annotation:** An intuitive GUI reduces manual effort.
- **Data Augmentation:** Options for resizing and brightness adjustments enhance dataset variability.
- **YOLOv8 Compatibility:** Generates datasets ready for model training.

6.2. Researchers in Computer Vision:

Researchers need reliable tools for creating datasets. The tool offers:

- **Customizable Annotations:** Precise bounding box placement for high-quality data.
- **Ease of Use:** A user-friendly interface accommodates varying technical backgrounds**.**
- **Experimental Flexibility:** Supports dataset splitting and format conversion.

6.3. Machine Learning Practitioners:

Practitioners focused on object detection benefit from:

- **YOLOv8 Integration:** Direct labeling for training YOLO models.

- **High-Quality Data:** Ensures precise annotations with validation features.
- **Dataset Management:** Automates the splitting of datasets into training, validation**,** and test sets.

7. LIMITATIONS

While the Yolo8 Annotation Tool offers a variety of powerful features, it also has limitations:

7.1. Single Category Annotation:

The tool currently supports only one object category per project. This can restrict flexibility for users dealing with datasets containing multiple object classes, resulting in:

- **Workflow Constraints:** Users must manage separate projects for different categories, leading to inefficiencies.
- **Reduced Data Richness:** This limitation may prevent users from generating diverse datasets essential for robust model training.

7.2. Single Format Support:

The tool only supports YOLOv8-compatible annotations and Pascal VOC format. This lack of flexibility can create challenges, such as:

- **Limited Interoperability:** Users may struggle when integrating datasets into systems using different annotation formats.
- **Impact on Research and Development:** Researchers experimenting with various models may find the tool's lack of format options limiting.

7.3. Wide display screen:

Annotation tool works best on wider screen than a laptop screen.

7.4. Dependency on python interpreter:

Installation of ultralytics is limitation to create exe file**.**

8. REPOSITORY & PREREQUISITES

8.1. https://github.com/RajeshRamadas/Yolo8-Annotation-Tool.git

8.2. Prerequisites

Before installing the Yolo8 Annotation Tool, make sure you have the following installed on your system:

- **Python 3.9+**: Ensure Python is installed. You can download it from python.org.
- **pip**: Python package manager, usually installed with Python.

8.3. Installation Steps & Execution

8.3.1 Clone the Repository

```
git clone hhttps://github.com/RajeshRamadas/Yolo8-Annotation-Tool.git
cd yolo8-annotation-tool
```

8.3.2. Create and Activate a Virtual Environment (optional but recommended):

```
python -m venv venv
source venv/bin/activate  # On Windows, use `venv\Scripts\activate`
```

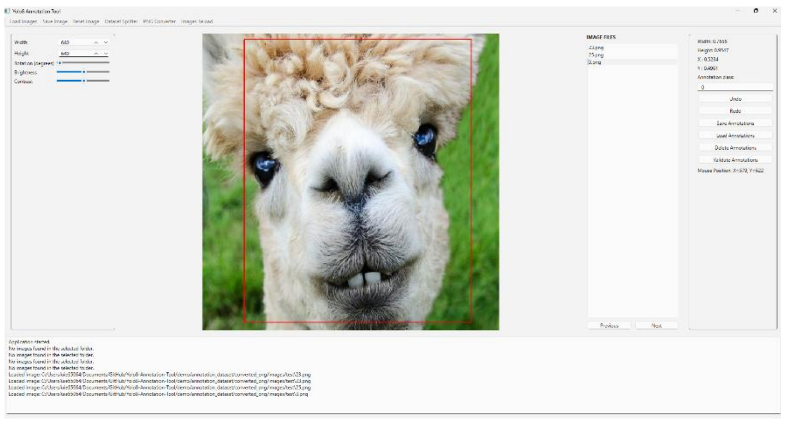
8.3.3. Install the Required Dependencies:

```
cd install_script
pip install -r requirements.txt
```

8.3.4 Run the Application:

```
# This will launch the Yolo8 Annotation Tool interface.
python main.py
```

8.4. Application

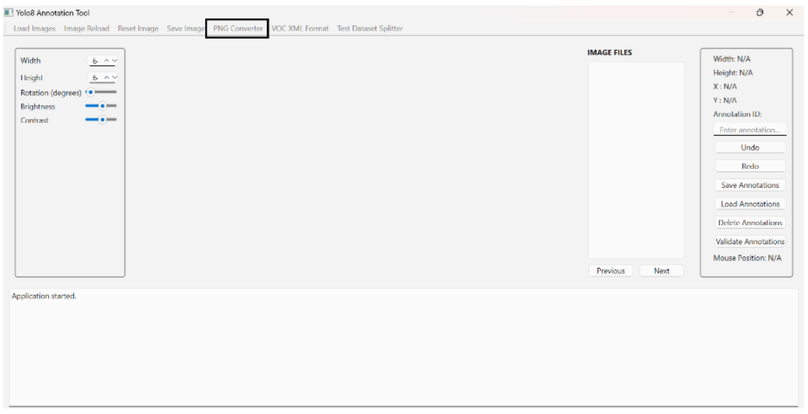


```
Application started.
No images found in the selected folder.
No images found in the selected folder.
No images found in the selected folder.
No images found in the selected folder.
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/annotation_dataset/converted_png/images/test/23.png
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/annotation_dataset/converted_png/images/test/23.png
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/annotation_dataset/converted_png/images/test/25.png
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/annotation_dataset/converted_png/images/test/3.png
```

Fig 8.4. Application snapshot

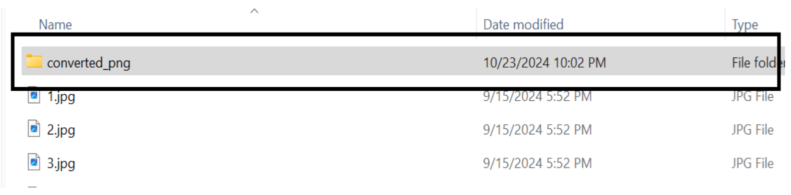
9. STEPS TO USE APPLICATION.

9.1. PNG Converter:



```
Application started.
```

Fig 9.1.1 Use the option to convert images from other formats to <.png> format.



Name	Date modified	Type
converted_png	10/23/2024 10:02 PM	File folder
1.jpg	9/15/2024 5:52 PM	JPG File
2.jpg	9/15/2024 5:52 PM	JPG File
3.jpg	9/15/2024 5:52 PM	JPG File

Fig 9.1.2. A folder named <converted_PNG> has been created, and the .png images have been placed inside it.

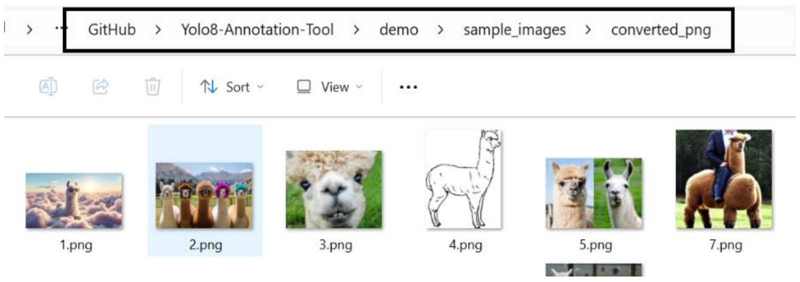
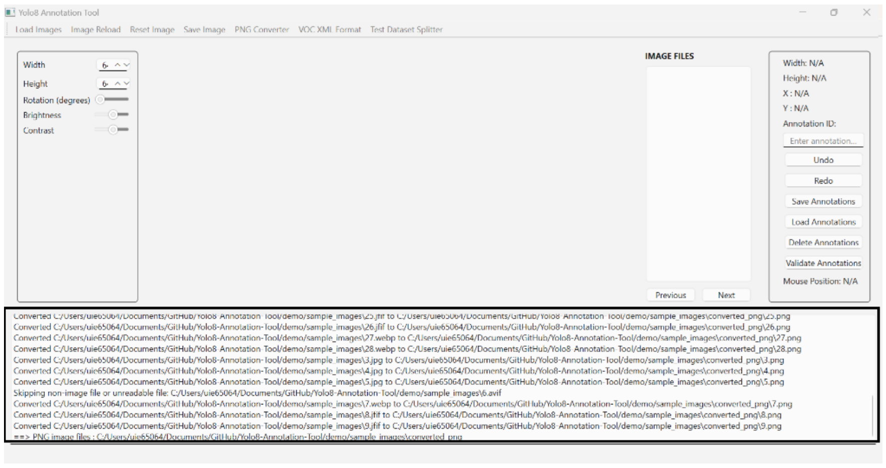

GitHub › Yolo8-Annotation-Tool › demo › sample_images › converted_png
Sort
View
1.png
2.png
3.png
4.png
5.png
7.png

Fig 10.1.3. PNG generated files as snapshot.

9.2. Log Window:

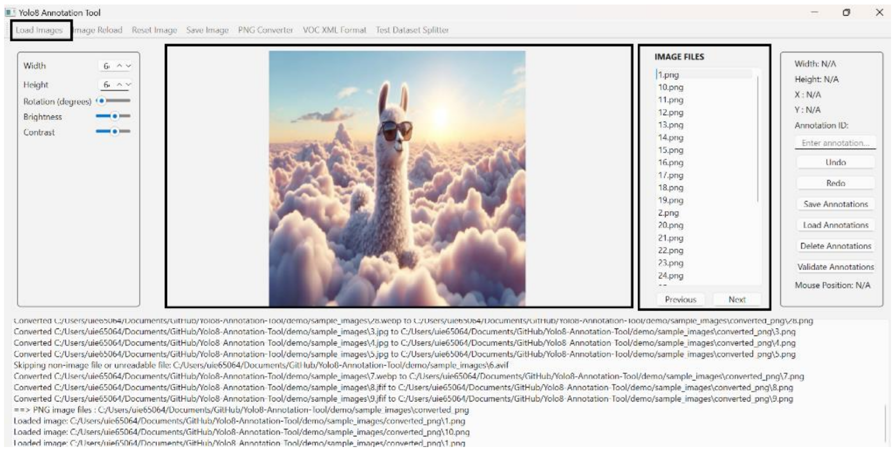


```
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\25.jfif to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\25.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\26.jfif to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\26.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\27.webp to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\27.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\28.webp to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\28.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\3.jpg to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\3.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\4.jpg to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\4.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\5.jpg to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\5.png
Skipping non-image file or unreadable file: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\6.avif
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\7.webp to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\7.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\8.jfif to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\8.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\9.jfif to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\9.png
==> PNG image files : C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png
```

Fig 9.2.1. Log for the PNG converter is available as snapshot.

9.3. Load Images:

- Select a folder that contains only <.png> format images.
- Once the images are loaded, the IMAGES FILES section will display a list of the loaded images.
- The display area will show the image selected from the IMAGES FILES list.

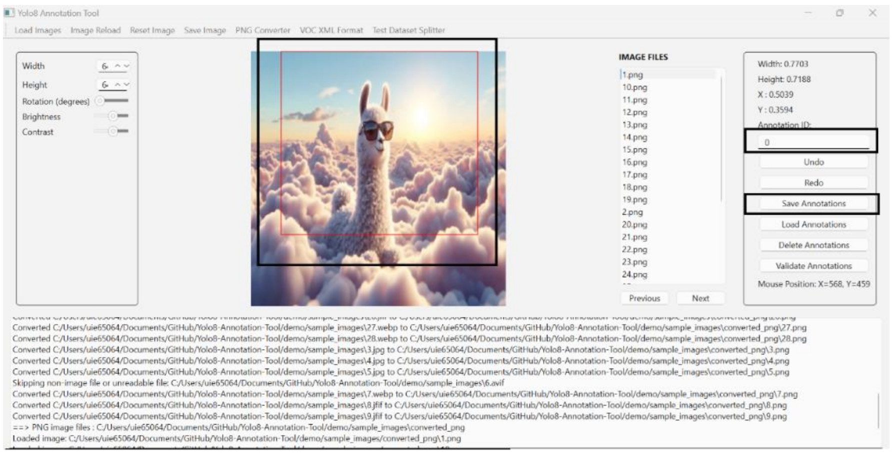


```
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\28.webp to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\28.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\3.jpg to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\3.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\4.jpg to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\4.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\5.jpg to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\5.png
Skipping non-image file or unreadable file: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\6.avif
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\7.webp to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\7.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\8.jfif to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\8.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\9.jfif to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\9.png
==> PNG image files : C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\1.png
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\10.png
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\1.png
```

Fig 9.3.1. Highlighted section is displaying area and Image files.

9.4. Bounding box:

- Select the top-left corner and drag downwards to create a bounding box.
- Enter the annotation ID, then click the "Save Annotation" button.
- Once the "Save Annotation" button is clicked, a resave pop-up window will appear.
- After the image is saved, a .txt file will be generated in the same folder as the image.

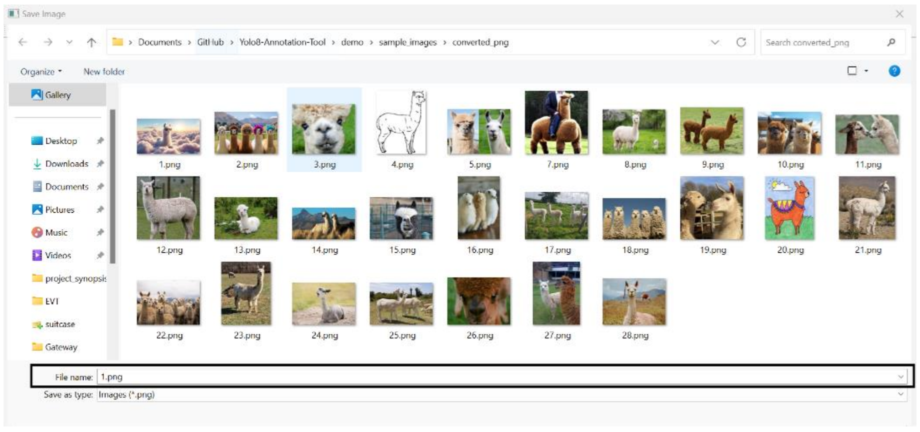


Width: 6
Height: 6
Rotation (degrees)
Brightness
Contrast

Width: 0.7703
Height: 0.7188
X : 0.5039
Y : 0.3594
Annotation ID: 0
Mouse Position: X=568, Y=459

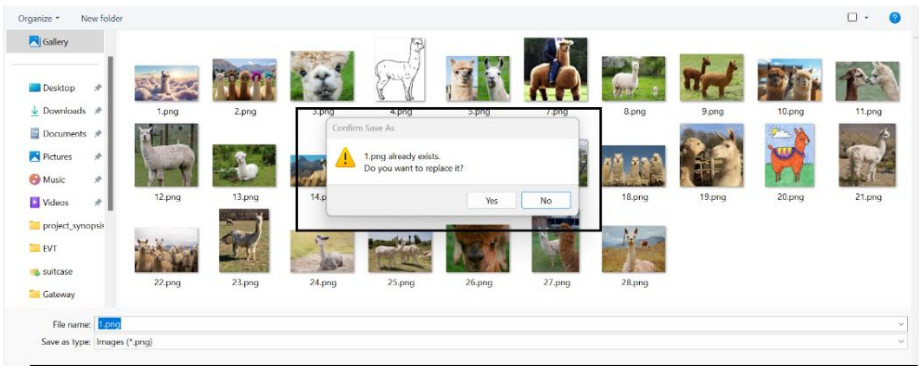
```
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\27.webp to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\27.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\28.webp to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\28.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\3.jpg to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\3.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\4.jpg to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\4.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\5.jpg to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\5.png
Skipping non-image file or unreadable file: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\6.avif
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\7.webp to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\7.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\8.jfif to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\8.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\9.jfif to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\9.png
==> PNG image files : C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\1.png
```

Fig 9.4.1. Bounding box snapshot



File name: 1.png
Save as type: Images (*.png)

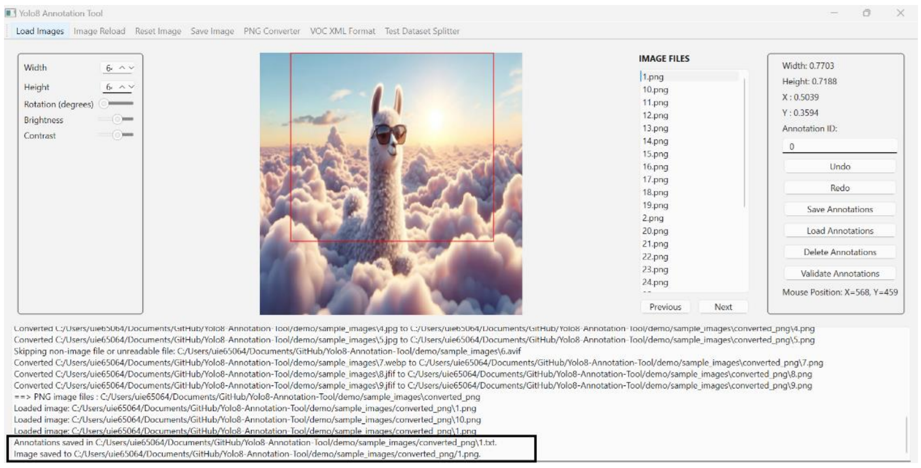
Fig 9.4.2. Save annotation triggers option to resave image.



1.png already exists.
Do you want to replace it?

File name: 1.png
Save as type: Images (*.png)

Fig 9.4.3. Pop-up window to resave image.



Width 6
Height 6
Rotation (degrees)
Brightness
Contrast

1.png
10.png
11.png
12.png
13.png
14.png
15.png
16.png
17.png
18.png
19.png
2.png
20.png
21.png
22.png
23.png
24.png

Width: 0.7703
Height: 0.7188
X : 0.5039
Y : 0.3594
Annotation ID: 0
Mouse Position: X=568, Y=459

```
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\4.jpg to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\4.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\5.jpg to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\5.png
Skipping non-image file or unreadable file: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\6.avif
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\7.webp to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\7.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\8.jfif to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\8.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\9.jfif to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\9.png
==> PNG image files : C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\1.png
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\10.png
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\1.png
Annotations saved in C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\1.txt.
Image saved to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png/1.png.
```

Fig 9.4.4. log window displays a record of the saved images.

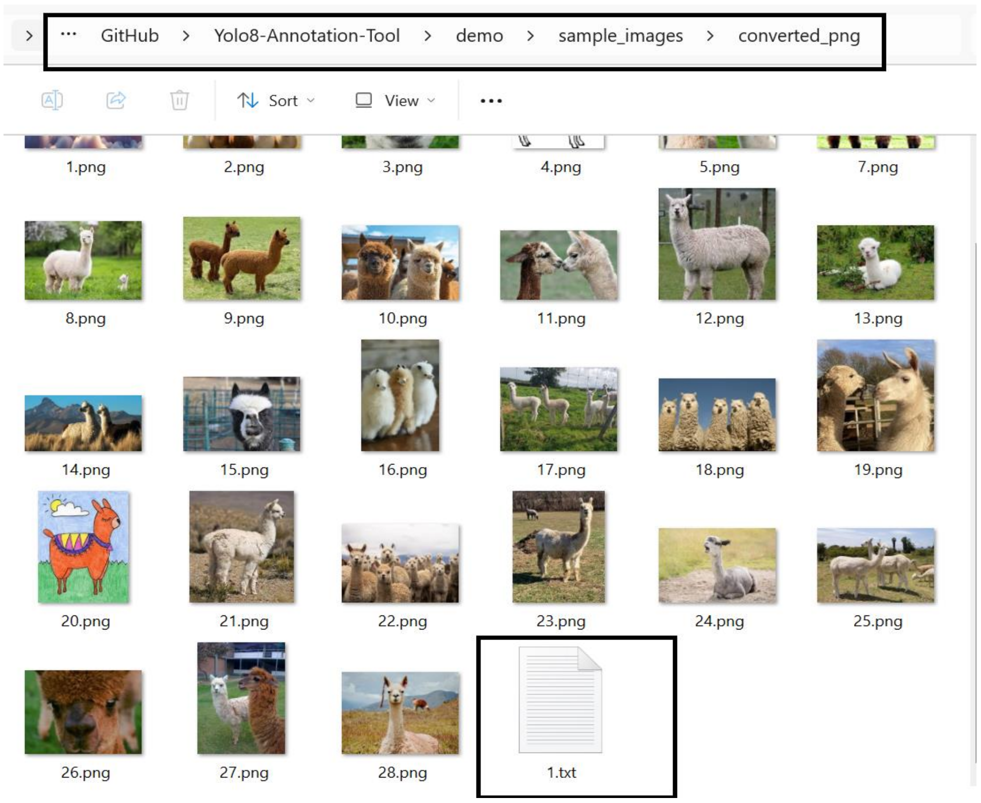
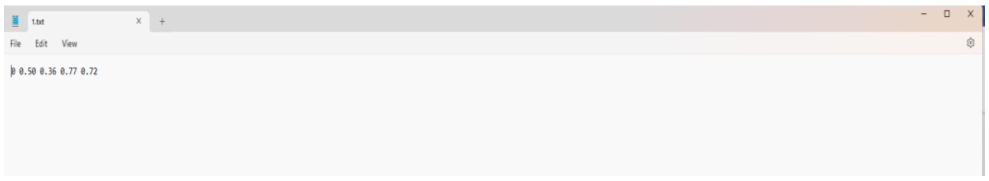


Fig 9.4.5. Annotation file generated with .txt extension.

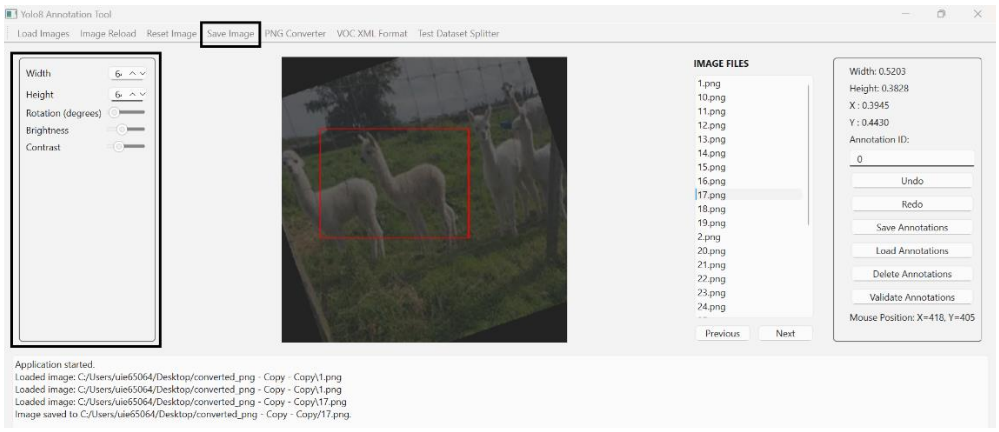


```
0 0.50 0.36 0.77 0.72
```

Fig 9.4.5. Annotation with yolo8 format

9.5. Image Setting (Data Augmentation):

- Set the image size by adjusting the height and width.
- Rotate the image with a 360-degree rotation option.
- Adjust the brightness and contrast as needed.
- To save the changes, click "Save Image" (please note that auto-save is not supported).



Width 6

Height 6

1.png
10.png
11.png
12.png
13.png
14.png
15.png
16.png
17.png
18.png
19.png
2.png
20.png
21.png
22.png
23.png
24.png

Width: 0.5203
Height: 0.3828
X : 0.3945
Y : 0.4430
Annotation ID: 0

Mouse Position: X=418, Y=405

```
Application started.
Loaded image: C:/Users/uie65064/Desktop/converted_png - Copy - Copy\1.png
Loaded image: C:/Users/uie65064/Desktop/converted_png - Copy - Copy\1.png
Loaded image: C:/Users/uie65064/Desktop/converted_png - Copy - Copy\17.png
Image saved to C:/Users/uie65064/Desktop/converted_png - Copy - Copy/17.png.
```

Fig 9.5.1. Image setting with rotation and save image snapshot.

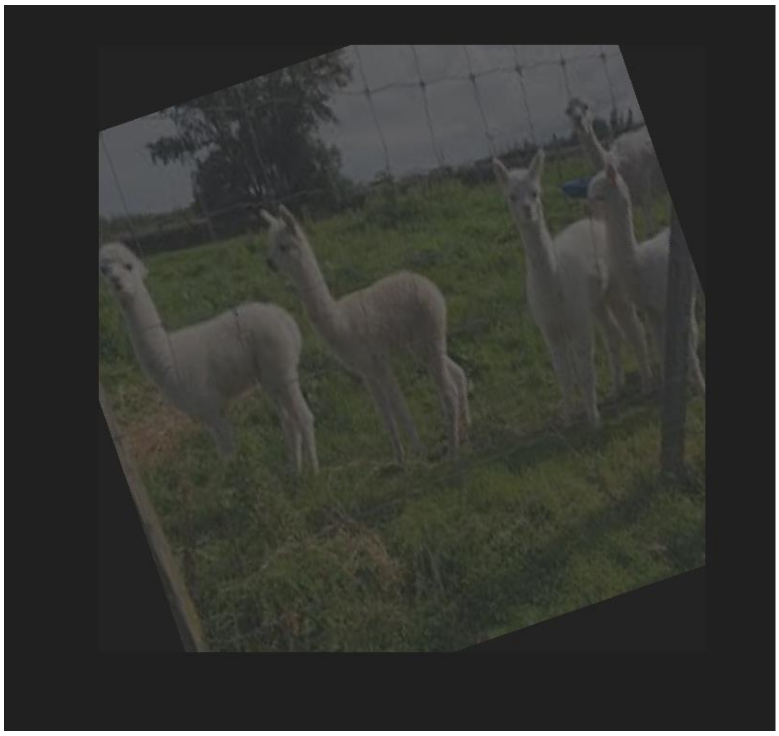
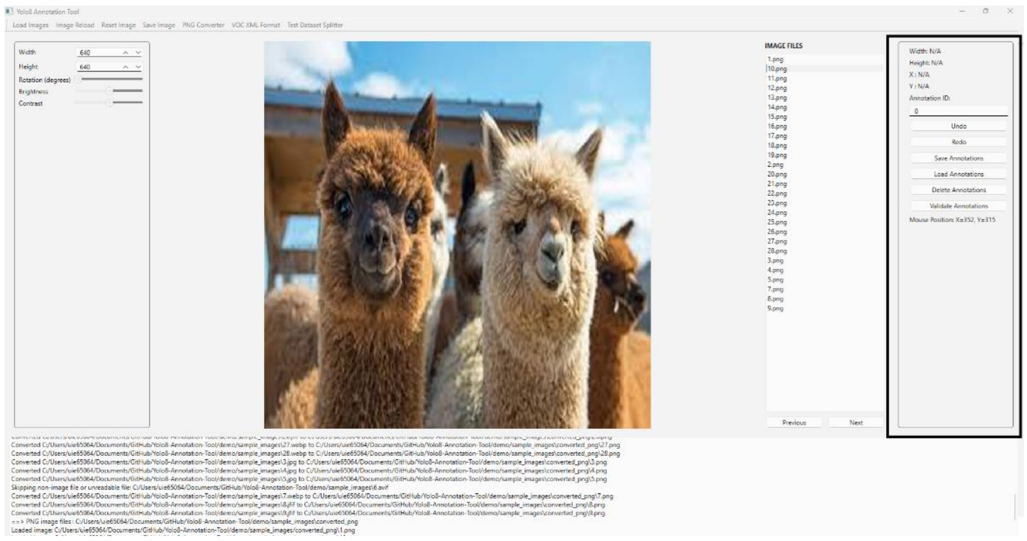


Fig 9.5.1. Saved image.

9.6. Annotation setting:

- **Load Annotation**: After an annotation is created, the bounding box can be displayed by selecting this option, provided the annotation file exists.
- **Delete Annotation:** The annotation file can be deleted using this option, but only if the annotation file is present.
- **Redo and Undo:** The annotation bounding box can be redone or undone as needed.

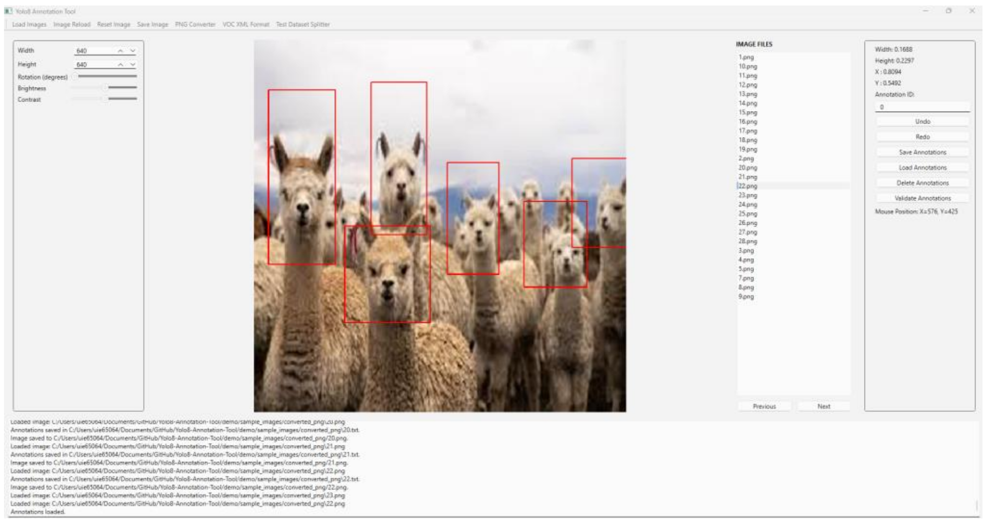


```
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\27.webp to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\27.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\28.webp to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\28.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\3.jpg to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\3.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\4.jpg to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\4.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\5.jpg to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\5.png
Skipping non-image file or unreadable file: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\6.avif
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\7.webp to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\7.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\8.jfif to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\8.png
Converted C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\9.jfif to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png\9.png
==> PNG image files : C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images\converted_png
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\1.png
```

Fig 10.6.1. Annotation setting as highlighted.

9.7. Annotation validation:

- **Validate Annotation:** Once all bounding boxes are updated, this option allows you to verify whether all annotation files have been generated.
  When the button is clicked, a pop-up window will display a list of files that are missing annotations. If all annotations are generated, no files will be listed.



```
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\20.png
Annotations saved in C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\20.txt.
Image saved to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png/20.png.
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\21.png
Annotations saved in C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\21.txt.
Image saved to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png/21.png.
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\22.png
Annotations saved in C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\22.txt.
Image saved to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png/22.png.
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\23.png
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\22.png
Annotations loaded.
```

Fig 9.7.1. Multiple bounding box

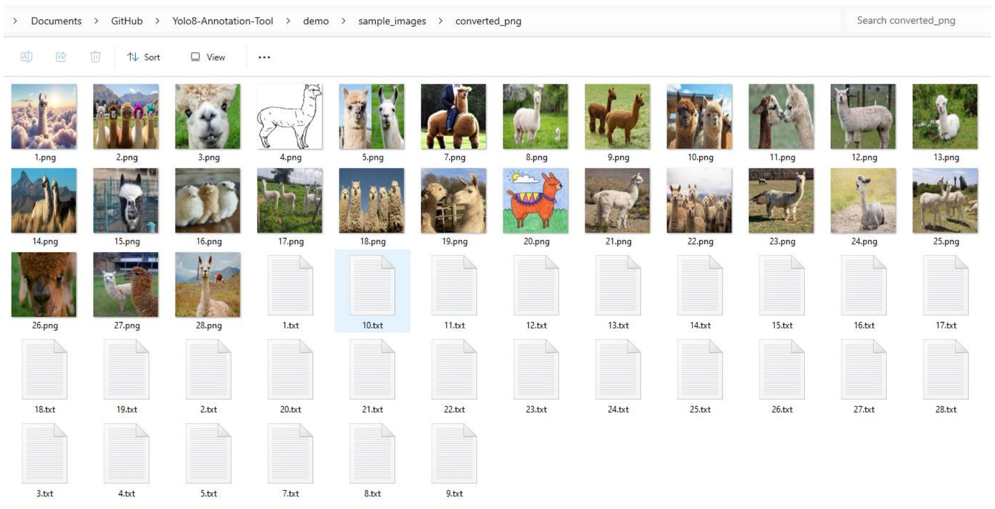
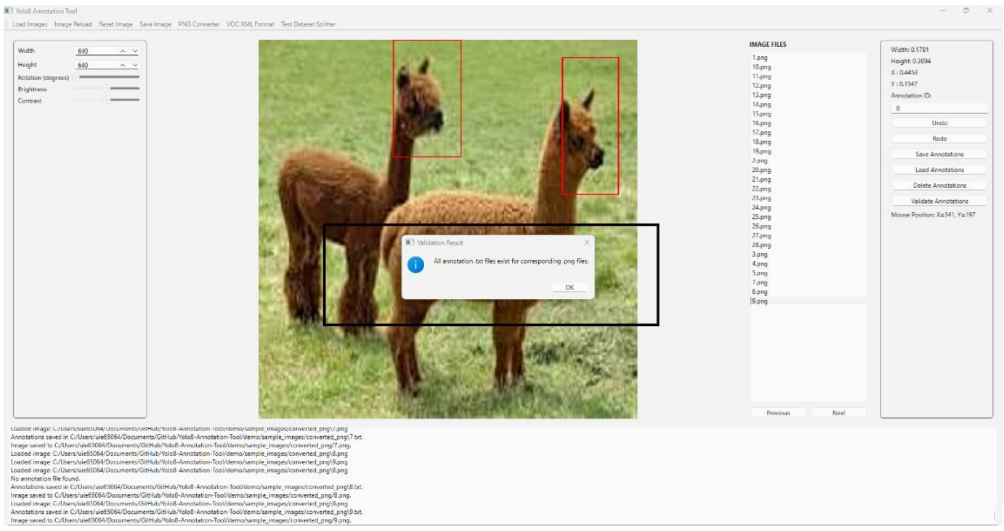

Documents > GitHub > Yolo8-Annotation-Tool > demo > sample_images > converted_png
Search converted_png
Sort
View
1.png 2.png 3.png 4.png 5.png 7.png 8.png 9.png 10.png 11.png 12.png 13.png
14.png 15.png 16.png 17.png 18.png 19.png 20.png 21.png 22.png 23.png 24.png 25.png
26.png 27.png 28.png 1.txt 10.txt 11.txt 12.txt 13.txt 14.txt 15.txt 16.txt 17.txt
18.txt 19.txt 2.txt 20.txt 21.txt 22.txt 23.txt 24.txt 25.txt 26.txt 27.txt 28.txt
3.txt 4.txt 5.txt 7.txt 8.txt 9.txt

Fig 9.7.2. Annotation files for respective images



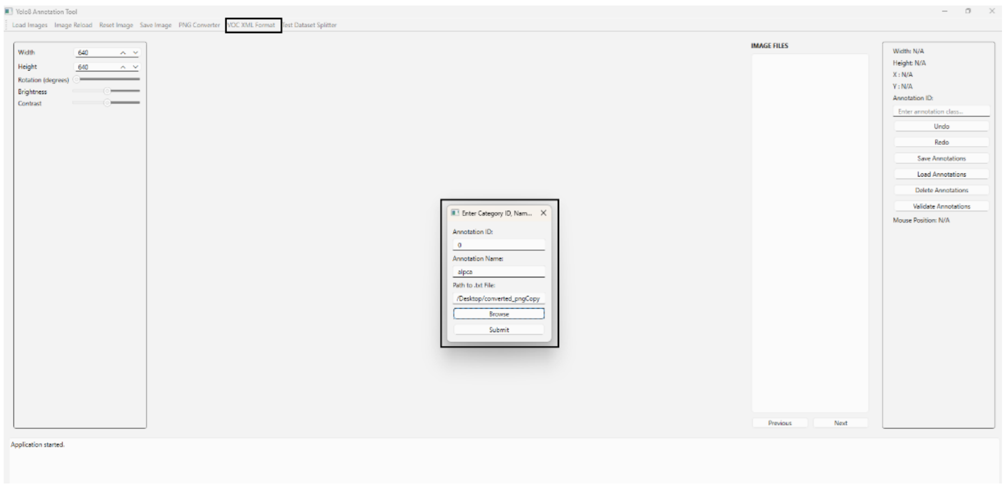
Width 640
Height 640

Width: 0.1781
Height: 0.3094
X : 0.4453
Y : 0.1547
Annotation ID: 0
Mouse Position: X=341, Y=197

All annotation .txt files exist for corresponding .png files.

```
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\7.png
Annotations saved in C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\7.txt.
Image saved to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png/7.png.
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\8.png
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\9.png
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\8.png
No annotation file found.
Annotations saved in C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\8.txt.
Image saved to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png/8.png.
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\9.png
Annotations saved in C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\9.txt.
Image saved to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png/9.png.
```

Fig 9.7.3. Pop-up window for validate annotation.



Width 640
Height 640

Width: N/A
Height: N/A
X : N/A
Y : N/A
Annotation ID:
Mouse Position: N/A

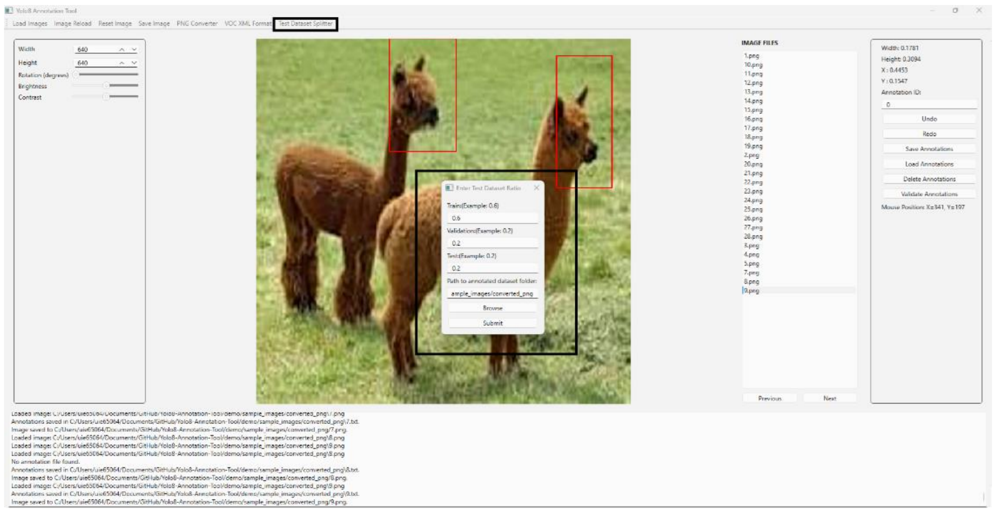
Annotation ID: 0
Annotation Name: alpca
Path to .txt File: /Desktop/converted_pngCopy

```
Application started.
```

Fig 9.7.4. Generation of VOC XML formal

9.8. Dataset splitter:

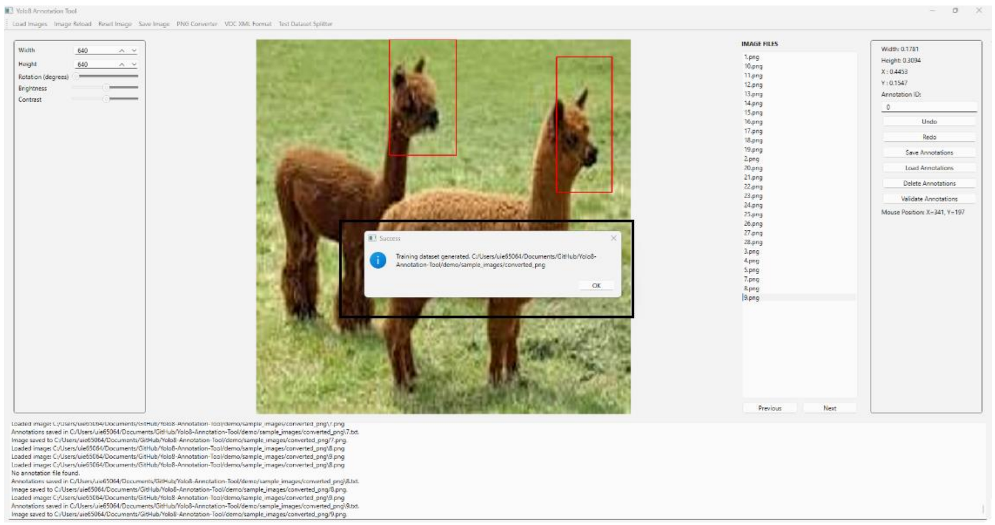
- Option offers a feature to easily split the dataset into training, validation, and testing sets, facilitating the process of preparing the dataset for deep learning models.



Train:(Example: 0.6)
0.6
Validations:(Example: 0.2)
0.2
Test:(Example: 0.2)
0.2
Path to annotated dataset folder:
ample_images/converted_png

```
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\7.png
Annotations saved in C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\7.txt.
Image saved to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png/7.png.
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\8.png
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\9.png
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\8.png
No annotation file found.
Annotations saved in C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\8.txt.
Image saved to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png/8.png.
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\9.png
Annotations saved in C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\9.txt.
Image saved to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png/9.png.
```

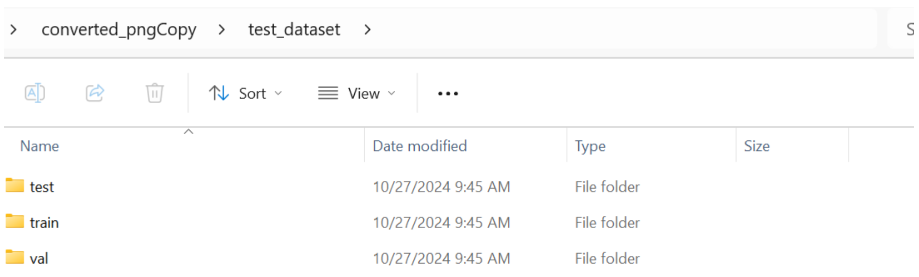
Fig 9.8.1. Pop-up window for splitting dataset in training, validation, and testing.



Training dataset generated. C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png

```
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\7.png
Annotations saved in C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\7.txt.
Image saved to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png/7.png.
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\8.png
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\9.png
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\8.png
No annotation file found.
Annotations saved in C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\8.txt.
Image saved to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png/8.png.
Loaded image: C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\9.png
Annotations saved in C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png\9.txt.
Image saved to C:/Users/uie65064/Documents/GitHub/Yolo8-Annotation-Tool/demo/sample_images/converted_png/9.png.
```

Fig 9.8.2. Pop-up window for splitting dataset is successful.



› converted_pngCopy › test_dataset ›

Name	Date modified	Type	Size
test	10/27/2024 9:45 AM	File folder	
train	10/27/2024 9:45 AM	File folder	
val	10/27/2024 9:45 AM	File folder	

Fig 9.8.3. Splitting dataset into folders (training, validation, and testing)

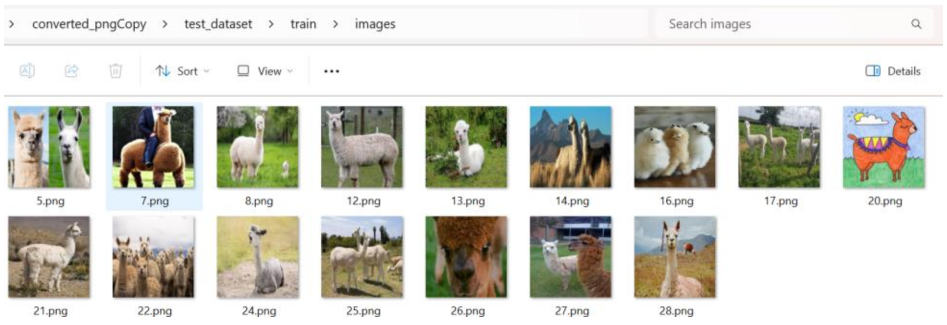


Fig 9.8.4. Splitting dataset into folders training images

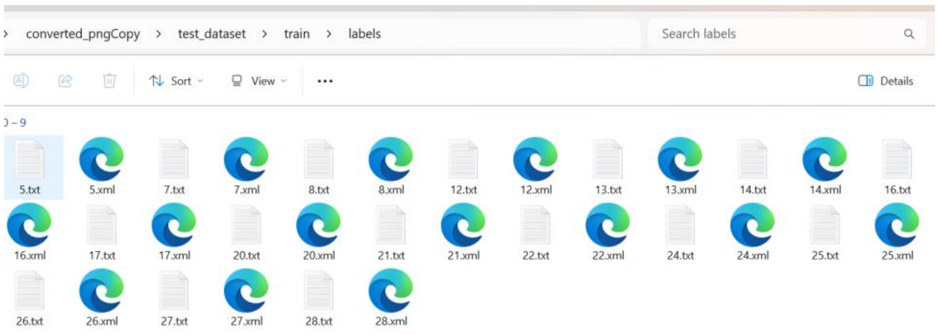
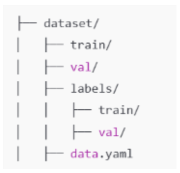


Fig 9.8.5. Splitting dataset into folders training annotation files. (xml/txt)

10. ANNOTATION VALIDATION WITH YOLO8 MODEL

10.1. Training Yolo8 Model:

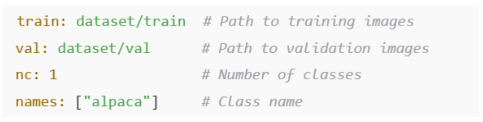
10.1.1. Dataset: YOLO models expect data in the COCO or YOLO format. A typical YOLO directory structure for custom datasets is:



```
├─ dataset/
|   ├─ train/
|   ├─ val/
|   ├─ labels/
|   |   ├─ train/
|   |   ├─ val/
|   ├─ data.yaml
```

Fig 10.1.1. directory structure for custom datasets.

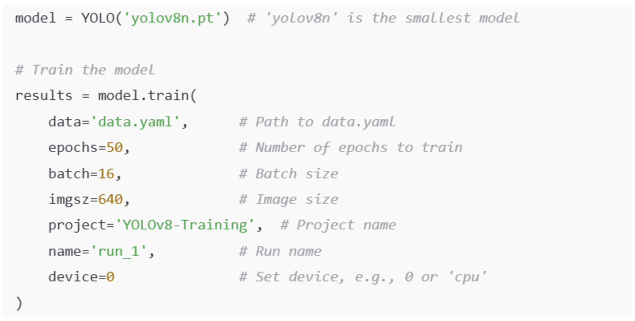
10.1.2. Data Configuration: Create a data.yaml file specifying paths and class names.



```
train: dataset/train  # Path to training images
val: dataset/val      # Path to validation images
nc: 1                 # Number of classes
names: ["alpaca"]     # Class name
```

Fig 10.1.2. Data Configuration with data.yaml file.

10.1.3. Training YOLOv8 Model: Python code for training a YOLOv8 model with custom data.



```
model = YOLO('yolov8n.pt')  # 'yolov8n' is the smallest model

# Train the model
results = model.train(
    data='data.yaml',       # Path to data.yaml
    epochs=50,              # Number of epochs to train
    batch=16,               # Batch size
    imgsz=640,              # Image size
    project='YOLOv8-Training',  # Project name
    name='run_1',           # Run name
    device=0                # Set device, e.g., 0 or 'cpu'
)
```

Fig 10.1.3. YOLOv8 train model.

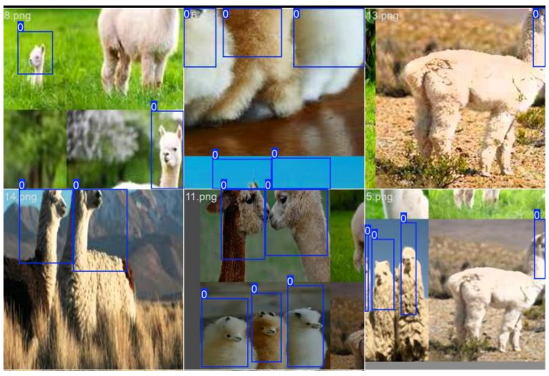


Fig 10.1.4. YOLOv8 model training image

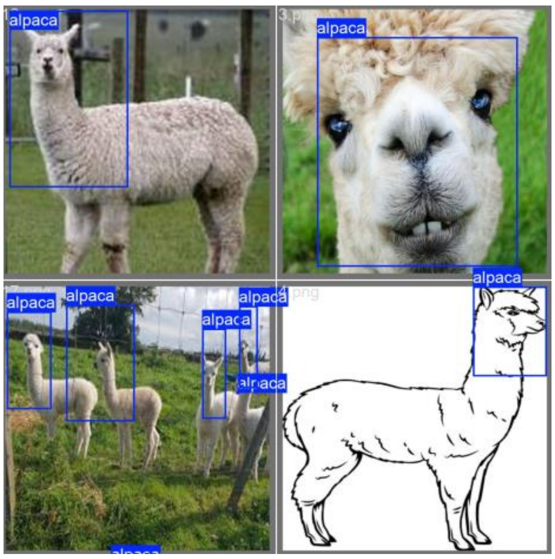
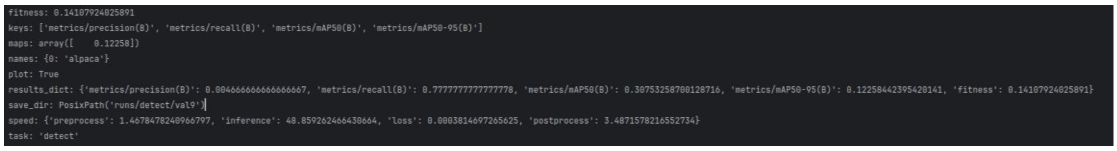


Fig 10.1.5. YOLOv8 model validation image

10.1.4. Evaluate the Model: After training, you can evaluate the model's performance using.

```
metrics = model.val()  # Runs validation and returns metrics
print(metrics)
```

Fig 10.1.6. YOLOv8 model validation code



```
fitness: 0.14107924025891
keys: ['metrics/precision(B)', 'metrics/recall(B)', 'metrics/mAP50(B)', 'metrics/mAP50-95(B)']
maps: array([    0.12258])
names: {0: 'alpaca'}
plot: True
results_dict: {'metrics/precision(B)': 0.004666666666666667, 'metrics/recall(B)': 0.7777777777777778, 'metrics/mAP50(B)': 0.30753258700128716, 'metrics/mAP50-95(B)': 0.12258442395420141, 'fitness': 0.14107924025891}
save_dir: PosixPath('runs/detect/val9')
speed: {'preprocess': 1.4678478240966797, 'inference': 48.859262466430664, 'loss': 0.0003814697265625, 'postprocess': 3.4871578216552734}
task: 'detect'
```

Fig 10.1.7. YOLOv8 model validation with limited dataset and CPU.

Precision (B): 0.0047

- Indicates a very low precision, meaning there are many false positives relative to true positives.

Recall (B): 0.7778

- This shows that the model is correctly identifying about 78% of actual alpacas, which is a significant improvement.

mAP@0.5 (B): 0.3075

- This indicates a reasonably good performance in terms of mean Average Precision at an IoU threshold of 0.5, suggesting that the model is better at correctly localizing detections.

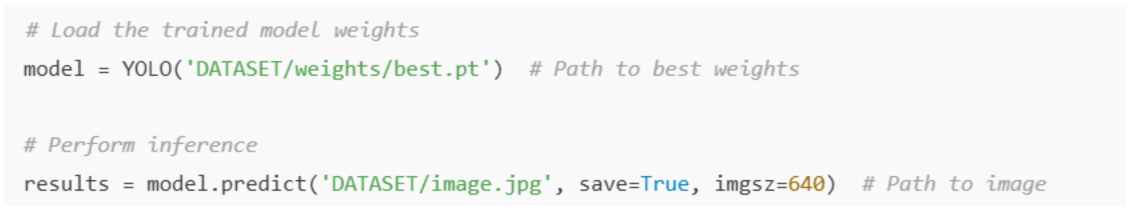
mAP@0.5:0.95 (B): 0.1226

- This value indicates that there is still room for improvement in the model's performance across a range of IoU thresholds, especially for higher precision.

Fitness Score: 0.1411

- The fitness score combines various metrics, and improvements in precision and mAP will enhance this score.

10.1.5. Prediction: After training and evaluation, model need to be tested with sample image.



```
# Load the trained model weights
model = YOLO('DATASET/weights/best.pt')  # Path to best weights

# Perform inference
results = model.predict('DATASET/image.jpg', save=True, imgsz=640)  # Path to image
```

Fig 10.1.5. YOLOv8 prediction

Note: Training a custom dataset from scratch requires substantial GPU resources and a large dataset. Due to resource constraints (CPU-only environment and limited dataset), we conducted training to verify that the YOLOv8 model (YOLOv8.pt) is capable of detecting and validating the annotations.

11. CONCLUSION

The Yolo8 Annotation Tool stands out as a powerful and user-friendly application designed to streamline the process of creating annotated datasets for object detection tasks. With its intuitive graphical user interface (GUI), the tool caters to a diverse range of users, including data scientists, computer vision researchers, and machine learning practitioners. Its key features, such as batch processing, bounding box annotation, data augmentation options, and dataset management capabilities, significantly enhance productivity and efficiency in preparing datasets for training machine learning models.

11.1. Key Strengths

The strengths of the Yolo8 Annotation Tool lie in its focus on usability, accuracy, and efficiency. The tool's ability to simplify the annotation process, along with its features for managing datasets and converting annotations, makes it a valuable resource for anyone involved in developing object detection models.

11.2. Future Directions

While the current version serves its purpose effectively, there is room for improvement. Future updates could expand the tool's capabilities by supporting multi-category annotations and incorporating additional formats for annotations. By continuously enhancing the tool, we can better meet the evolving needs of users and keep pace with advancements in machine learning and computer vision.

Overall, the Yolo8 Annotation Tool is a significant step forward in facilitating the creation of high-quality datasets, helping users produce better-performing models and pushing the boundaries of what is possible in the field of object detection.

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