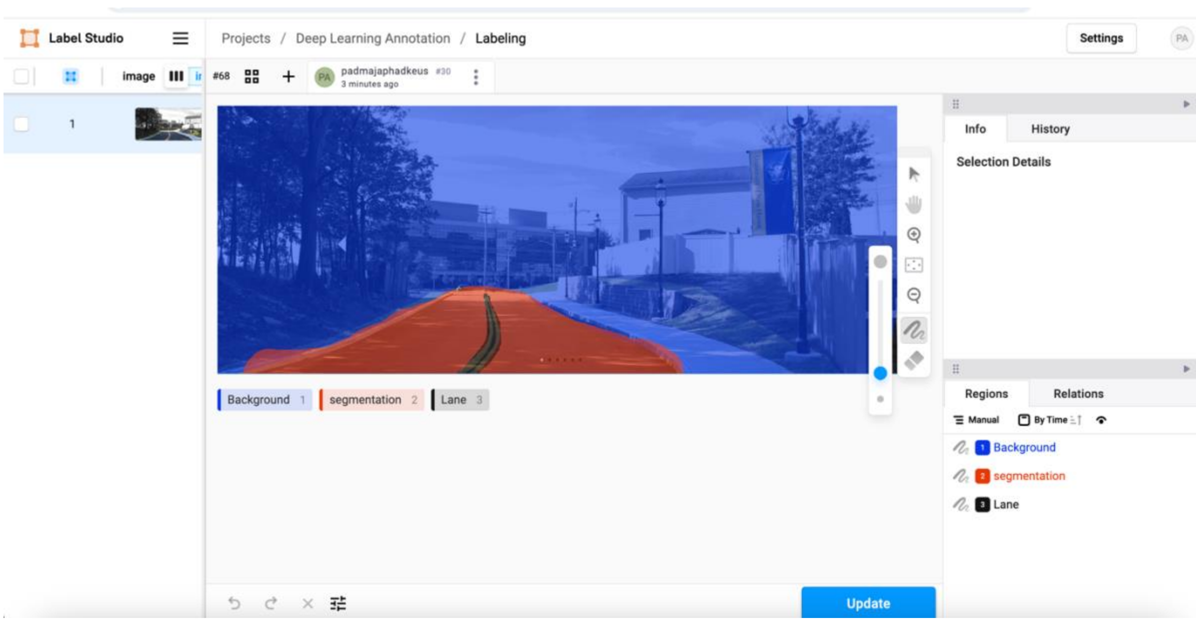
Dataset Description:

This dataset contains images for Drivable Area segmentation and Lane detection.
The project we are working on has two label outputs for each sample.
Link to our project's repository- [link]

Annotation:

- Our project leverages **Label Studio**, an image annotation tool, to meticulously label road lines and drivable areas within our image dataset.
- Link: https://labelstud.io/guide



Original Image:

Annotation for Drivable area segmentation:

Annotation for Lane detection:

Partitioning:

The dataset is structured into three distinct partitions: Train, Test, and Validation. The Train split comprises 80% of the dataset, containing both the input images and their corresponding labels. Meanwhile, the Test and Validation splits each contain 10% of the data, with a similar structure, consisting of image data and label information.

Within each of these splits, there are three folders:

- Images: This folder contains the original images, serving as the raw input data for the task at hand.
- Segments: Here, you can access the labels specifically designed for Drivable Area Segmentation, crucial for understanding road structure and drivable areas.
- Lane: This folder contains labels dedicated to Lane Detection, assisting in identifying and marking lanes on the road.

Transformation:

1. Random Perspective Transformation:
   This transformation simulates changes in the camera's perspective, including rotation, scaling, shearing, and translation. It is applied with random parameters:
   - **degrees:** Random rotation in the range of -10 to 10 degrees.
   - **translate:** Random translation in the range of -0.1 to 0.1 times the image

dimensions.

- **scale:** Random scaling in the range of 0.9 to 1.1 times the original size.
- **shear:** Random shearing in the range of -10 to 10 degrees.
- **perspective:** A slight random perspective distortion.

2. HSV Color Augmentation:
   - This changes the hue, saturation, and value of the image.
   - Random gains for hue, saturation, and value are applied.
   - The hue is modified by rotating the color wheel.
   - The saturation and value are adjusted by multiplying with random factors.
   - This helps to make the model invariant to changes in lighting and color variations.
3. Image Resizing:
   - If the Images are not in the specified size, the images are resized to a fixed size (640x360) using cv2.resize.
4. Label Preprocessing:
   - The labels (segmentation masks) are thresholded to create binary masks. This means that pixel values are set to 0 or 255 based on a threshold (usually 1 in this case).
   - The binary masks are also inverted to create a binary mask for the background.
   - These binary masks are converted to PyTorch tensors for use in training the semantic segmentation model.

Loss:

Two loss functions are used here one is focal loss and another is tversky loss. Focal Loss:

$$Loss_{focal} = -\frac{1}{N}\sum_{c=0}^{C-1}\sum_{i=1}^{N} p_i(c)(1-\hat{p}_i(c))^{\gamma} log(\hat{p}_i(c))$$

Tversky Loss:

$$Loss_{tversky} = \sum_{c=0}^{C}(1 - \frac{TP(c)}{TP(c) - \alpha FN(c) - \beta FP(c)})$$

Total Loss:

$$Loss_{total} = Loss_{focal} + Loss_{tversky}$$

Optimization:

In this setup, an Adam optimizer with a dynamically decreasing learning rate is employed. This adaptive learning rate is regulated using a Polynomial Learning Rate Scheduler, which gradually reduces the learning rate as the training progresses.