11TH MINDANAO POLICY RESEARCH FORUM

Shaping Mindanao's Farming Future with AI: A Study on Corn Crop Disease Detection Using YOLOv8 CNN

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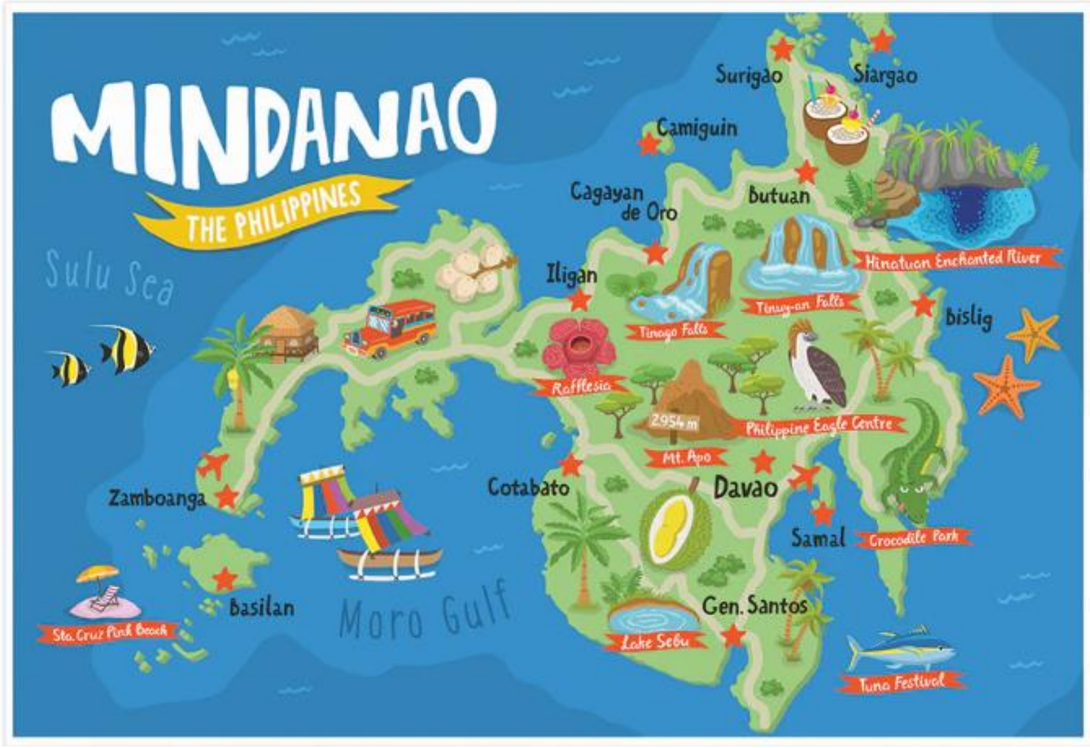
COT-ITD FACULTY

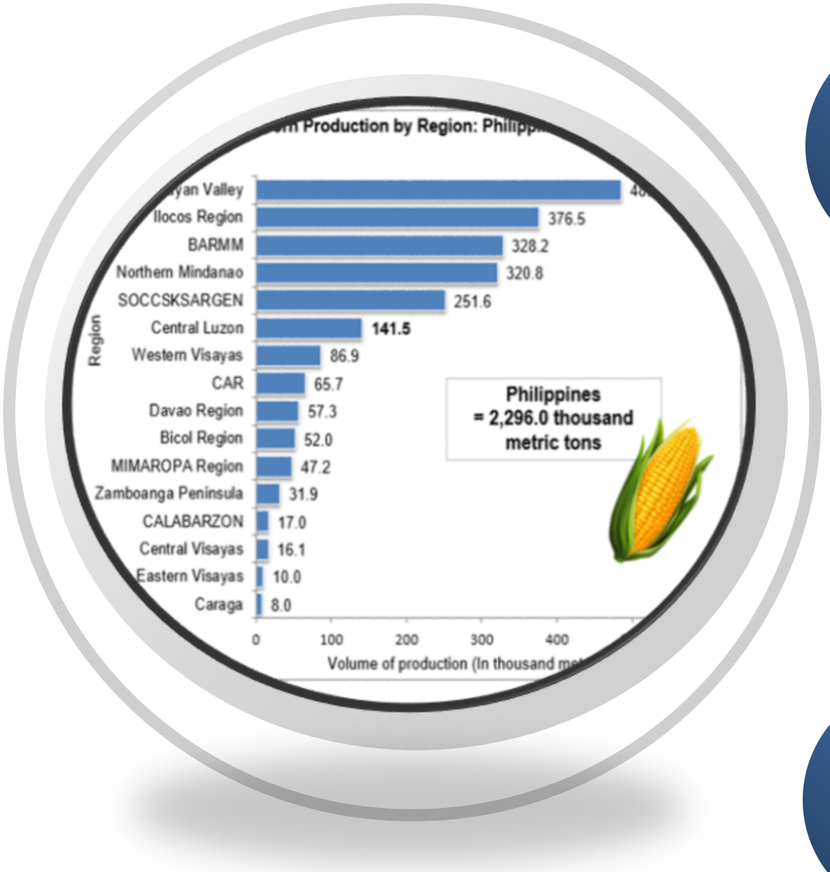
Republic of the Philippines
MINDANAO DEVELOPMENT AUTHORITY
INTEGRATING MINDANAO



Mindanao feeds the nation — but what would it take for our farmers to harness AI and secure that future?

Research Title: Corn Crop Disease Detection Using Convolutional Neural Network (CNN) to Support Smart Agricultural Farming

Rationale



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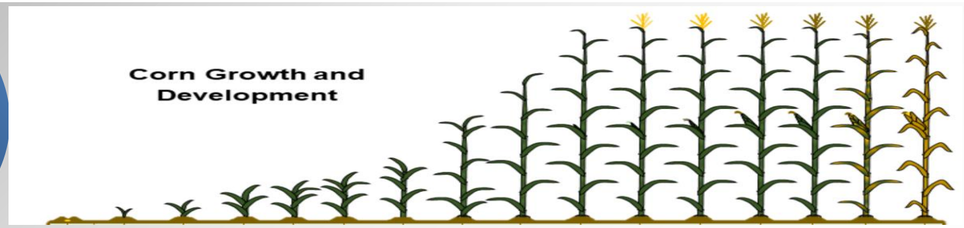


105 to 110 days,
Yield of 15 MT/ha.

2

Northern Mindanao **558.9** thousand metric tons **(28.2%)**

3

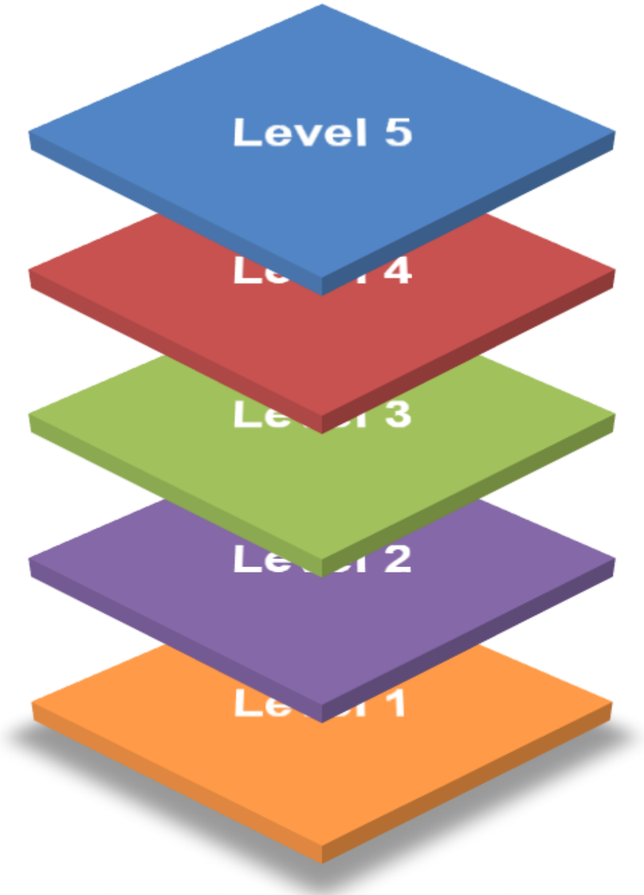
80% hybrid varieties
78% white corn growers use traditional varieties

Current Issues with Corn Production

Lack of Access to High-Quality Seeds

Climate Change and Extreme Weather Events

Pests and Diseases



Price Volatility

Post-Harvest Losses

Problems associated with corn production in the Philippines.

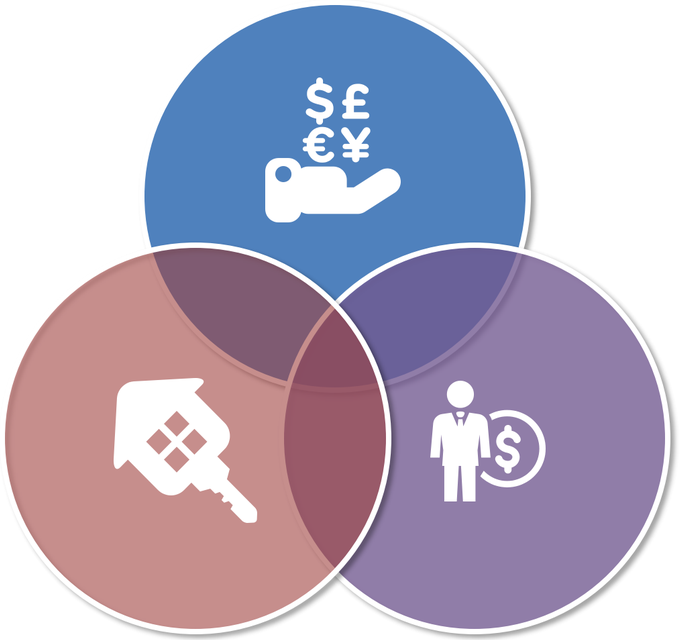
Objectives of the Study

The general objective of this study is to develop and evaluate a robust corn crop disease detection system using YOLOv8, aiming to enhance smart agricultural farming practices

- Collect and annotate the dataset of corn crop images, encompassing various disease states and growth stages, to serve as the training and evaluation data for the YOLOv8 model
- Preprocess the corn crop dataset to enhance the model's ability to generalize and accurately detect different disease symptoms under varying environmental conditions
- Train and fine-tune the YOLOv8 model using the annotated dataset, optimizing its performance for accurate and efficient corn crop disease detection.
- Evaluate the performance of the developed YOLOv8-based system in terms of detection accuracy, precision, recall, and processing speed, using appropriate evaluation metrics and benchmark datasets
- Compare the performance of the YOLOv8 model with other existing object detection algorithms or models to assess its effectiveness in corn crop disease detection

Significance of the Study

Improved crop productivity



Cost-effective and efficient detection

Advancement of smart agricultural farming

Related Studies

Related literature explores the use of YOLOv8, a deep learning model, for corn crop disease detection and its implications in supporting smart agricultural practices.

- *On YOLO Algorithm*
- *On Smart Smart Agricultural Farming Applications*
- *On Deep Learning Approaches for Crop Diseases*

Method	Accuracy	Speed	Model Size	Dataset Size	Application
YOLOv3	High	Fast	Moderate	Large	Object Detection
YOLOv4	Very High	Fast	Large	Large	Object Detection
YOLOv5	High	Very Fast	Small	Moderate	Object Detection
YOLOv8	High	Fast	Moderate	Large	Object Detection
Faster R-CNN	High	Moderate	Large	Large	Object Detection
SSD	Moderate	Fast	Small	Moderate	Object Detection
RetinaNet	High	Slow	Large	Large	Object Detection
Mask R-CNN	High	Slow	Large	Large	Object Detection
EfficientDet	High	Fast	Small	Large	Object Detection
MobileNet-SSD	Moderate	Very Fast	Very Small	Small	Object Detection
DeepLabv3+	High	Slow	Large	Large	Semantic Segmentation
U-Net	High	Slow	Moderate	Moderate	Semantic Segmentation

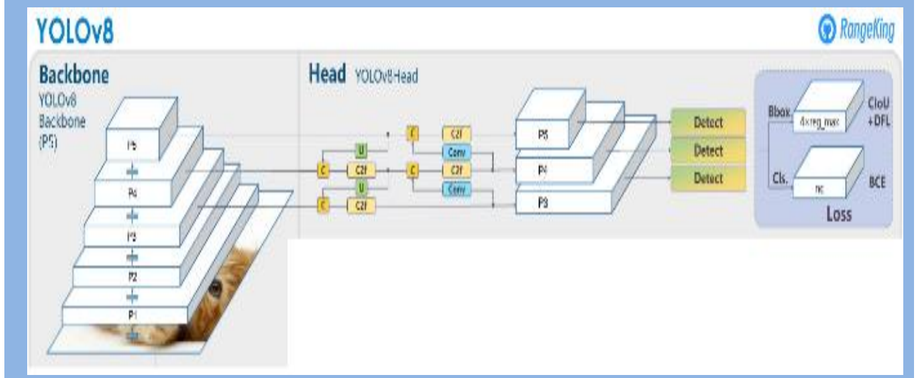
Comparative analysis of deep learning image detection

METHODS

Data Collection and Preprocessing

- The dataset used in this study was obtained from Kaggle and consists of images of corn crops with four distinct parameters: blight, common burst, gray leaf spot, and healthy.
- In the data pre-processing stage, all images in the dataset were annotated with the assistance of ROBOFLOW and makesense.ai. This annotation process involved labeling the images to indicate the presence of specific corn crop diseases such as blight, common burst, gray leaf spot, or the absence of any disease (healthy).

Model Architecture



Model Architecture Selection

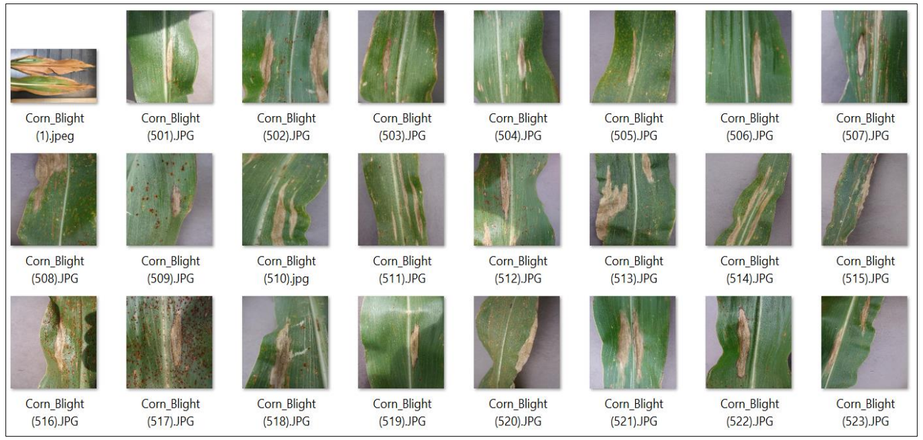
➢The model architecture used in this study for corn crop disease detection was YOLOv8. YOLOv8 (You Only Look Once version 8) is a state-of-the-art object detection algorithm that combines high accuracy and real-time performance.

Model Training, Testing, & Validation

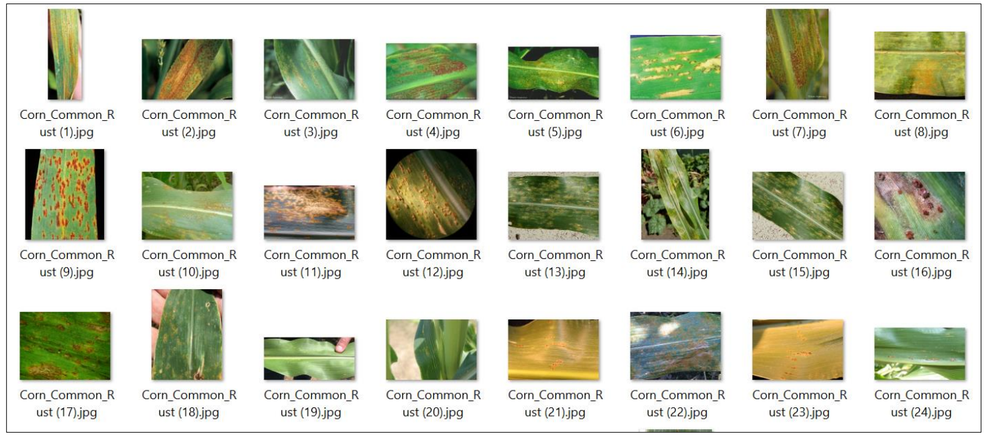
➢The model training process in this study involved using a total of 1.3k train images, 359 valid images, and 180 test images. These images were prepared and formatted using Roboflow, specifically in the YOLOv8 format.

➢Assess the final trained model's performance on the independent testing set to evaluate its generalization ability

➢Validate using 10-fold cross validation

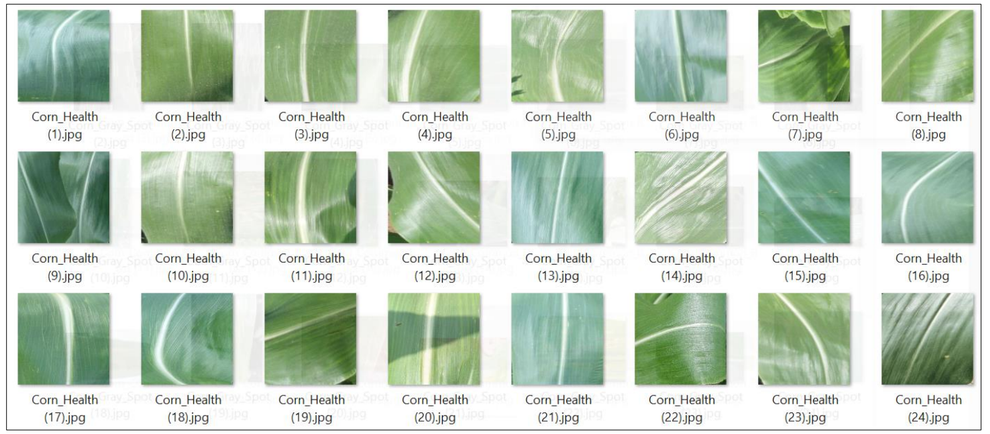


Corn-Blight



Corn-Common Rust

Corn-Gray Leaf Spot



Corn-Healthy

Results and Discussion

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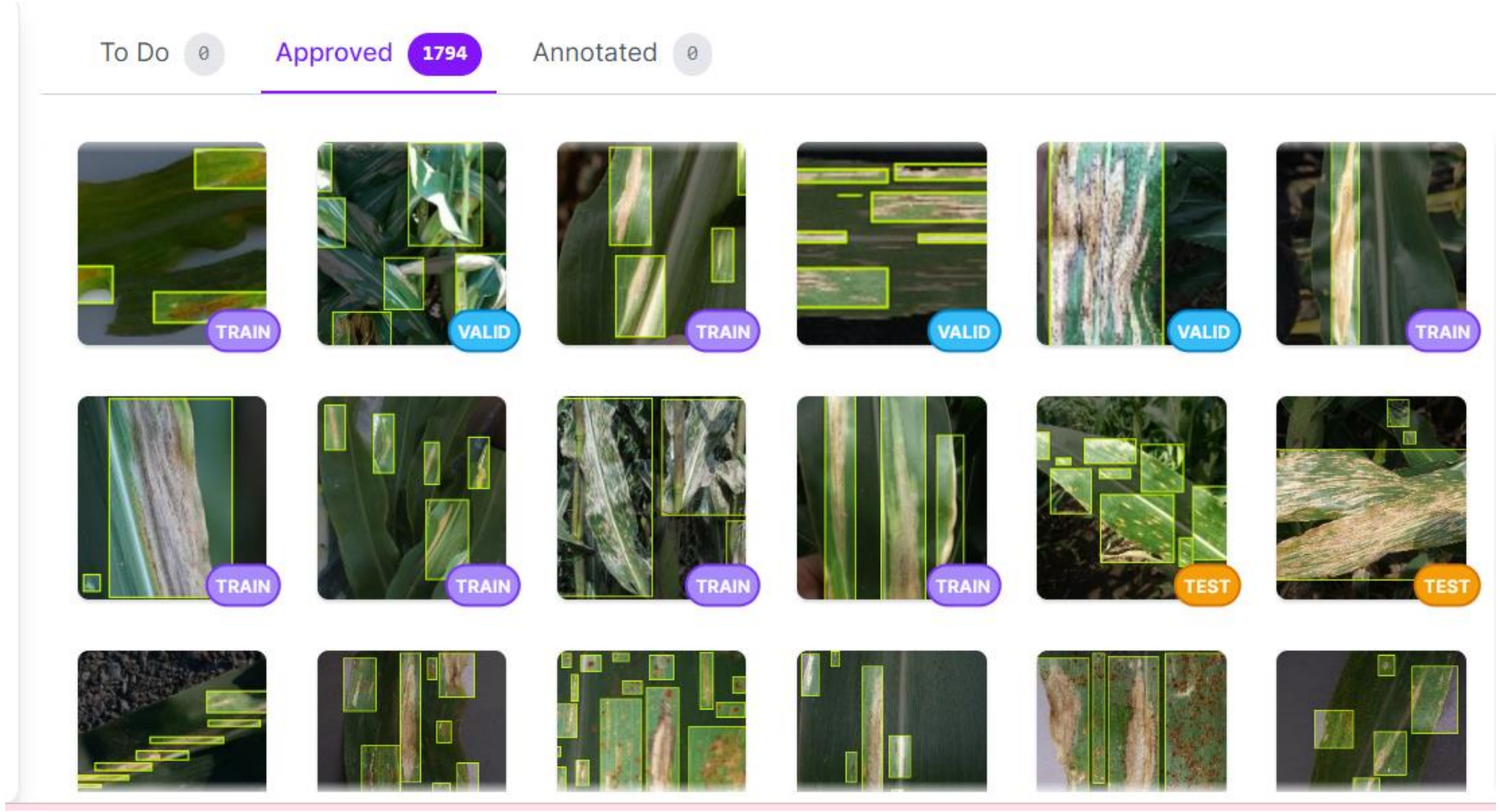
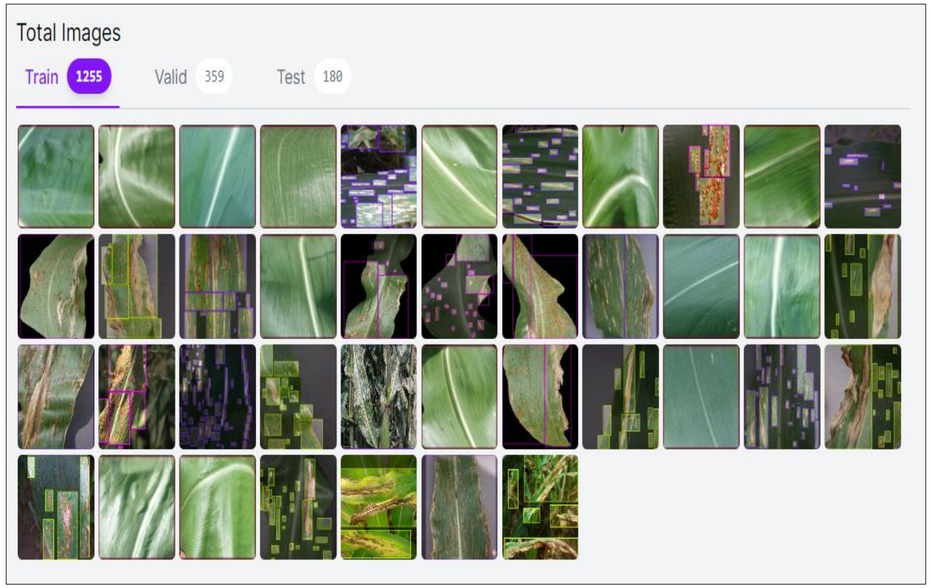
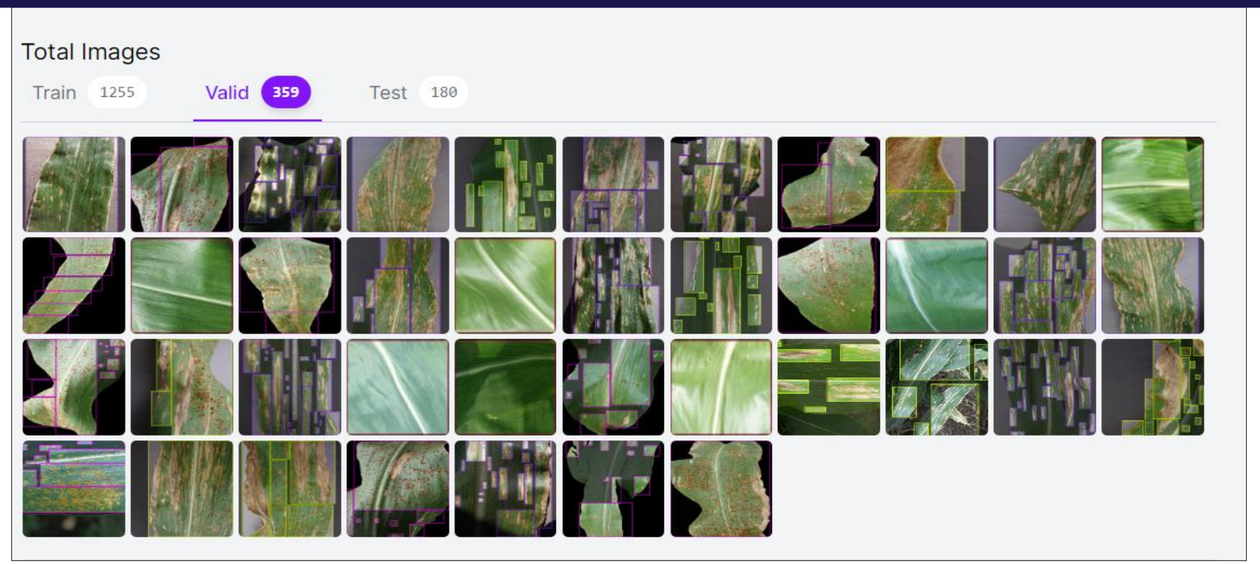


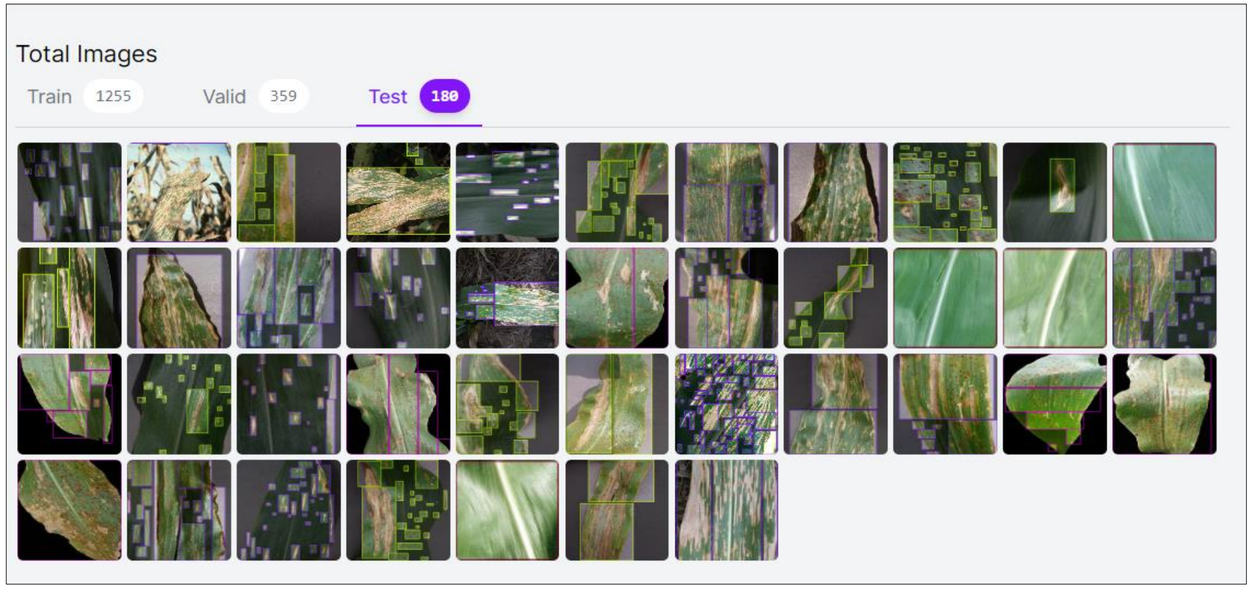
Results and Discussion



Train

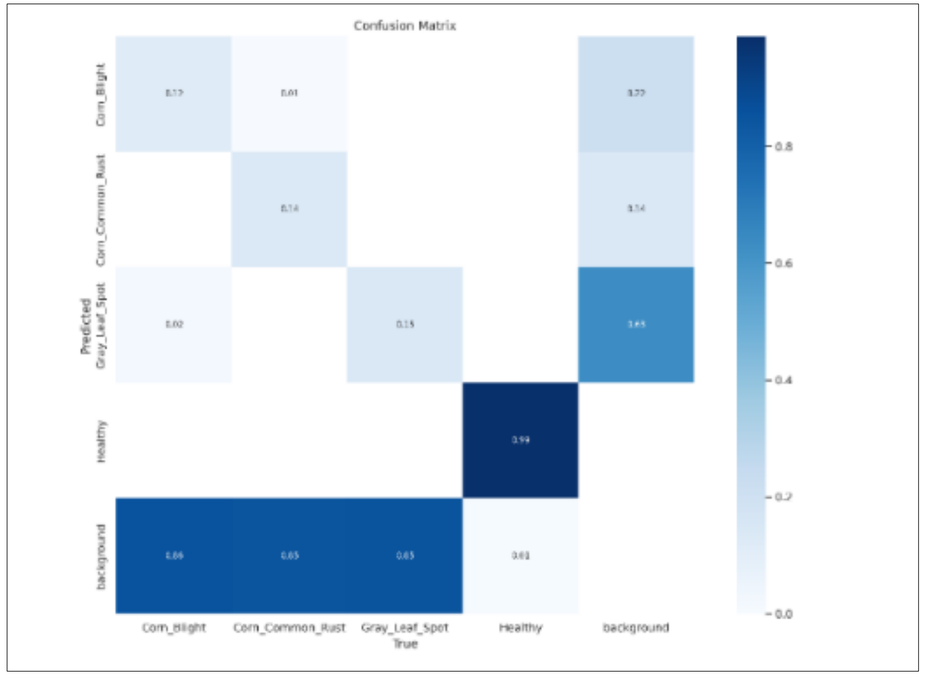


Valid

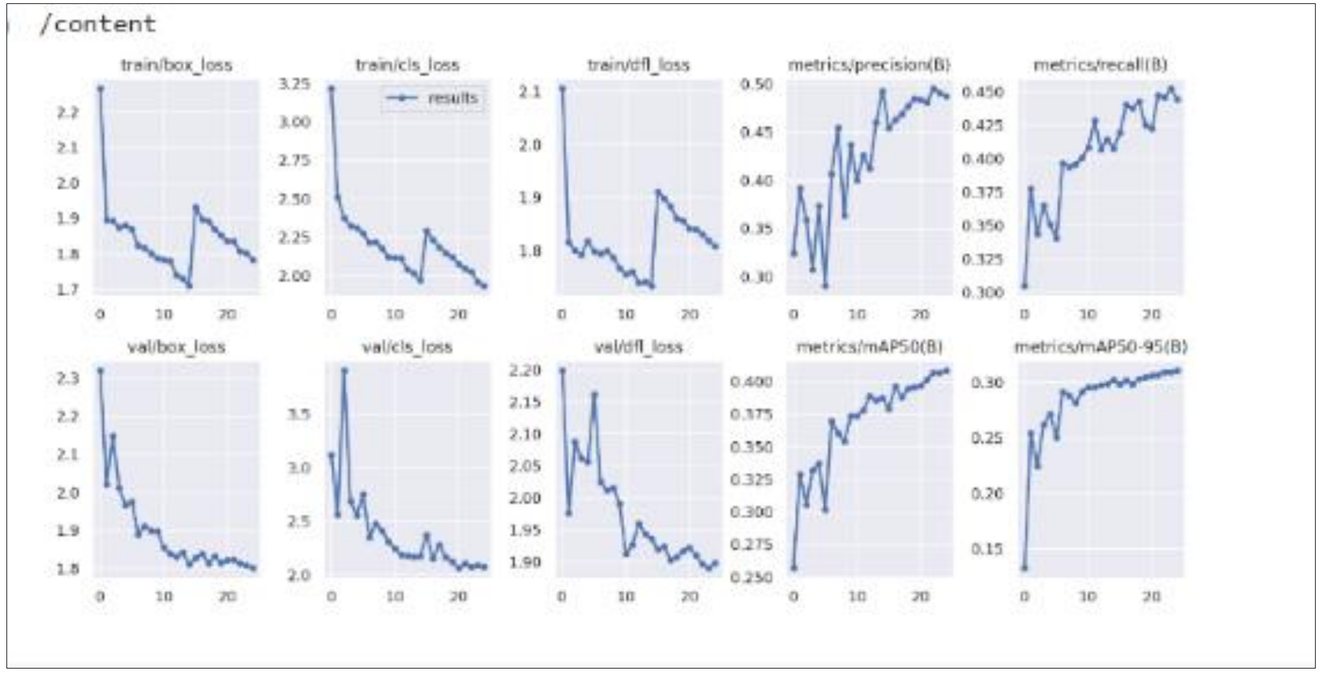


Test

Results and Discussion

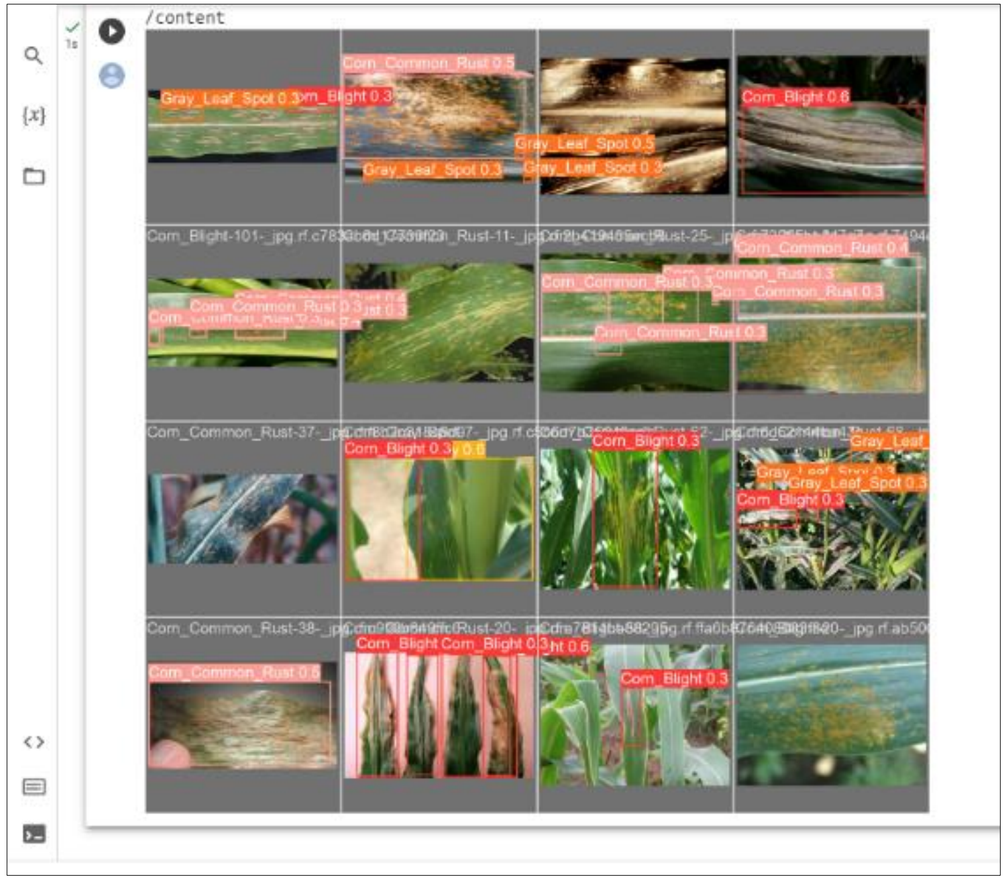


Confusion Matrix



Training Loss/Validation Loss

Results and Discussion



Model Testing

Validate Custom Model

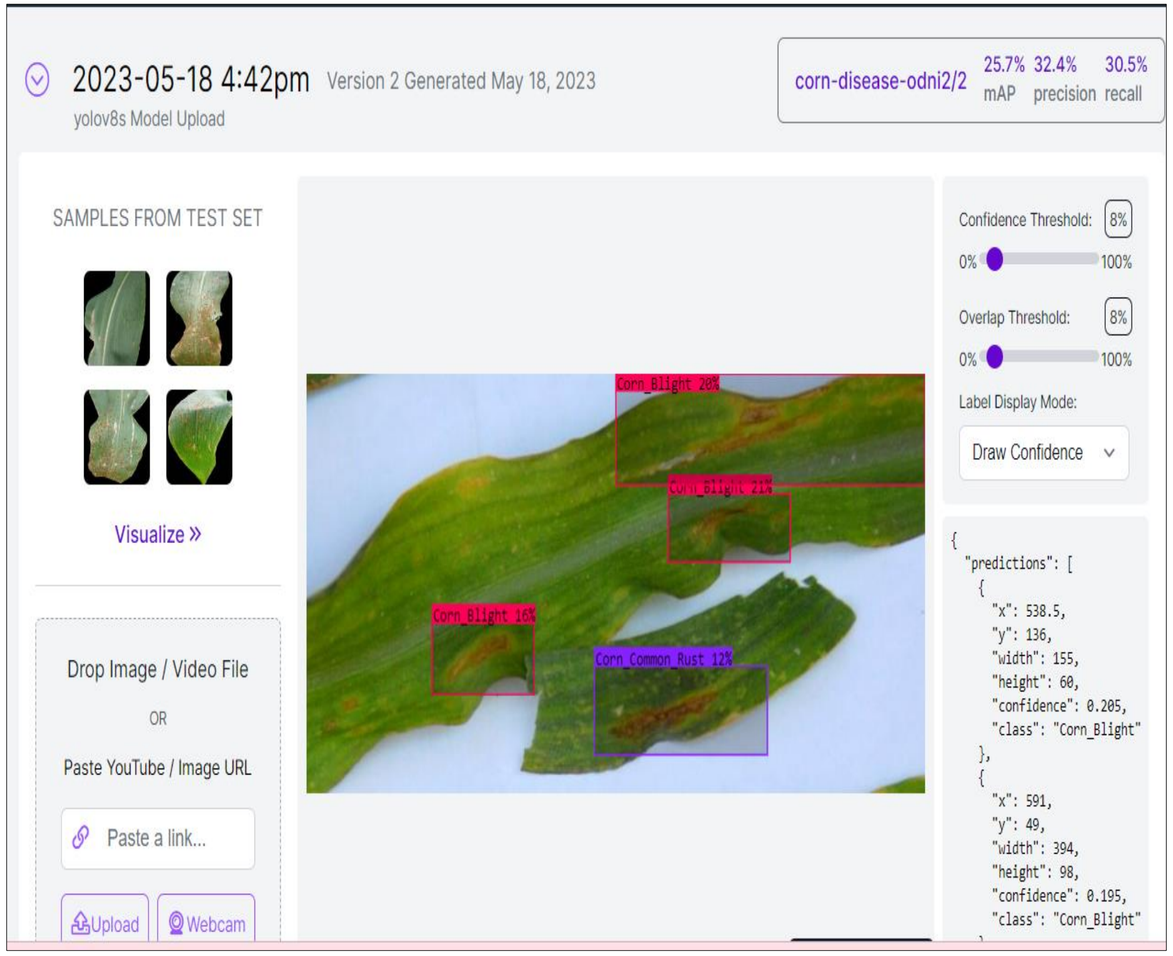
```
%cd {HOME}

!yolo task=detect mode=val model={HOME}/runs/detect/train/weights/best.pt data={dataset.location}/data.yaml
```

```
/content
2023-05-19 06:01:15.847423: W tensorflow/compiler/tf2tensorrt/utils/py_utils.cc:38] TF-TRT Warning: Could not find TensorRT
Ultralytics YOLOv8.0.20 🚀 Python-3.10.11 torch-2.0.1+cu118 CUDA:0 (Tesla T4, 15102MiB)
Model summary (fused): 168 layers, 11127132 parameters, 0 gradients, 28.4 GFLOPs
val: Scanning /content/datasets/Corn-Disease--1/valid/labels.cache... 359 images, 0 backgrounds, 0 corrupt: 100% 359/359 [00:00<?, ?it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100% 23/23 [00:15<00:00,  1.44it/s]
                   all        359       3169      0.488      0.446      0.409       0.31
           Corn_Blight        359        927      0.326      0.265      0.233     0.0858
      Corn_Common_Rust        359        543      0.331      0.252      0.209     0.0869
        Gray_Leaf_Spot        359       1604      0.305      0.267      0.198     0.0743
               Healthy        359         95       0.99      0.998      0.995      0.995
Speed: 1.4ms pre-process, 14.9ms inference, 0.0ms loss, 5.9ms post-process per image
```

Model Validation

Results and Discussion



Model Implementation

Upload an image, video, or even use webcam to obtain predictions for corn crop diseases.

If an image of a corn plant is uploaded, the model processes and generates the corresponding results. It classifies the image into:

- **blight,**
- **common rust,**
- **gray leaf spot, or**
- **healthy.**

The model's prediction will be displayed, indicating the specific disease or declaring the plant as healthy.

Conclusion

- The implementation of **YOLOv8** for **corn crop disease detection** has yielded promising outcomes.
- The model demonstrates strong performance with **high mean Average Precision** (mAP) values across different disease categories, including blight, common rust, and gray leaf spot.
- The model achieves an exceptional **mAP of 0.99** for the healthy class, indicating its accuracy in recognizing disease-free corn plants.
- These findings showcase the potential of YOLOv8 as an **effective tool for supporting smart agricultural farming practices**, enabling early disease detection and precise interventions to ensure crop health and optimize yields.

Utilization

Republic of the Philippines
Province of Bukidnon
CITY OF MALAYBALAY

BAGONG PILIPINAS

CITY OF MALAYBALAY OFFICIAL SEAL

CITY AGRICULTURE MALAYBALAY

CERTIFICATE
OF UTILIZATION

THIS IS TO CERTIFY that the research study entitled "CORN CROP DISEASE DETECTION USING CONVOLUTIONAL NEURAL NETWORK (CNN) TO SUPPORT SMART AGRICULTURAL FARMING" authored by JOVELIN M. LAPATES has been successfully utilized by the Bukidnon State University and Local Government Unit of Malaybalay City in the year 2024.

The study served as the basis for the software developed by the IT department and it's use in detecting diseases in corn crop.

Given this 27th day of December 2024 at the Municipality of Malaybalay City, Bukidnon.

Engr. RICHARD B. LEONO
CITY AGRICULTURIST

When we give farmers the power of knowledge and technology, we harvest not only crops — we harvest the future.

-unknown-

Thank You!