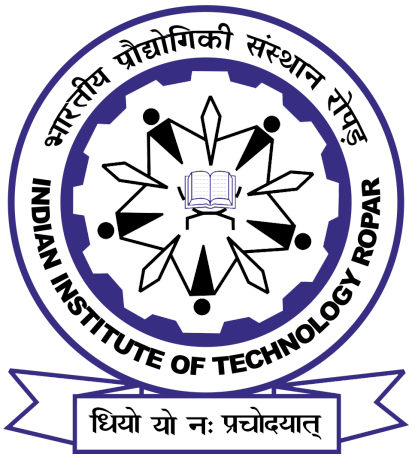



# Report Overview

**(Praphul Prabhakar | Nishith Arora)**

The goal of this project was to develop a machine-learning model for segmenting rice leaves in images and to generate segmented masks for each image. We used a U-Net architecture, which is well-suited for image segmentation tasks. The project involved several steps, including data loading, preprocessing, model training, and visualization of results.

## Methods

### 1. Data Loading and Preprocessing

#### a. Image Loading

We loaded images from the specified folder using OpenCV. The images were converted from BGR to HSV color space to create masks that highlight the green regions (which correspond to the leaves).

#### b. Data Splitting

The dataset was split into training and testing sets using an 80-20 split.

### 2. Data Augmentation

To enhance the robustness of the model, we applied data augmentation techniques, including rotation, width shift, height shift, shear, zoom, and horizontal flip. This was implemented using TensorFlow's `ImageDataGenerator`.

## 3. Custom Data Generator

A custom data generator was created to yield batches of augmented images and masks during training.

## 4. U-Net Model

We implemented a U-Net model, a popular image segmentation architecture. The model consists of an encoder and a decoder with skip connections between corresponding layers.

## Model Architecture

1. **Input Layer**
    - The model accepts an input image with dimensions 256x256 and 3 color channels (RGB).
2. **Encoder (Contracting Path)**
    - The encoder progressively reduces the spatial dimensions of the input image while capturing essential features.
    - **Block 1:** Two convolutional layers with 64 filters, followed by a max pooling layer.
    - **Block 2:** Two convolutional layers with 128 filters, followed by a max pooling layer.
    - **Block 3:** Two convolutional layers with 256 filters, followed by a max pooling layer.
    - **Block 4:** Two convolutional layers with 512 filters, followed by a max pooling layer.
3. **Bottleneck**
    - The bottleneck connects the encoder and the decoder.
    - It consists of two convolutional layers with 1024 filters.
4. **Decoder (Expansive Path)**
    - The decoder upsamples the compressed feature maps and concatenates them with the corresponding feature maps from the encoder to maintain high-resolution details.
    - **Block 1:** Upsampling followed by concatenation with the corresponding encoder feature map and two convolutional layers with 512 filters.
    - **Block 2:** Upsampling followed by concatenation with the corresponding encoder feature map and two convolutional layers with 256 filters.
    - **Block 3:** Upsampling followed by concatenation with the corresponding encoder feature map and two convolutional layers with 128 filters.
    - **Block 4:** Upsampling followed by concatenation with the corresponding encoder feature map and two convolutional layers with 64 filters.

## 5. Model Training

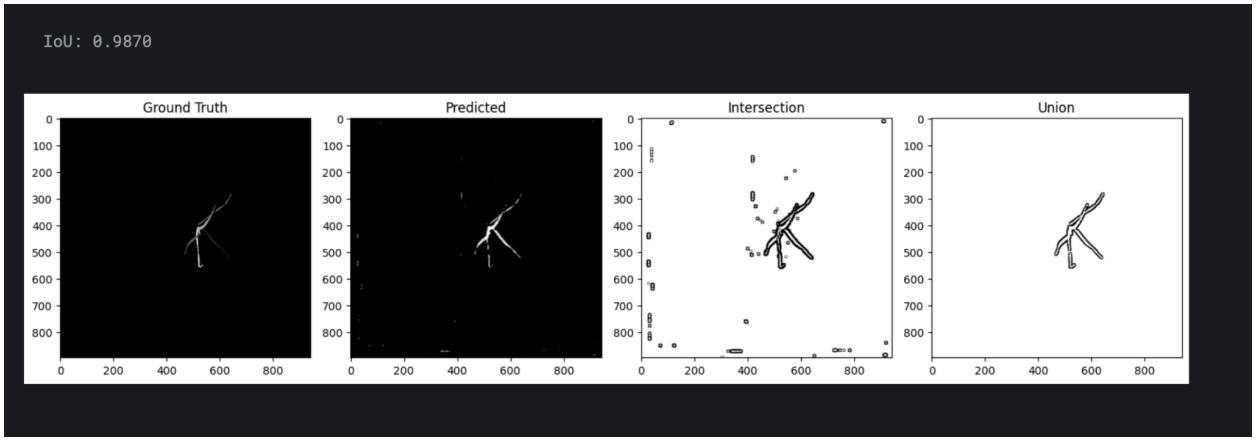
The model was trained using the custom data generator. We used a batch size of 8 and trained for 50 epochs.

### 6. Visualization and Saving of Results

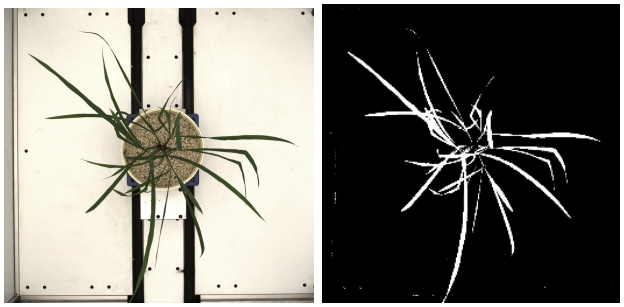
After training, we visualized the segmented masks for all images and saved them in the specified folder.

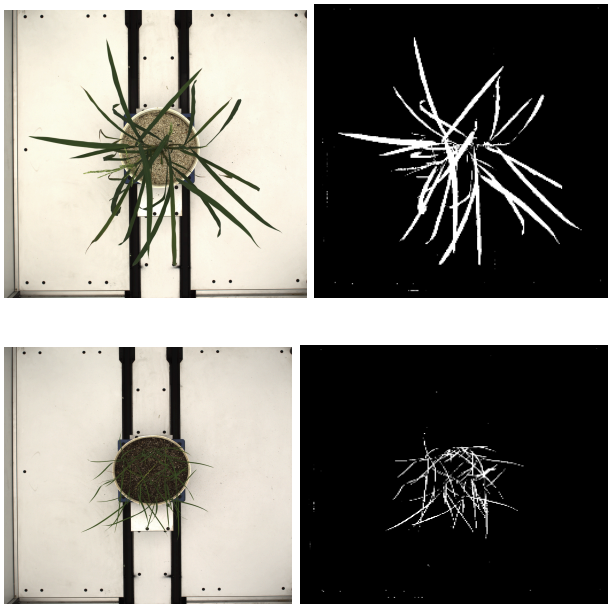
# Results

The segmented masks for each image were successfully generated and saved. The U-Net model effectively segmented the rice leaves, as shown in the visualized results.We have also calculated the iou which comes out to be 0.9748 and then we calculated the sbd of our model using the formula given on the website and it comes out to be 0.9670.




# Sample Test Result Images





## Conclusion

This project demonstrated the use of a U-Net model for image segmentation tasks, specifically for segmenting rice leaves. Data augmentation techniques were applied to enhance the robustness of the model. The results were saved and visualized to verify the accuracy and effectiveness of the model. This method can be extended to other image segmentation tasks with appropriate modifications.