An Expert System For Disease Prediction And Fertilizer Recommendation Using Deep Learning

K.Geethika, G.Krishna Prathibha, G.Sneha

Under the esteemed guidance of

Mr. A. Rajashekar Reddy

Assistant Professor

Bachelor of Technology

Department of Information Technology

BVRIT HYDERABAD college of engineering for Women

May 2, 2024

Overview

Overview of Completed Project Work in Stage I

- Collected Tomato village data set from Plant village dataset contains images of tomato plants, both healthy and diseased, categorized into 10 distinct classes.
- Augmented the dataset by applying techniques such as flipping, rotating
- The data is trained with different models like DenseNet201, DenseNet121, MobileNetV2, ResNet50 and detected the tomato leaf disease.

Overview of Completed Project Work in Stage I

The data is trained with different models as shown below and obtained the following accuracies with test data ie, unseen and untrained data.

Model	**Testing Accuracy**
ResNet50	97.43%
MobileNetV2	94.47%
DenseNet121	97.24%
DenseNet201	97.50%

Architecture of Proposed Expert System

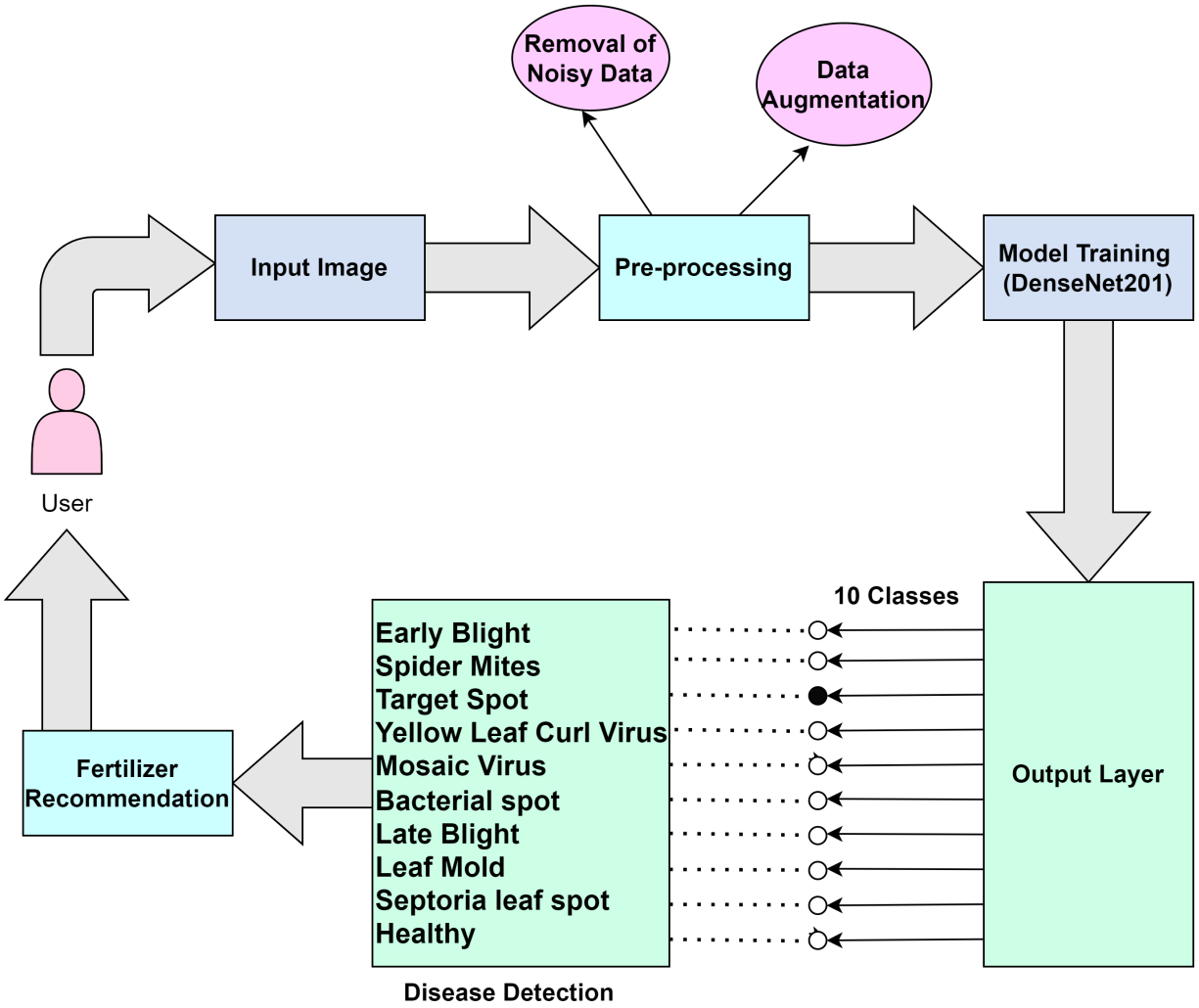


Figure: Architecture of Proposed Expert System

Modules

- Data Collection
- Data Preprocessing
- Model Initialization
- Model Training
- Disease Detection
- Fertilizer Recommendation
- Visualization (GUI)

Data Collection

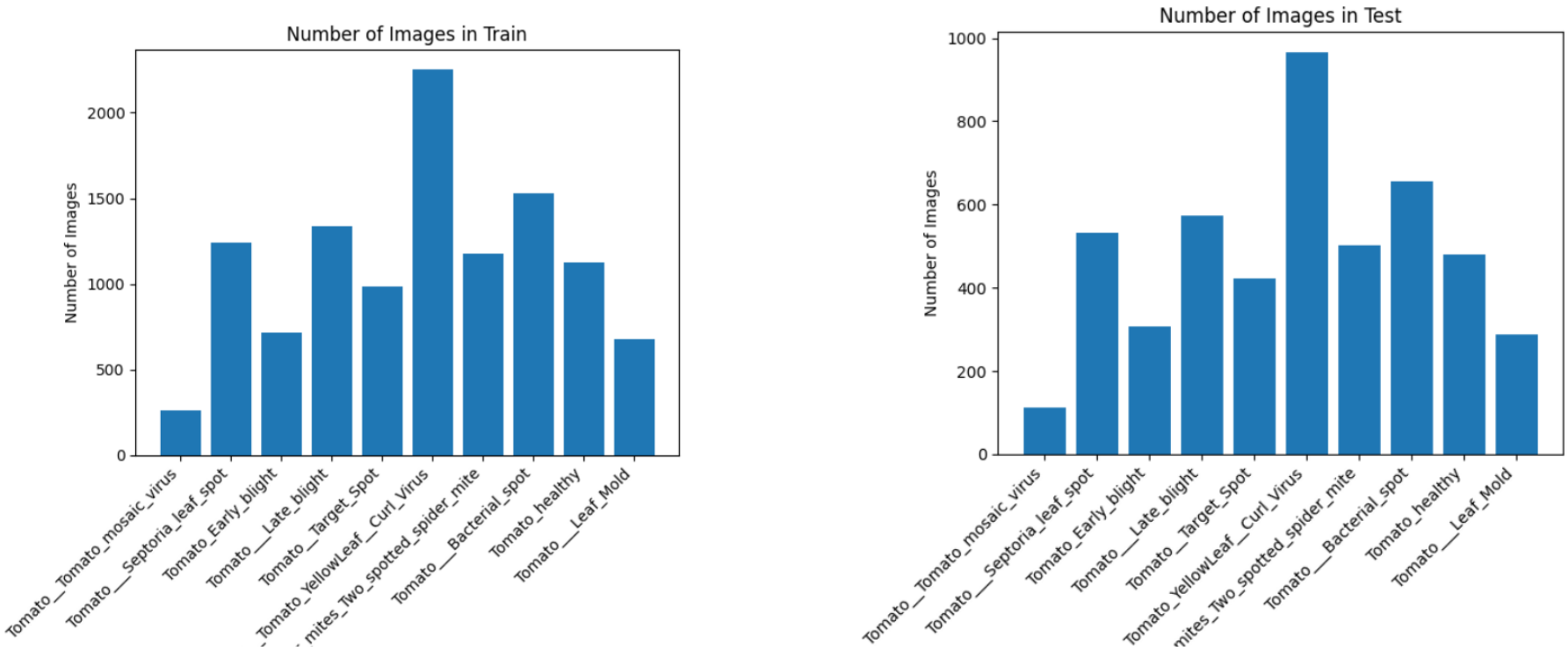


Figure: Frequency of train and test data in each class

Data Preprocessing

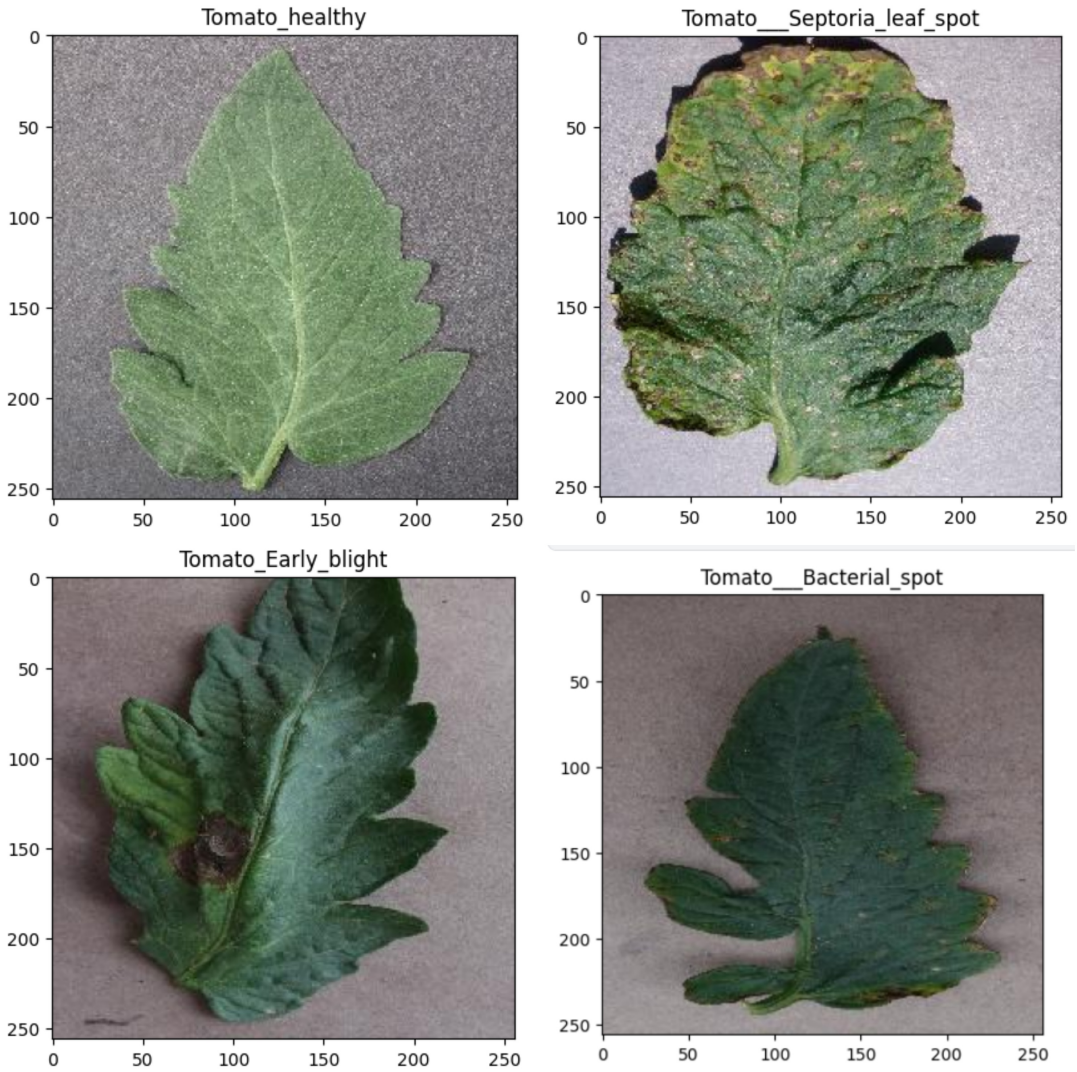


Figure: Leaf Images after Preprocessing

Model Initialization

Model: "functional_1"

Layer (type)	Output Shape	Param #
input_layer_1 (InputLayer)	(None, 224, 224, 3)	0
conv2d (Conv2D)	(None, 224, 224, 3)	84
densenet201 (Functional)	(None, 7, 7, 1920)	18,321,984
global_average_pooling2d (GlobalAveragePooling2D)	(None, 1920)	0
dense (Dense)	(None, 1024)	1,967,104
dropout (Dropout)	(None, 1024)	0
dense_1 (Dense)	(None, 512)	524,800
dropout_1 (Dropout)	(None, 512)	0
dense_2 (Dense)	(None, 128)	65,664
dropout_2 (Dropout)	(None, 128)	0
root (Dense)	(None, 10)	1,290

Total params: 20,880,926 (79.65 MB)

Trainable params: 20,651,870 (78.78 MB)

Non-trainable params: 229,056 (894.75 KB)

Figure: Model Architecture of Proposed Model

Model Training

[45]:

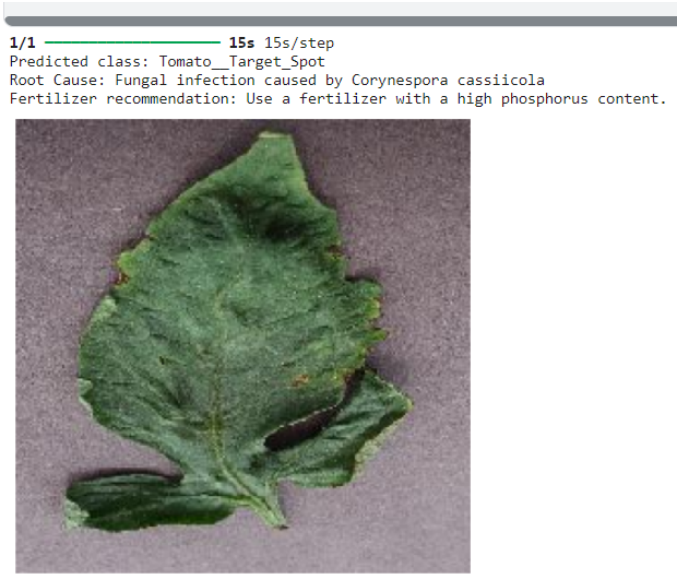
```
# Train the model
# history = model.fit(train_generator, epochs=10, validation_data=validation_generator, callbacks=[Earl
history = model.fit(train_generator, epochs=10, validation_data=validation_generator,
                    callbacks=[checkpoint]) # 75 epochs
```

```
Epoch 1/10
127/177 ━━━━━━━━━━━━━━━━━━━━ 33s 663ms/step - accuracy: 0.9692 - loss: 0.1066
W0000 00:00:1711732536.571951    5368 graph_launch.cc:161] Evict all gpu graphs from executor 0x58b937b11e00
128/177 ━━━━━━━━━━━━━━━━━━━━ 32s 661ms/step - accuracy: 0.9692 - loss: 0.1066
W0000 00:00:1711732537.208138    5371 graph_launch.cc:161] Evict all gpu graphs from executor 0x58b937b11e00
177/177 ━━━━━━━━━━━━━━━━━━━━ 0s 659ms/step - accuracy: 0.9686 - loss: 0.1074
Epoch 1: val_accuracy did not improve from 0.86010
177/177 ━━━━━━━━━━━━━━━━━━━━ 171s 939ms/step - accuracy: 0.9686 - loss: 0.1074 - val_accuracy: 0.6733 - val_loss: 2.0515
Epoch 2/10
 84/177 ━━━━━━━━━━━━━━━━━━━━ 1:01 665ms/step - accuracy: 0.9691 - loss: 0.1013
W0000 00:00:1711732679.149616    5369 graph_launch.cc:161] Evict all gpu graphs from executor 0x58b937b11e00
 85/177 ━━━━━━━━━━━━━━━━━━━━ 1:00 663ms/step - accuracy: 0.9691 - loss: 0.1013
W0000 00:00:1711732679.799893    5368 graph_launch.cc:161] Evict all gpu graphs from executor 0x58b937b11e00
177/177 ━━━━━━━━━━━━━━━━━━━━ 0s 663ms/step - accuracy: 0.9683 - loss: 0.1024
Epoch 2: val_accuracy improved from 0.86010 to 0.94276, saving model to /kaggle/working/best_model.weights.h5
177/177 ━━━━━━━━━━━━━━━━━━━━ 175s 964ms/step - accuracy: 0.9683 - loss: 0.1025 - val_accuracy: 0.9428 - val_loss: 0.1810
Epoch 3/10
 51/177 ━━━━━━━━━━━━━━━━━━━━ 1:25 676ms/step - accuracy: 0.9721 - loss: 0.1066
W0000 00:00:1711732833.339701    5368 graph_launch.cc:161] Evict all gpu graphs from executor 0x58b937b11e00
 52/177 ━━━━━━━━━━━━━━━━━━━━ 1:24 674ms/step - accuracy: 0.9721 - loss: 0.1065
W0000 00:00:1711732834.009203    5370 graph_launch.cc:161] Evict all gpu graphs from executor 0x58b937b11e00
177/177 ━━━━━━━━━━━━━━━━━━━━ 0s 668ms/step - accuracy: 0.9696 - loss: 0.0994
Epoch 3: val_accuracy did not improve from 0.94276
177/177 ━━━━━━━━━━━━━━━━━━━━ 171s 938ms/step - accuracy: 0.9695 - loss: 0.0994 - val_accuracy: 0.7971 - val_loss: 1.3180
Epoch 4/10
162/177 ━━━━━━━━━━━━━━━━━━━━ 9s 665ms/step - accuracy: 0.9687 - loss: 0.1015
W0000 00:00:1711733077.079990    5368 graph_launch.cc:161] Evict all gpu graphs from executor 0x58b937b11e00
163/177 ━━━━━━━━━━━━━━━━━━━━ 9s 664ms/step - accuracy: 0.9687 - loss: 0.1015
W0000 00:00:1711733077.752013    5369 graph_launch.cc:161] Evict all gpu graphs from executor 0x58b937b11e00
177/177 ━━━━━━━━━━━━━━━━━━━━ 0s 661ms/step - accuracy: 0.9685 - loss: 0.1020
Epoch 4: val_accuracy did not improve from 0.94276
```

Figure: Model Training

Disease Detection and Fertilizer Recommendation

[Fig(a)]



[Fig(b)]

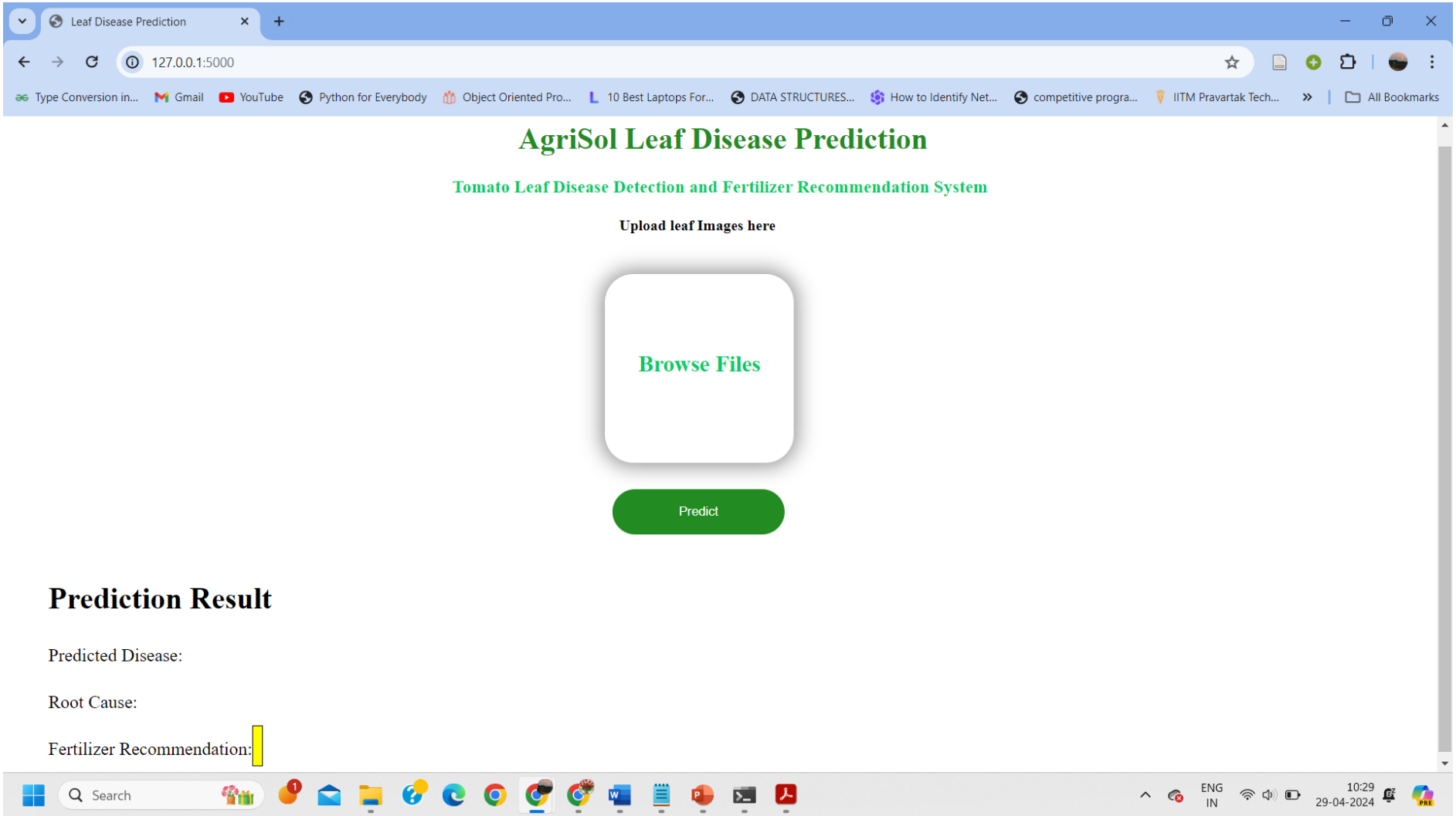
Figure: Fig(a) Disease Detection and Fig(b) Fertilizer Recommendation for Detected Disease

Module Integration

We have 2 main modules in our project, (all the previously mentioned modules are sub modules of these 2 modules)

- **Disease Detection:**
  - The data is trained with a defined model (using DenseNet201 as feature Extractor) and pre-trained MobileNetV2.
  - Disease Detection is done by the trained model
- **Fertilizer Recommendation:**
  - Detected disease is given to the rule based instruction set for fertilizer recommendation.
  - Built Graphical User Interface for better usage.

Interface


Leaf Disease Prediction
127.0.0.1:5000
Type Conversion in...
Gmail
YouTube
Python for Everybody
Object Oriented Pro...
10 Best Laptops For...
DATA STRUCTURES...
How to Identify Net...
competitive progra...
IITM Pravartak Tech...
All Bookmarks
AgriSol Leaf Disease Prediction
Tomato Leaf Disease Detection and Fertilizer Recommendation System
Upload leaf Images here
Browse Files
Predict
Prediction Result
Predicted Disease:
Root Cause:
Fertilizer Recommendation:
Search
ENG
IN
10:29
29-04-2024

Leaf Disease Prediction

127.0.0.1:5000

Type Conversion in... Gmail YouTube Python for Everybody Object Oriented Pro... 10 Best Laptops For... DATA STRUCTURES... How to Identify Net... competitive progra... IITM Pravartak Tech... All Bookmarks

AgriSol Leaf Disease Prediction

Tomato Leaf Disease Detection and Fertilizer Recommendation System

Upload leaf Images here

Predict

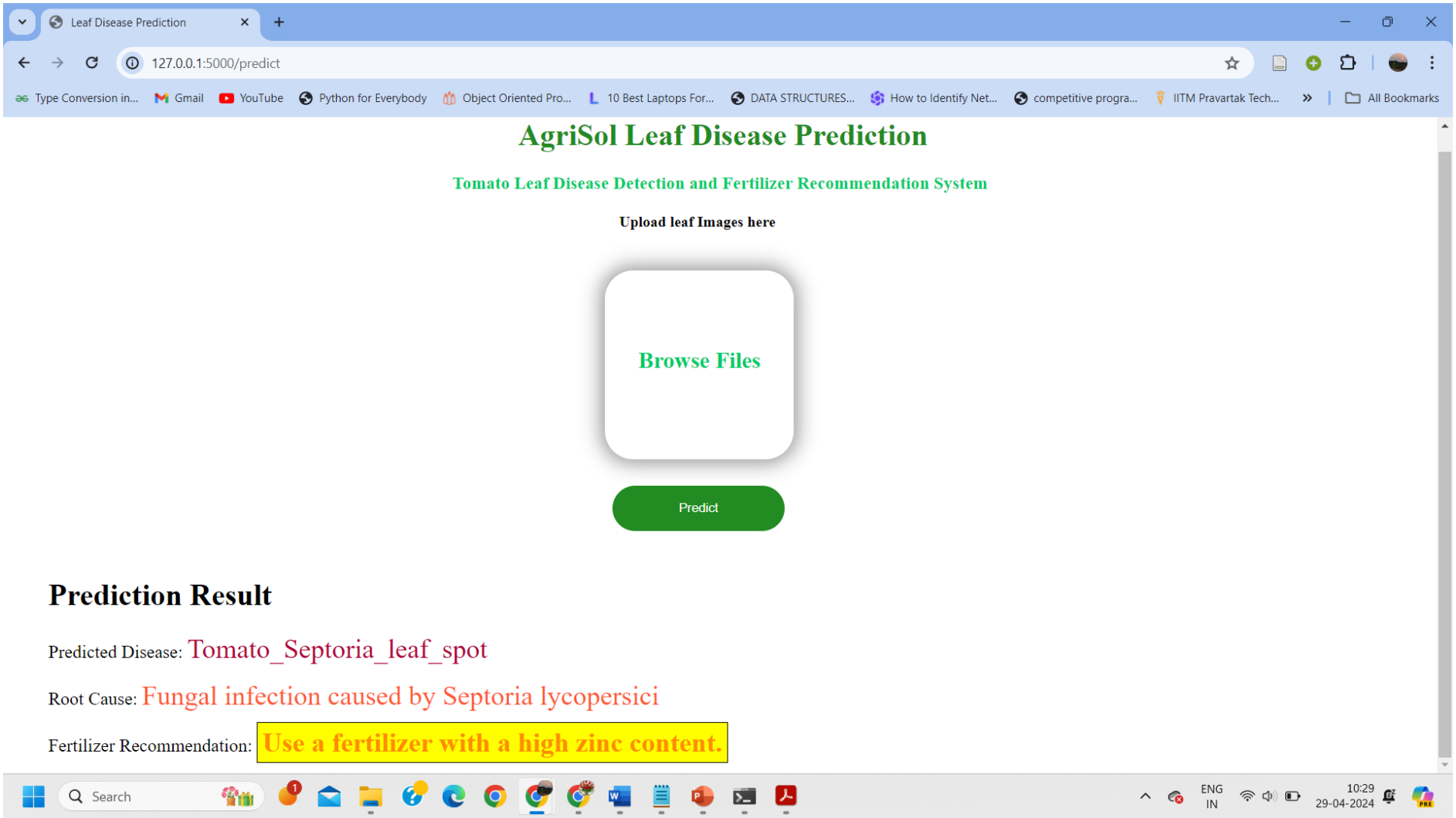
Prediction Result

Predicted Disease:

Root Cause:

Fertilizer Recommendation:

Search ENG IN 10:29 29-04-2024


Leaf Disease Prediction
127.0.0.1:5000/predict
Type Conversion in...
Gmail
YouTube
Python for Everybody
Object Oriented Pro...
10 Best Laptops For...
DATA STRUCTURES...
How to Identify Net...
competitive progra...
IITM Pravartak Tech...
All Bookmarks
AgriSol Leaf Disease Prediction
Tomato Leaf Disease Detection and Fertilizer Recommendation System
Upload leaf Images here
Browse Files
Predict
Prediction Result
Predicted Disease: Tomato_Septoria_leaf_spot
Root Cause: Fungal infection caused by Septoria lycopersici
Fertilizer Recommendation: Use a fertilizer with a high zinc content.
Search
ENG
IN
10:29
29-04-2024

Comparision of Different Models

The DenseNet201 model achieved an impressive accuracy of 99.1%. During training, its dense connectivity pattern facilitated the extraction of complex features from images.

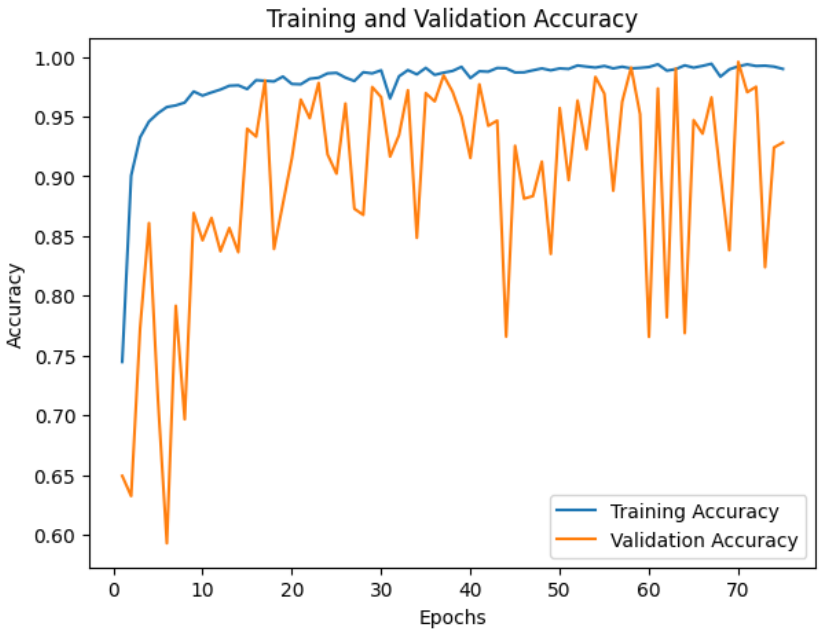
Model	Accuracy
DenseNet201	99.1
DenseNet121	97.2
MobileNetV2	94.4

Performance Analysis of Different Activation Functions

The Quantum ReLU activation function exhibited better performance than ReLU and Leaky ReLU in correspondence with the proposed model (DenseNet201 + CNN Layers).

S.No.	ReLU type	Performance
1.	ReLU	99.1
2.	Leaky ReLU	98.6
3.	Quantum ReLU	99.5

Analysis of Accuracy and Loss



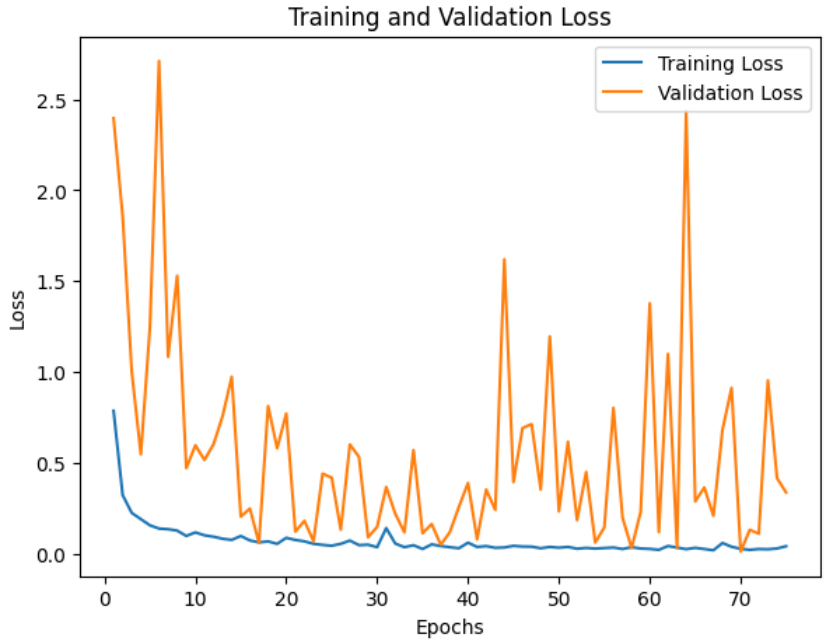


Figure: Accuracy and Loss graphs for 75 epochs with proposed model

Confusion Matrix

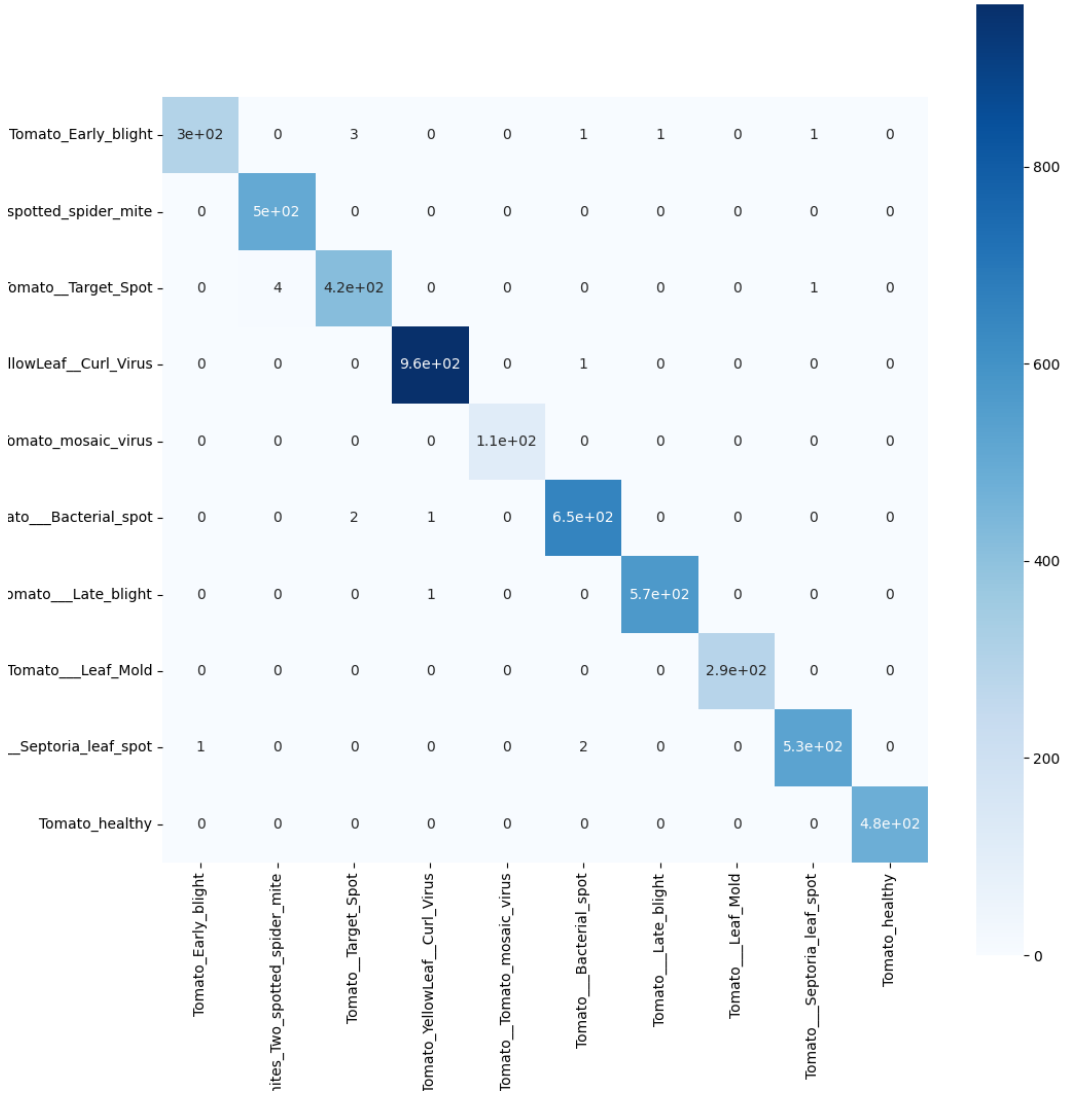


Figure: Confusion matrix of DenseNet201 + CNN layers with QReLU

Video Demonstration

To See Project Excecution **click here**

Publication Details

Hello,

The following submission has been created.

Track Name: ICACECS2024

Paper ID: 674

Paper Title: An Expert System for Disease Prediction and Fertilizer Recommendation using Transfer Learning

Abstract:
The agricultural production of tomatoes is vulnerable to a range of diseases. To make the matters worse, imprecise fertilizers application also aggravates diseases that results in poor harvests for farmers. It however does not only connote but also exists a tomato plant disease detection system with different advanced deep learning models. Their only problem is that they always give disease detection but not fertilizer recommendations. This paper will try to fill this gap by coming up with a hybrid expert system for disease detection and user-friendly efficient fertilizer recommendations for tomato plants. The proposed expert system will employ advanced deep learning techniques such as MobileNetV2 and DenseNet121, DenseNet201 for disease recognition and feature extraction. Moreover, fertilization recommendation for detected disease based on rules. Dataset of “tomato village” is used for training and validation. The expert system proposed for disease diagnosis and fertilizer recommendation aims to transform tomato cultivation, enhancing crop yield, reducing environmental impact, and promoting agricultural sustainability. Its implementation promises a brighter future for tomato production, offering holistic solutions to farmers' challenges and advancing the agricultural industry.

Created on: Wed, 01 May 2024 10:40:58 GMT

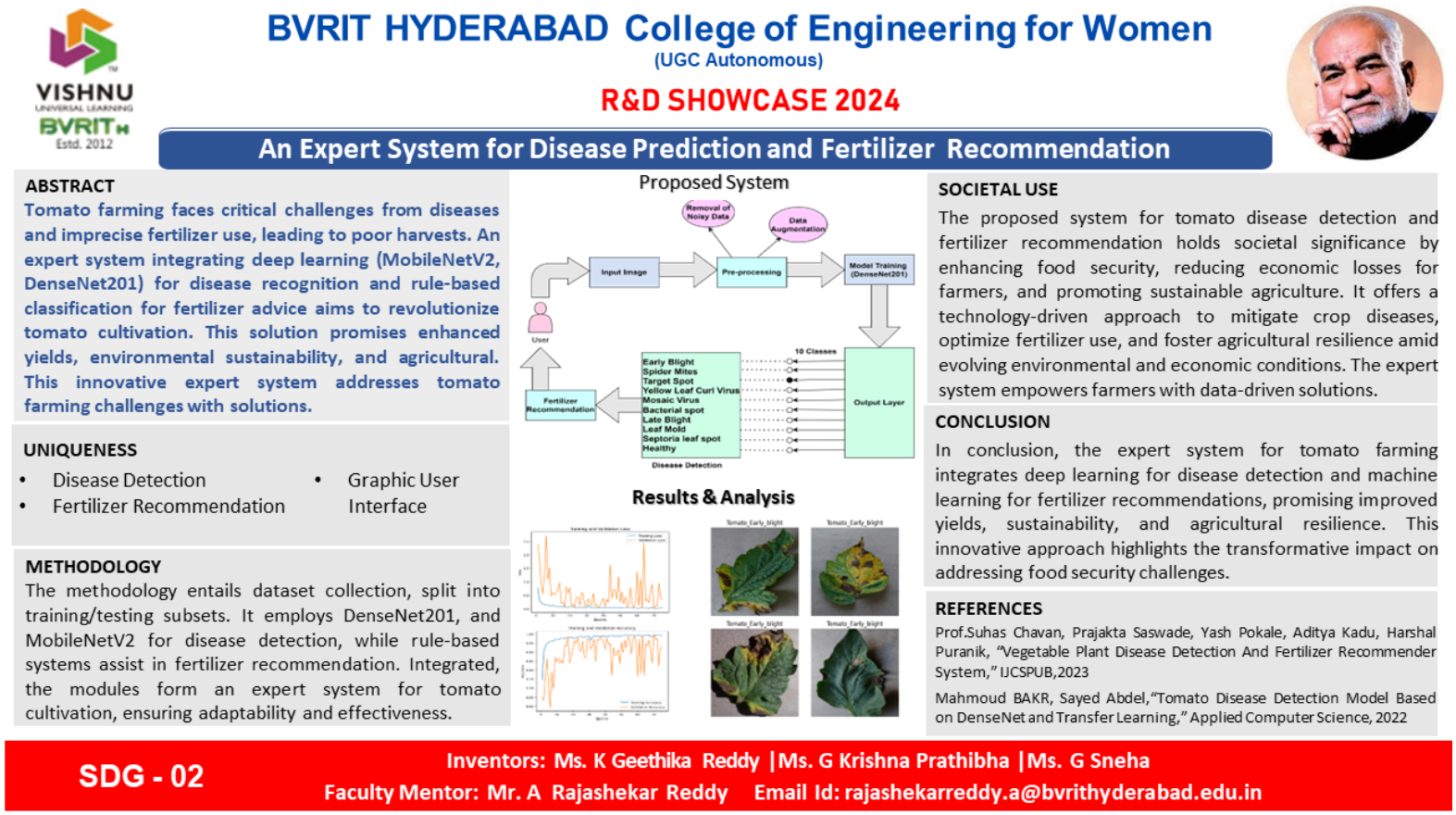
Last Modified: Wed, 01 May 2024 10:40:58 GMT

Authors:
- 20wh1a1270@bvrithyderabad.edu.in (Primary)
- 20wh1a12b0@bvrithyderabad.edu.in
- 20wh1a12b5@bvrithyderabad.edu.in
- rajashekarreddy.a@bvrithyderabad.edu.in

Secondary Subject Areas: Not Entered
Submission Files: Springer format - An Expert System for Tomato Disease Prediction and Fertilizer Recommendation.pdf (547 Kb, Wed, 01 May 2024 10:40:45 GMT)

Submission Questions Response: Not Entered

R&D Showcase Display



BVRIT HYDERABAD College of Engineering for Women
(UGC Autonomous)

R&D SHOWCASE 2024

An Expert System for Disease Prediction and Fertilizer Recommendation

ABSTRACT

Tomato farming faces critical challenges from diseases and imprecise fertilizer use, leading to poor harvests. An expert system integrating deep learning (MobileNetV2, DenseNet201) for disease recognition and rule-based classification for fertilizer advice aims to revolutionize tomato cultivation. This solution promises enhanced yields, environmental sustainability, and agricultural. This innovative expert system addresses tomato farming challenges with solutions.

UNIQUENESS

- Disease Detection
- Fertilizer Recommendation
- Graphic User Interface

METHODOLOGY

The methodology entails dataset collection, split into training/testing subsets. It employs DenseNet201, and MobileNetV2 for disease detection, while rule-based systems assist in fertilizer recommendation. Integrated, the modules form an expert system for tomato cultivation, ensuring adaptability and effectiveness.

Proposed System

Results & Analysis

SOCIETAL USE

The proposed system for tomato disease detection and fertilizer recommendation holds societal significance by enhancing food security, reducing economic losses for farmers, and promoting sustainable agriculture. It offers a technology-driven approach to mitigate crop diseases, optimize fertilizer use, and foster agricultural resilience amid evolving environmental and economic conditions. The expert system empowers farmers with data-driven solutions.

CONCLUSION

In conclusion, the expert system for tomato farming integrates deep learning for disease detection and machine learning for fertilizer recommendations, promising improved yields, sustainability, and agricultural resilience. This innovative approach highlights the transformative impact on addressing food security challenges.

REFERENCES

Prof.Suhas Chavan, Prajakta Saswade, Yash Pokale, Aditya Kadu, Harshal Puranik, "Vegetable Plant Disease Detection And Fertilizer Recommender System," IJCSPUB,2023

Mahmoud BAKR, Sayed Abdel,"Tomato Disease Detection Model Based on DenseNet and Transfer Learning," Applied Computer Science, 2022

SDG - 02

Inventors: Ms. K Geethika Reddy |Ms. G Krishna Prathibha |Ms. G Sneha
Faculty Mentor: Mr. A Rajashekar Reddy Email Id: rajashekarreddy.a@bvrithyderabad.edu.in

Figure: One Page Report of the Project

Conclusion

- Implemented Tomato Leaf disease detection and Fertilizer recommendation for same and added GUI.
- Quantum ReLU achieves a high accuracy of 99.5% in classifying tomato leaf diseases compared to traditional ReLU and Leaky ReLU models.
- Enabling the farmer to get fertilizer recommendation for detected disease.

References

- Vegetable Plant Disease Detection And Fertilizer Recommender System Prof.Suhas Chavan ,Prajakta Saswade, Yash Pokale,Aditya Kadu,Harshal Puranik,2023
- Detection of Tomato Leaf Diseases for Agro-Based Industries Using Novel PCA DeepNet KYAMELIA ROY1,2023
- Developing an Expert System to Diagnose Tomato Diseases Mohanad H. Al-Qadi, Mohammed F. El-Habibi, Mosa M. M. Megdad, Mohammed J. A. AlQatrawi, Raed Z. Sababa, Samy S. Abu-Naser,2022

- DCNet: DenseNet-77-based CornerNet model for the tomato plant leaf disease detection and classification Saleh Albahli1 and Marriam Nawaz,2022
- TOMATO DISEASE DETECTION MODEL BASED ON DENSENET AND TRANSFER LEARNING,Mahmoud BAKR , Sayed ABDEL-GABER, 2022
- Less Is More: Lighter and Faster Deep Neural Architecture for Tomato Leaf Disease Classification SABBIR AHMED , MD. BAKHTIAR HASAN , TASNIM AHMED, MD. REDWAN KARIM SONY, and MD. HASANUL KABIR, 2021

Any Questions ?

Thank you