Early stage detection of plant diseases using ML and web interface

H. M. Tanvir Shuvo[1], Siraj Us Salekin Rupak[2], M.K.M Rahman[3]
[1]*Dept. of EEE, United Int. Univ.,* Dhaka, Bangladesh
[2]*Dept. of CSE, AIUB,* Dhaka, Bangladesh
[3]*Associate Prof. Dept. of EEE, United Int. Univ.,* Dhaka, Bangladesh
[1]hmtanvirshuvo@hotmail.com, [2]rupaksalekin2018@gmail.com, [3]masuk@eee.uiu,ac,bd

***Abstract*—Early and accurate detection of plant diseases can help farmers to take proper action on time and hence prevent unnecessary crop loss. It also results in less use of pesticides which in terms reduce pollution and ensures economical and environmental welfare. Artificial Intelligence (AI) based techniques such as convolutional neural network (CNN) have gained a lot of success in image recognition that can be used for recognition of plant diseases. Our project focuses on implementation of a web-based interface for disease recognition system where CNN was used at its core. The system includes a web portal where users can submit potentially disease affected plant leaves. Upon receiving the image at the server where the machine learning model resides, a prediction result will be generated. Afterwards this result will be sent back to the user through the web portal. In addition to disease recognition the web-portal also provides useful information to the farmers related to different types of crops.**

***Index Terms*—plant diseases, accurate detection, convolutional neural network(CNN), implementation, web interface, prediction**

I. Introduction

In a country like Bangladesh, our economy is mostly dependent on agriculture. Most of our people depends on agriculture. Different varieties of crops are being produced all year here. Main corps being rice, corn, potato etc. Over half of the population of the world is dependent on rice [4]. Although many problems occur during production but due to the inability to recognize plant diseases, plenty of our crops are being lost every year. These diseases are caused by mainly bacteria and virus. The loss of crops introduces food shortage and dependencies on other countries for food. Yet there is hardly any effective system available for the farmers and the farms to recognize the disease at an early stage. For this reason, we have developed a web-based system for recognizing plant diseases to prevent a lot of crop loss. Through our project users will be able to recognize a disease of the essential crops without any delay and can get necessary suggestion. So, the main objectives of our project become,

- Early detection of plant-based disease.
- Inform users of any potential disease.
- Reduce crop loss and above all food shortage.

II. Literature Review

Rahman, Chowdhury R. et al. [1]. detected rice diseases through a memory efficient CNN model and also provided a comparative study of other popular CNN model.

Esgario, José GM et al. [2]. identified and estimated stress severity on coffee leaves caused by biotic agents through CNN and data augmentation.

Reyes, Angie K., et al. [3]. used fine tuning and transfer learning through CNN to recognize plants.

Srdjan Sladojvic et al. [4]. presented a different approach for development of recognition model for plant disease which is based on leaf image classification. This model has implemented by using deep convolutional networks.

Peng Jiang et al. [5]. proposed a deep learning-based approach which is based on improved CNN system for apple leaves which detects diseases in real time.

Marko Arsenovic et al. [6]. discussed and solved the limitations of current detection models for plant diseases.

III. Methodology

The working principle of our project mainly depends on the submission of images for analysis. After images are sent, they are passed into the machine learning model which are trained. Then the model predicts the type of disease and it should suggest appropriate measures so that crop loss can be reduced through the means of early detection.

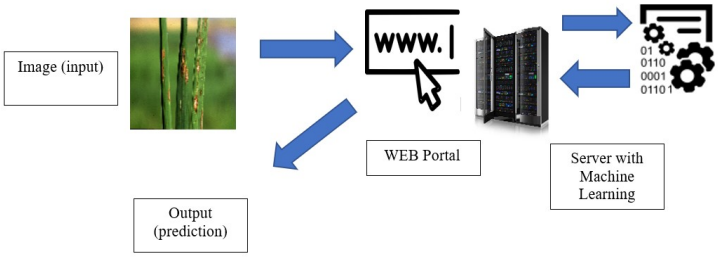

Figure 1: Visual Representation of The System

Upon analysis, we have segmented our work into the following distinct parts,

- Web Portal and Server
- Machine Learning

Machine learning is used for image detection and prediction of diseases of plant leaves. Whereas the web poral and server focuses on how the users should interact with the Convolutional Neural Network (CNN) model of machine learning part

through the web portal and server. And, how the results will be displayed.

A. Web Portal Server

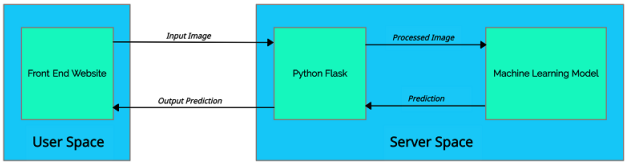

Figure 2: Web portal flow

B. Machine Learning

Upon receiving the image from the server, the image will be further processed by checking, is it actually image or not. If so, then the image will be passed on the trained model and also will be stored for future reference and usage. Afterwards the image will be compared to the model and upon analysis a prediction will be passed back to the webpage and there it will be displayed.

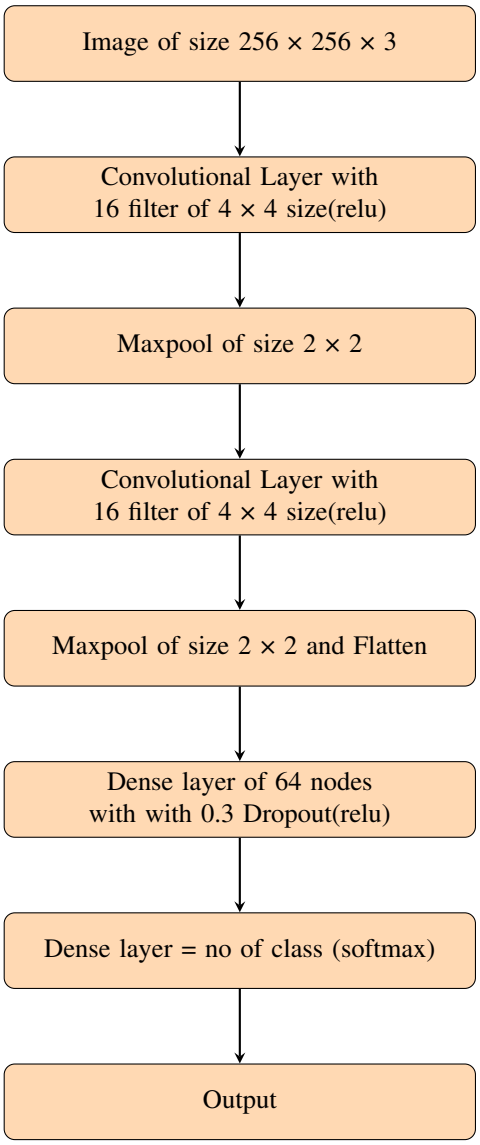

Figure 3.2: CNN model

IV. Results and Discussion

The target of our project is to detect plant-based disease at an earlier stage by the means of image recognition and inform users (mainly farmers) about potential diseases. When pictures of potential plant leaves with disease are uploaded through the web-portal, they are sent and received to the server where trained model of Potato, Corn, Tomato and Rice are located. These models are compared with the pictures that were sent. Afterward the results are generated. Then they are sent back to the users.

A. Experimental Setup

Datasets of potato, corn, tomato and rice were gathered through reaching out different personal working on the field. Due to the current pandemic, we were unable to gather image data ourselves. Hence, we had to rely on others for data. On larger dataset no augmentation techniques were used to increase dataset. But on dataset for rice, basic augmentation

techniques such as mirroring of x and y axis and rotation was used to increase dataset. The images of the dataset were standardized in the training time by 256×256×3 size. Afterwards, they were passed for training model. Our dataset can be found at the following link: https://drive.google.com/drive/folders/10iX2s7SHCC4nMzuae_afaBJiIgslQoG5?usp=sharingt

Table 4.A.a: Potato Images used in the Dataset

Name of the Class	Training Images	Test Images	Total Images
Potato Early blight	3878	970	4848
Potato Healthy	3648	912	4560
Potato Late Blight	3878	970	4848

Table 4.A.b: Corn Images used in the Dataset

Name of the Class	Training Images	Test Images	Total Images
Gray leaf spot	3284	820	4104
Common Rust	3814	954	4768
Healthy plant	3718	930	4648
Northern Leaf Blight	3284	820	4104

Table 4.A.c: Tomato Images used in the Dataset

Name of the Class	Training Images	Test Images	Total Images
Healthy	3852	962	4814
Late Blight	3702	926	4628
Leaf Mold	3764	940	4704
Septoria Leaf Spot	3490	872	4362
Spider mites Two spotted spider mite	3482	870	4352
Target Spot	3654	914	4568
Mosaic virus	3580	896	4476
Yellow Leaf Curl Virus	3922	980	4902

Table 4.A.d: Rice Images used in the Dataset

Name of the Class	Training Images	Test Images	Total Images
Bacterial Leaf Blight	412	140	552
Brown Plant Hopper	192	92	284
Brown Spot	304	140	444
False Smut	292	80	372
Healthy Plant	720	216	936
Hispa	224	68	292
Neck Blast	884	256	1140
Sheath Blight Rot	648	228	876
Stemborer	612	192	804

B. Trained Model

We have trained for leaves of Potato, Corn, Tomato and Rice. Where Potato contains 3 categories, Corn contains 3 categories, Tomato contains 8 categories and Rice Contains 9 categories of images where 20 types of disease and 4 types of healthy category is defined and our system can distinguish the categories. For training purpose, a personal computer with AMD Ryzen 5 3600 with 16gb ram and NVDIA RTX 2060 graphics card was used. Upon training the trained model were saved into H5 models. Then they were used in-conjunction with Flask [8] for website. The Loss vs Validation Loss of each model represents how our models performs. The accuracy of the models as follows,

Table 4.B.a: Model Accuracy on Testing set

Plant	Accuracy
Potato	91%
Corn	95%
Tomato	85%
Rice	68%

V. Conclusion

We have implemented a web-based disease detection system through the use of machine learning. We have used python as our main language for machine learning and flask to connecting it to the web portal. We have achieved decent accuracy on most of our models and tested our system for detection. Most of the time the detection was satisfactory. As, disease detection of plants at an earlier stage can ensure the reduction of crop loss and less use of insecticide, our project can have a positive impact on our environment and on our economy as well.

Acknowledgment

The preferred spelling of the word “acknowledgment” in America is without an “e” after the “g”. Avoid the stilted expression “one of us (R. B. G.) thanks . . .”. Instead, try “R. B. G. thanks. . .”. Put sponsor acknowledgments in the unnumbered footnote on the first page. [**?**].

REFERENCES

[1] C. R. Rahman, P. S. Arko, M. E. Ali, M. A. I. Khan, S. H. Apon, F. Nowrin, and A. Wasif, "Identification and recognition of rice diseases and pests using convolutional neural networks," *Biosystems Engineering*, vol. 194, pp. 112–120, 2020.

[2] J. G. Esgario, R. A. Krohling, and J. A. Ventura, "Deep learning for classification and severity estimation of coffee leaf biotic stress," *Computers and Electronics in Agriculture*, vol. 169, p. 105162, 2020.

[3] A. K. Reyes, J. C. Caicedo, and J. E. Camargo, "Fine-tuning deep convolutional networks for plant recognition." *CLEF (Working Notes)*, vol. 1391, pp. 467–475, 2015.

[4] S. Sladojevic, M. Arsenovic, A. Anderla, D. Culibrk, and D. Stefanovic, "Deep neural networks based recognition of plant diseases by leaf image classification," *Computational intelligence and neuroscience*, vol. 2016, 2016.

[5] P. Jiang, Y. Chen, B. Liu, D. He, and C. Liang, "Real-time detection of apple leaf diseases using deep learning approach based on improved convolutional neural networks," *IEEE Access*, vol. 7, pp. 59 069–59 080, 2019.

[6] M. Arsenovic, M. Karanovic, S. Sladojevic, A. Anderla, and D. Stefanovic, "Solving current limitations of deep learning based approaches for plant disease detection," *Symmetry*, vol. 11, no. 7, p. 939, 2019.