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LEAF DISEASE DETECTION USING CNN

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ABSTRACT

Agriculture field has a high impact on our life. Agriculture is the most important sector of our Economy. Proper management leads to a profit in agricultural products. Farmers do not expertise in leaf disease so they produce less production. The most agriculture fields are under developed in the lack of deployment of eco technologies. Currently, deep learning (DL) methods, especially those based on convolutional neural network (CNN), have gained widespread application in plant disease classification. The impact of climate change in India, most of the agricultural crops are being badly affected in terms of their performance over a period of the last two decades. Segmentation of leaf images, which is an important aspect for disease classification, is done by using CNN algorithm. A variety of neuron-wise and layer-wise visualization methods were applied and trained using a CNN, with a publicly available plant disease given image dataset. So, it can easily observe that neural networks can capture the colors and appearance of regions specific to respective diseases. Convenient results have been given by the experiments done on leaf images.

INTRODUCTION:

The most important sector of our Economy is Agriculture. The problem of efficient disease protection is closely associated with the problems of sustainable agriculture Inexperienced pesticide usage can cause the event of long-term resistance of the pathogens, severely reducing the power to fight back. Farmers have a variety of cultivation options in the field. These crops are still cultivated in a technical manner for the best harvest and the highest quality of production. The automated identification of plant diseases based on plant leaves is a major landmark in the field of agriculture. Moreover, the early and timely identification of plant diseases positively impacts crop yield and quality. Various types of disease damage the plant leaves and effects the production of crop there for Leaf disease detection is important.Indian economy is highly dependent of agricultural productivity. Therefore, in field of agriculture, detection of disease in Leafs plays an important role. To detect a leaf disease in very initial stage. Regular maintenance of plant leaves is the profit in agricultural products.

Variations in symptoms indicated by diseased plants may lead to an unsuitable diagnosis since unprofessional gardeners and hobbyists could have more difficulties determining it than knowledgeable plant pathologist. Here in India, farmers cultivate a great diversity of crops. Various factors such as climatic conditions, soil conditions, various disease, etc. affect the production of the crops.

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However, in the rural areas of developing countries, visual observation is still the primary approach of disease identification.In small countries, farmers do not have proper facilities or even idea that they can contact to experts. Due to which consulting experts even cost high as well as time consuming too. The existing method for plants disease detection is simply naked eye observation which requires more man labour, properly equipped laboratories, expensive devices, etc. In order to overcome the above problems, researchers have thought of several solutions. Various types of feature sets can be used in machine learning for the classification of plant diseases. Among these, the most popular feature sets are traditional handcrafted and deep-learning (DL)-based features. The plant disease detection can be done by observing the spot on the leaves of the affected plant. The method we are adopting to detect plant diseases is using Convolution neural network (CNN). Pre-processing, such as image enhancement, color transformation, and segmentation, is an essential before efficiently extracting features. After feature extraction, different classifiers can be used.In such conditions, the suggested technique proves to be beneficial in monitoring large fields of crops. Automatic detection of the diseases by just seeing the symptoms on the plant leaves makes it easier as well as cheaper. So, we can utilize picture handling procedures for recognizable proof of plant disorder. By and large we can watch the side effects of disease on leafs, stems, blossoms and so forth so here we use leafs for distinguishing proof of sickness influenced plants.

Literature Survey on Machine Learning

Dataset	**Model**	**Input**	**Performance/accuracy**	**Reference**
plantdoc	CNN	image	98.60	[1]
Plant village	Super vector machine, K-Nearest Neighbour	image	Super vector machine-88% K-NN-97.6%	[2]
Maize disease	Naive Bayes (NB), Decision Tree (DT), K-Nearest Neighbor (KNN), Support Vector Machine, (SVM) and Random Forest (RF)	image	SVM 77.56 NB 77.46 KNN 76.16 DT 74.35 RF 79.23	[3]
New Plant Diseases	Support Vector Machine, Convolutional neural network	image	SVM=80% CNN=97.1	[4]

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Rice leaf disease	KNN, Decision tree, Logistic regression and Naive Bayes	image	Logistic regression-88.2 KNN-89.9 Decision tree-97.9167 Naive Bayes-78.2	[5]
plant village	Random Forest	image	97%	[6]
Plantvillage	Extreme Learning	image	84.94%	[7]
	Machine (ELM)			
PlantVillage	), Support Vector Machine , (SVM) and Random Forest (RF)	image	SVM-98.38% Random Forest-91.47%	[8]

Tab-1

Literature Survey on Deep Learning

Dataset	Model	Input	Performance/accuracy	Reference
Rice leaf disease	Convolutional Neural Network (CNN)	Image	97%	[1]
ImageNet	Convolutional Neural Network (CNN)	Image	95.75%	[2]
Plant village	Logistic regression, Convolutional Neural Network (CNN)	Image	97.8%	[3]
ImageNet	MobileNet,Inception V3	Image	MobileNet – 99.62% InceptionV3 – 99.74%	[4]
PlantVillage	Convolutional Neural Network (CNN)	Image	98.5%	[5]
Apple leaf disease	Convolutional Neural Network (CNN)	Image	97.95%	[6]

Tab-2

How deep leaning algorithm works

Deep learning algorithms feature self-learning representations. It learns by finding structures in the data they experience. By building computational models that contains multiple processing layers, these networks create multiple levels of abstraction to represent the data. A deep learning model known as CNN(convolutional neural network) can be trained using large number of images such as leafs, It learns from the pixels contained in the image it acquires. It classify the group of pixels that are representative of leaf's features such as apex, margin, midrib, veins indicating the presence of the leaf in an image.

Convolutional Neural Networks (CNNs)

Artificial neural networks are motivated by the learning capabilities of the human brain which consists of neurons interconnected by synapses. ANNs are not suitable for images because these networks lead to over-fitting due to size of image. The major difference between a traditional Artificial Neural Network (ANN) and CNN is that only the last layer is connected to every other neuron as shown in Fig.4 Convolutional neural networks use images directly as input. Instead of handcrafted features, convolutional neural networks are used to automatically learn a hierarchy of features which can then be used for classification purposes. This is accomplished by successively convolving the input image with learned filters to build up a hierarchy of feature maps. The hierarchical approach allows learning more complex, as well as translation and distortion invariant, features in higher layers. A Convolutional Neural Network (CNN) has four Types of layers as follows:

1. Convolutional Layer (CONV)
2. Rectified Linear Unit Layer (ReLu)
3. Pooling Layer (POOL)
4. Fully-Connected Layer (FC)

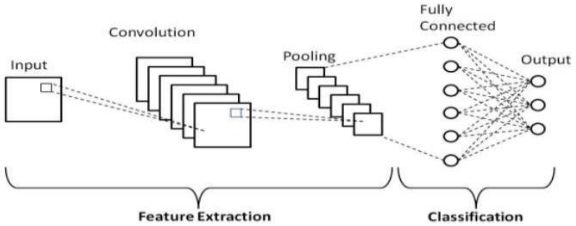

Fig-3

CONVOLUTION LAYER:

Convolution is the first layer which is used to extract features from an input image. It preserves the relationship between pixels by learning image features using small squares of input data. The Layer contains N filters which are small in size (for example [3x3] as in Fig 4.2. These 3x3 filters are convoluted with the input image matrix by sliding the filter slide through the width and height of the image. Firstly, the feature matrix is multiplied pixel by pixel with the selected square from the image. Then the values are added and finally divided by the total number of pixels (in our example it is 9 due to 3x3 filter size). The obtained value is inserted in a new matrix. This process helps to reduce the image without loss of any feature.

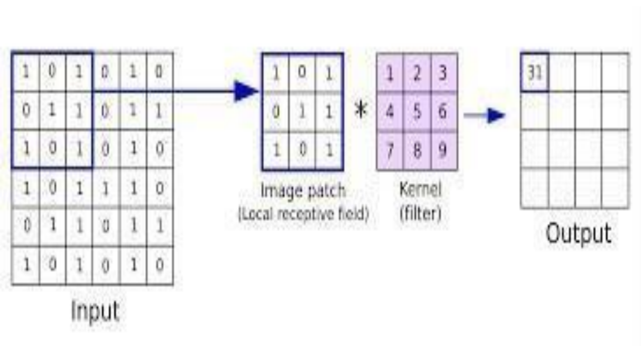

Fig-4

RECTIFIED LINEAR UNIT LAYER:

In ReLu layer the pixels which are not necessary are deactivated and only the important pixels are kept. From Conv layer we get positive as well as negative pixel values. The positive pixels are important for the further finding of features and the negative values are of less importance. The ReLu layer either converts the pixel to 0 or 1. If the value of pixel is negative then it is converted to 0 and for any value greater than 0 it retains the same value.

POOLING LAYER:

The Pooling layer does a simple job of down sampling or compressing the dimensions of the input image. A stride is selected which can be 2x2 or 5x5 etc. After the selection of stride it is applied to the dimension matrix obtained from the Conv Layer. Maximum value is taken from each stride and stored in a new matrix. Depending on the stride Pooling is of two types Max Pooling and Minimum Pooling. When the stride is large such Pooling is known as Max Pooling whereas small stride is known as Minimum Pooling. For example, if the input is [64*64*12] and if a stride of 2x2 is applied then after down sampling the output will be [32*32*12]. This type of layer is often placed between two layers of convolutional. It receives several feature maps and applies the pooling operation to each of them.

The pooling operation consists in reducing the size of the images while preserving their important characteristics.

There of 2 types of pooling layers they are

- Max Pooling
- Average Pooling

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Max Pooling:

Max pooling selects the maximum element from the region of the feature map covered by filter. The output of the ma pooling layer would be a feature map containing the most prominent features of the previous feature map.

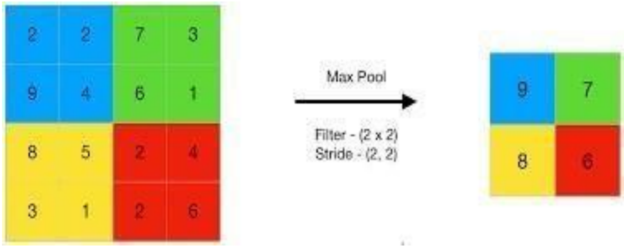

Fig-5

Average Pooling:

Average pooling computes the average of the elements present in the region of the feature map covered by filter. While max pooling gives the most prominent feature in a particular patch of feature map, where as average pooling gives the average of features present in patch.

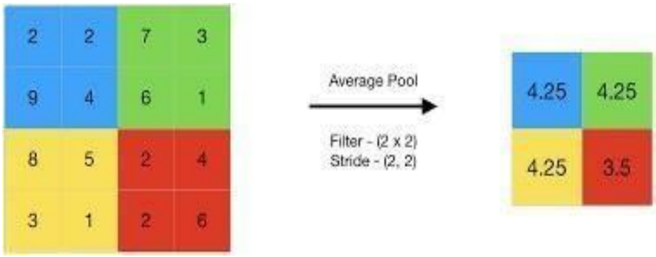

Fig-6

LAYER STACKING:

Multiple Layers are stacked of Convolution, ReLu and Pooling according to the architecture. The number of layers to be stacked varies as per use of the predefined architectures like Google Le Net, Alex Net etc. The output obtained is the minimized matrix of the input image.

FULLY CONNECTED LAYER:

The Fully Connected Layer in CNN has neurons that are fully connected to all the neurons of the previous layer. Multiple FC layers are stacked as per the architecture used. It is often the last layer used in CNN which is responsible to predict the output or the label of the input class. Different activation functions are used like SOFTMAX which is used to classify multi-class problems. Hence, it has an output dimension of [1x1xM] where M is the number of classes or labels used for classification. 5. SYSTEM OVERVIEW General explanation: 1. The input test image is acquired and preprocessed in the next stage and then it is converted into array form for Comparison. 2. The selected database is properly segregated and preprocessed and then renamed into proper folders. 3. The model is properly trained using CNN and then classification takes place. 4. The comparison of the test image and the trained model take place followed by the display of the result. 5. If there is a defect or disease in the plant the software displays the disease along with the remedy.

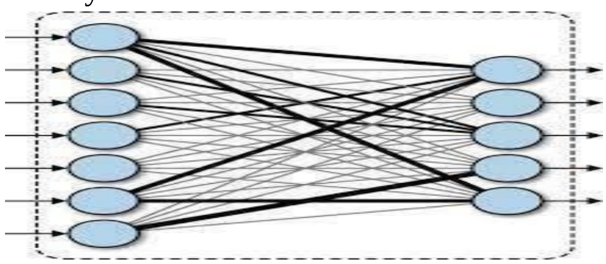

Fig-7

IMAGE DATA SET

The data sets used in the research include the descriptions of the leaves before and after the diseases affect them. The data comprises tables and images of the leaves that are taken in the fields. The data is analyzed and classified in a way that is easy for the readers

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to understand. For example, Wallelign et al. [9] show the leaves used to determine the soybean plants affected by the diseases. The data set shows healthy leaves and the ones that had dents due to the attack by septorial leaf blight, others by frogeye leaf spot.

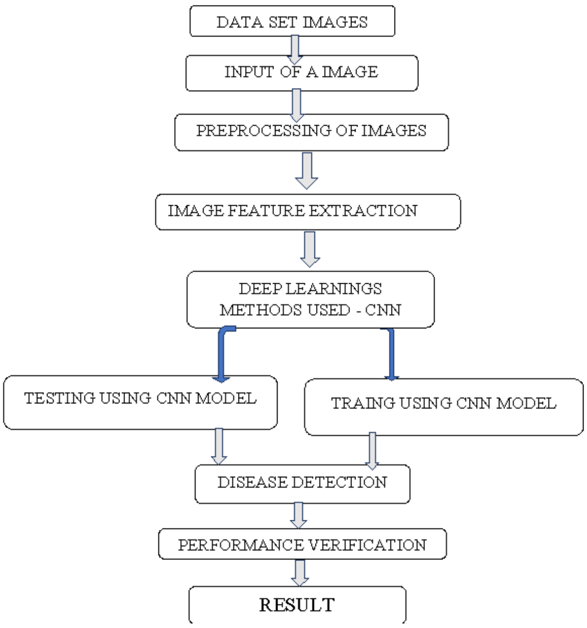
Fig-8

The images in Figure 8show that there were visible differences between the leaves affected by the disease and those that had not. The data set was clear and easy to understand. Another form of data was the table that showed the number of leaves that were classified under each disease

Fig-9

The other feature is that the data sets for leaves' analysis are based on the primary data collected in the fields. The reliability of the data is high because it is based on the observable features of the leaves. The data sets are also divided into sections that are easy to understand. For example, the work of [32] shows the divisions of the work in terms of the diseases like Rice Blast (RB), Bacterial leaf Blight (BLB), and Sheath Blight (SB). The use of a PlantVillage data set was also applied in the research by [32]. The data set consists of 54,306 images of 14 different crops representing 26 plant diseases. The images that were included in the data set included leaves having different colors.

DESIGN METHODOLOGY



DATA SET :

The data sets used in the research include the descriptions of the leaves before and after the diseases affect them. The data set consists of 21,901 images of 3 different crops representing 26 plant diseases. The images that were included in the data set included leaves having different colors.

PREPROCESSING OF IMAGE:

Data preprocessing refers to the technique of preparing (cleaning and organizing) the raw data to make it suitable for a building and training models. It is a data mining technique that transforms raw data into an understandable and readable format.

1.Acquire the dataset
2. Import all the crucial libraries
3. Import the dataset
4. Identifying and handling the missing values
5. Encoding the categorical data
6. Splitting the dataset
7. Feature scaling

FEATURE EXTRACTION:

Feature extraction is a part of the dimensionality reduction process, in which, an initial set of the raw data is divided and reduced to more manageable groups. So, when you want to process it will be easier. The most important characteristic of these large data sets is that they have a large number of variables. These variables require a lot of computing resources to process. So, Feature extraction helps to get the best feature from those big data sets by selecting and combining variables into features, thus, effectively reducing the amount of data. These features are easy to process, but still able to describe the actual data set with accuracy and originality.

* Deep learning method used - Convolutional Neural Network (CNN)

TRAINING DATA:

In Deep learning, datasets are split into two subsets. The first subset is known as the training data - it's a portion of our actual dataset that is fed into the Deep learning model to discover and learn patterns. In this way, it trains our model. Training data is typically larger than testing data. This is because we want to feed the model with as much data as possible to find and learn meaningful patterns.

TESTING DATA:

Once the Deep learning model is built with your training data, you need unseen data to test your model. This data is called testing data, and you can use it to evaluate the performance and progress of your algorithms' training and adjust or optimize it for improved results.
In data science, it's typical to see your data split into 80% for training and 20% for testing.

DISEASE DETECTION:

After the training and testing of image data the disease detection of the plant will be done based on the features of the data. Those features are extracted by building a CNN model to detect the spots on the leaf and identifying the leaf disease.

PERFORMANCE EVALUATION:

The accuracy of our model we built is 70.636 %.

TRAINING

The dataset is preprocessed like Image reshaping, resizing and conversion to an array form. Similar processing is additionally done on the test image. A dataset consisting of about 38 different plant leaf diseases is obtained, out of which any image is often used as a test image for the software.

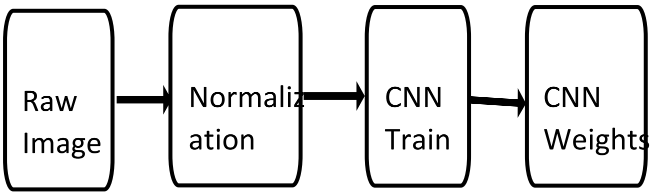


Fig-11

TESTING

The train dataset is employed to coach the model (CNN) so that it can identify the test image and therefore the disease it is CNN has different layers that are Dense, Dropout, Activation, Flatten, Convolution2D, and maxpooling2d. After the model is trained successfully, the software can identify the disease if the plant species is contained within the dataset. After successful training and preprocessing, comparison of the test image and trained model takes place to predict the disease.

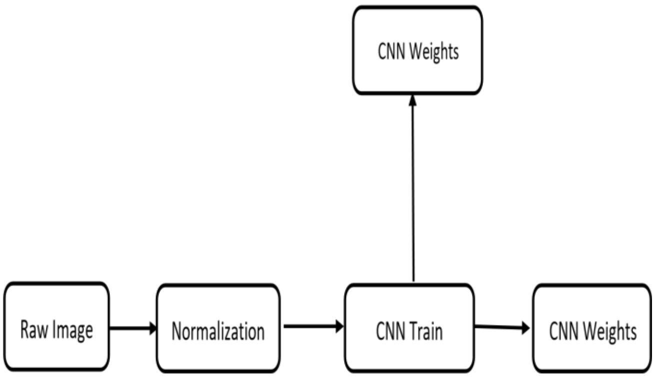


Fig-12

RESULT ANALYSIS

As it is known that convolutional networks are ready to learn features when trained on larger datasets, results achieved when trained with only original images will not be explored. After fine-tuning the parameters of the network, an overall accuracy of 88% was achieved. Furthermore, the trained model was tested on each class individually. Test was performed on every image from the validation set.

As suggested by good practice principles, achieved results should be compared with some other results. additionally, there are still no commercial solutions on the market, except those handling plant species recognition based on the leaf's images. during this paper, an approach of using deep learning method was explored to automatically classify and detect plant diseases from leaf images. the entire procedure was described, respectively, from collecting the pictures used for training and validation to image pre-processing and augmentation and eventually the procedure of coaching the deep CNN and fine-tuning. Different tests were performed to see the performance of newly created model. As the presented method has not been exploited, as far as we all know, in the field of disease recognition, there was no comparison with related results, using the precise technique. Here the test picture we have provided is tomato leaf with Septoria leaf spot. As it is known that convolutional networks are ready to learn features when trained on larger datasets, results achieved when trained with only original images will not be explored. After fine-tuning the parameters of the network, an overall accuracy of 88% was achieved. Furthermore, the trained model was tested on each class individually. Test was performed on every image from the validation set.

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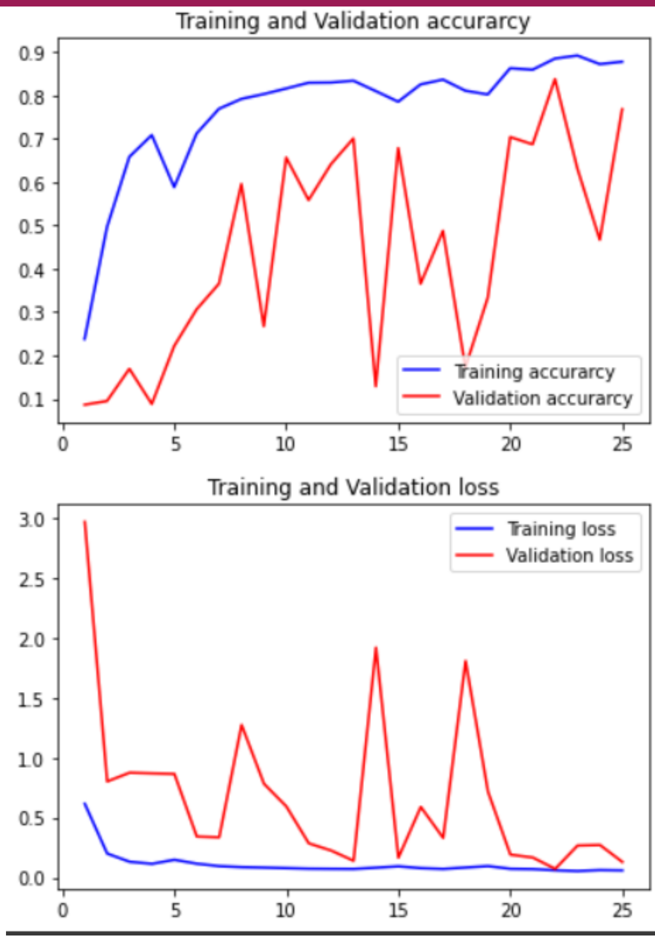
As it is known that convolutional networks are ready to learn features when trained on larger datasets, results achieved when trained with only original images will not be explored. After fine-tuning the parameters of the network, an overall accuracy of 70% was achieved. Furthermore, the trained model was tested on each class individually. Test was performed on every image from the validation set. As suggested by good practice principles, achieved results should be compared with some other results. Additionally, there are still no commercial solutions on the market, except those handling plant species recognition based on the leaf's images. During this paper, an approach of using deep learning method was explored to automatically classify and detect plant diseases from leaf images. The entire procedure was described, respectively, from collecting the pictures used for training and validation to image pre-processing and augmentation and eventually the procedure of coaching the deep CNN and fine-tuning. Different tests were performed to see the performance of newly created model. As the presented method has not been exploited, as far as we all know, in the field of disease recognition, there was no comparison with related results, using the precise technique. Here the test picture we have provided is leaf with consists leaf spot.



7.CONCLUSION

Convolutional networks are ready to learn features when trained on larger datasets, results achieved when trained with only original images will not be explored. After fine-tuning the parameters of the network, an overall accuracy of 75% was achieved. Furthermore, the trained model was tested on each class individually. Test was performed on every image from the validation set. As suggested by good practice principles, achieved results should be compared with some other results. Additionally, there are still no commercial solutions on the market, except those handling plant species recognition based on the leaf's images. During this approach of using deep learning method was explored to automatically classify and detect diseases from leaf images. The entire procedure was described, respectively, from collecting the pictures used for training and validation to image pre-processing and augmentation and eventually the procedure of coaching the deep CNN. Different tests were performed to see the performance of newly created model. As the presented method has not been exploited, as far as we all know, in the field of disease recognition, there was no comparison with related results, using the precise technique

9. REFERENCES

[1] Jinzhu Lu 1,2,*, Lijuan Tan 1,2 and Huanyu Jiang “. Review on Convolutional Neural Network (CNN) Applied to Plant Leaf Disease Classification.” Agriculture 2021, 11, 707.
https:// doi.org/10.3390/agriculture11080707

[2] Anami, B.S.; Malvade, N.N.; Palaiah, S. Deep learning approach for recognition and classification of yield affecting paddy crop stresses using field images. Artif. Intell. Agric. 2020, 4, 12–20.

[3] Bansal, P.; Kumar, R.; Kumar, S. Disease Detection in Apple Leaves Using Deep Convolutional Neural Network. Agriculture 2021, 11, 617.

[4] Hossain, S.M.M.; Deb, K.; Dhar, P.K.; Koshiba, T. Plant Leaf Disease Recognition Using DepthWise Separable Convolution-Based Models. Symmetry 2021, 13, 511.
https://dx.doi.org/10.3390/ sym13030.

[5] Chohan, M., Khan, A., Katper, S., Mahar, M., 2020. Plant disease detection using deep learning. Int. J. Recent Technol. Eng. 9 (1), 909–914.

[6] Chowdhury, M.E.H.; Rahman, T.; Khandakar, A.; Ayari, M.A.; Khan, A.U.; Khan, M.S.; AlEmadi, N.; Reaz, M.B.I.; Islam, M.T.; Ali, S.H.M. Automatic and Reliable Leaf Disease Detection Using Deep Learning Techniques. AgriEngineering 2021, 3, 294–312.
https://doi.org/10.3390/
agriengineering3020020.

[7] Tiwari, D., Ashish, M., Gangwar, N., Sharma, A., Patel, S., Bhardwaj, S., 2020. Potato leaf diseases detection using deep learning. 2020 4th International Conference on Intelligent
Computing and Control Systems (ICICCS). IEEE, Madurai, India, India, pp. 461–466.

[8] Boulent, J., Foucher, S., Theau, J., St-Charles, P.L.: Convolutional Neural Network for the automatic identification of plant diseases. Front Plant Sci. 10 (2019).

[9] ParismitaBharali, Chandrika Bhuyan, Abhijit Boruah, Plant Disease Detection by Leaf
Image Classification Using Convolutional Neural Network ICICCT 2019, pp.194-205.

[10] Hassan, S.M.; Maji, A.K.; Jasinski, M.; Leonowicz, Z.; Jasinska, E. Identification of PlantLeaf Diseases Using CNN and Transfer-Learning Approach. Electronics 2021, 10, 1388.

[11] Chohan, M., Khan, A., Katper, S., Mahar, M., 2020. Plant disease detection using deep learning. Int. J. Recent Technol. Eng. 9 (1), 909–914.

[12] Bansal, P.; Kumar, R.; Kumar, S. Disease Detection in Apple Leaves Using Deep Convolutional Neural Network. Agriculture 2021, 11, 617.