e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:02/February-2024 Impact Factor- 7.868 www.irjmets.com

DEEP LEARNING ALGORITHM FOR PLANT DISEASE WITH IOT MONITORING

Ujjwal Sonawane[*1], Vishnu Kant Pandey[*2], Mukesh Singhaniya[*3], Prof. T.V. Kafare[*4]

[*1,2,3]Student, Electronic And Tele Communication Engineering, Sinhgad College Of Engineering, Pune, India.

[*4]Prof., Department Of Electronic And Tele Communication Engineering, Sinhgad College Of Engineering, Pune, India.

DOI : https://www.doi.org/10.56726/IRJMETS49152

ABSTRACT

The agricultural sector plays a key role in supplying quality food and makes the greatest contribution to growing economies and populations. Plant disease may cause significant losses in food production and eradicate diversity in species. Early diagnosis of plant diseases using accurate or automatic detection techniques can enhance the quality of food production and minimize economic losses. In recent years, deep learning has brought tremendous improvements in the recognition accuracy of image classification and object detection systems. Hence, in this paper, we utilized convolutional neural network (CNN)-based pre-trained models for efficient plant disease identification. Smart farming plays a vital role in the Indian economy. But nowadays, farming agriculture in Indian is undergoing a structural change leading to a crisis. The only remedy to the crisis is to do all that is possible to make agriculture a profitable enterprise and attract the farmers to continue the crop production activities so our proposed model focuses on cultivation's with the help of machine learning predicting the appropriate crop based on the climatic situations and determine the crop disease based on the historic data.

Keywords: CNN, Dataset, Kaggle, API.

I. INTRODUCTION

Agriculture is the backbone of India and about 70% of the population depends on agriculture. Farmers have large range of diversity for selecting various suitable crops and finding the suitable pesticides for plant. Disease on plant leads to the significant reduction in both the quality and quantity of agricultural product. The studies of plant disease refer to the studies of visually observable patterns on the plants. Monitoring of health and disease on plant plays an important role in successful cultivation of crops in the farm. In early days the monitoring and analysis of plant diseases were done manually by an expert person in the field. This requires tremendous amount of work and also requires excessive processing time. Our system uses ML Model to detect healthy and unhealthy leaves by training images and finding accurate results.

II. METHODOLOGY

Machine learning trained and tested models which detect crop leaf disease are stored on operating device. You can check if a leaf is diseased or not on a locally hosted website by uploading an image on it. 2.2 Operating Device The operating device serves as the central processing unit for the system. It stores the machine learning (ML) model, which was trained to detect plant leaf diseases. The operating device can be a personal computer (PC) or a similar device with sufficient computational power. It runs the necessary software, such as a Python IDE, to handle ML model inference and data processing.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:02/February-2024 Impact Factor- 7.868 www.irjmets.com

III. MODELING AND ANALYSIS

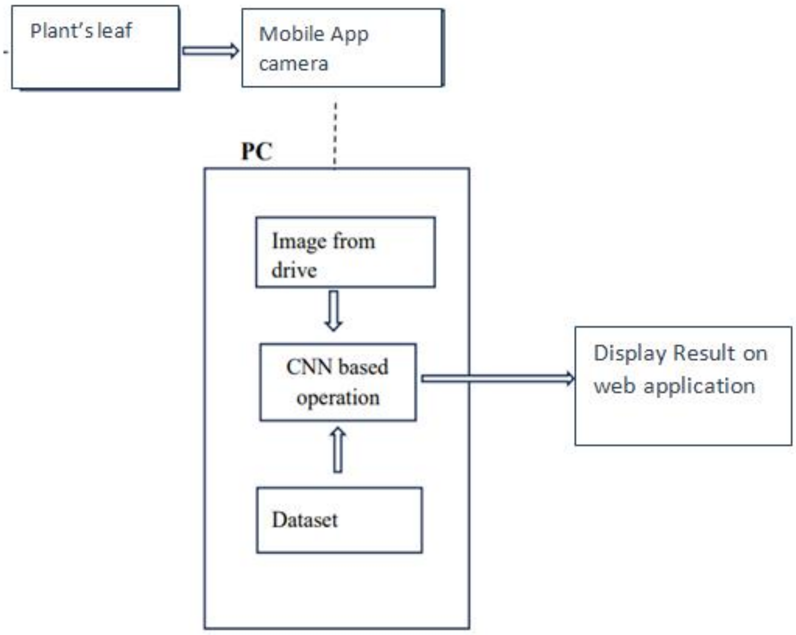

Fig 1. Block Diagram

A Convolutional Neural Network (CNN) is a deep learning algorithm primarily used for image recognition and computer vision tasks. It consists of several interconnected layers that learn to extract meaningful features from input images. Here's a concise explanation of how CNNs work:

1. Convolutional layer: The input image is convolved with a set of learnable filters, also known as kernels or feature detectors. Each filter scans the image in small regions, performing element-wise multiplication and aggregation to produce a feature map. Convolutional layers capture local patterns and spatial hierarchies.
2. Activation function: The feature map is then passed through a non-linear activation function (e.g., ReLU) to introduce non-linearity, allowing the network to learn complex relationships between features.
3. Pooling layer: To reduce spatial dimensionality and make the learned features more robust to variations, a pooling layer is applied. Common pooling methods include max pooling, which selects the maximum value in each region, and average pooling, which calculates the average value. Pooling reduces the computational complexity and helps with translation invariance.
4. Fully connected layer: The output of the convolutional and pooling layers is flattened and connected to a traditional Neural network architecture, typically composed of fully connected layers. These layers learn high-level representations and make predictions based on the extracted features.
5. Output layer: The final fully connected layer is followed by an activation function suitable for the specific task, such as soft max for multi-class classification or sigmoid for binary classification. It generates the network's output probabilities or class predictions.
6. Training: CNNs are trained using back propagation and optimization algorithms (e.g., stochastic gradient descent) to minimize a loss function. The loss is computed by comparing the predicted output with the true labels using appropriate metrics like cross-entropy.
7. Optimization: The network's weights and biases are updated iteratively during training to minimize the loss. This process is typically performed on batches of input images to improve computational efficiency.
8. Evaluation and prediction: Once trained, the CNN can be used for inference on new, unseen images. The forward pass through the network applies the learned filters and computes predictions based on the learned representations.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:02/February-2024 Impact Factor- 7.868 www.irjmets.com

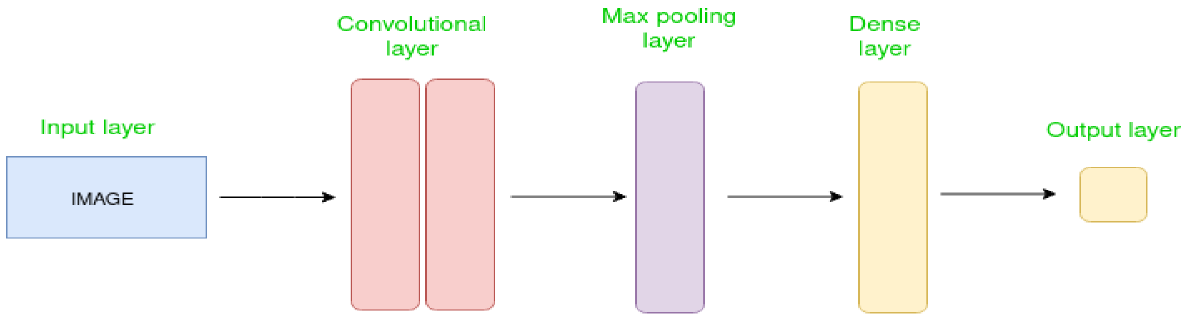

Fig 2. CNN Layers

IV. RESULTS AND DISCUSSION

In this research, we developed a crop disease detection system to identify common diseases in different types of plants.

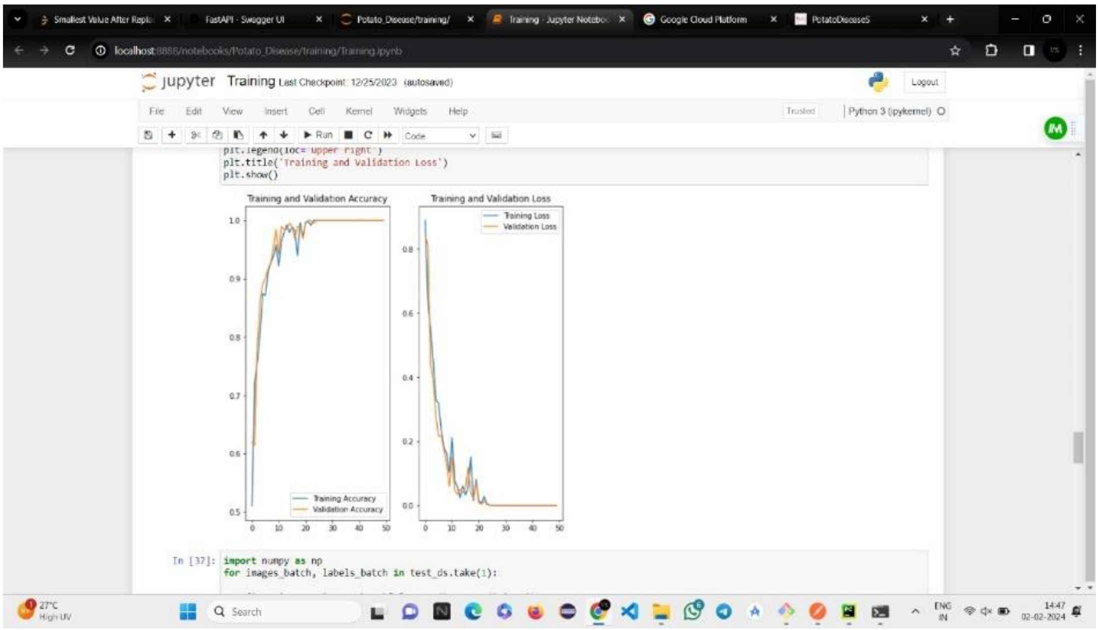

Fig 3. Predication of image (analysis)

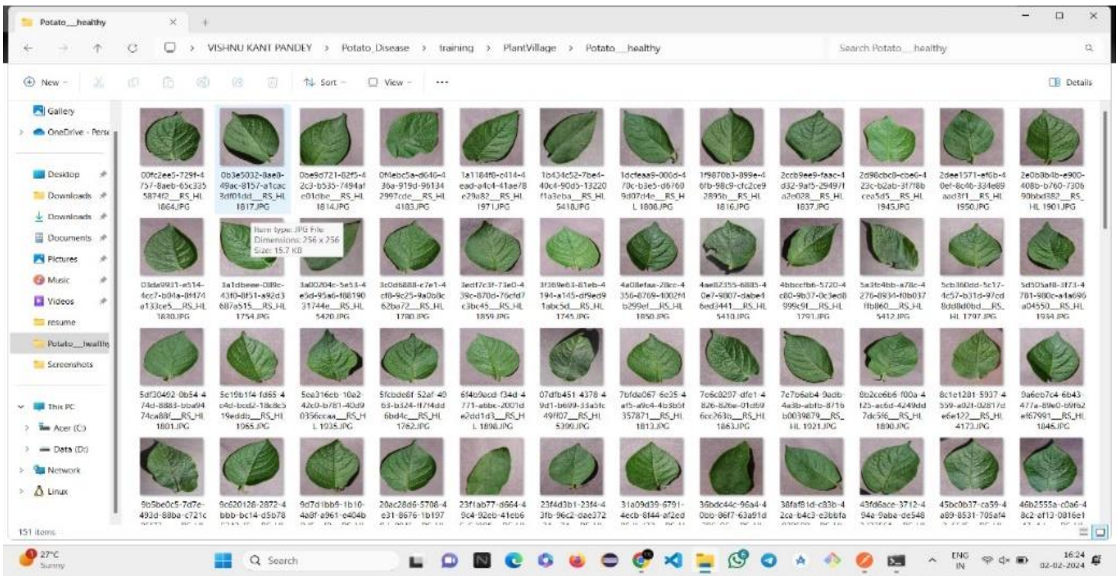

Fig 4. Some pictures of leaves

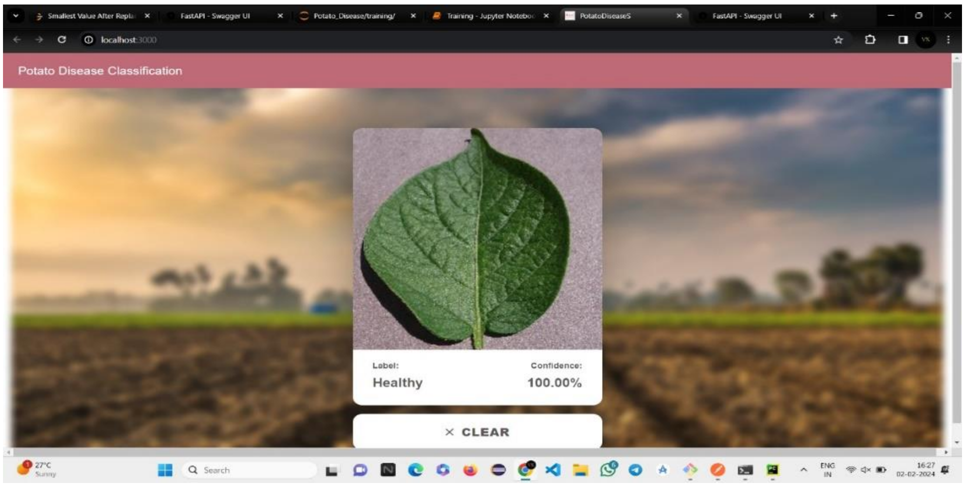

Fig 5. Result of Image

V. APPLICATION

1. **Agriculture**: Farmers can optimize the use of pesticides and fertilizers by targeting specific areas affected by diseases, reducing environmental impact, and saving costs.
2. **Plant Research**: Deep learning accelerates research in plant pathology, enabling scientists to study diseases in-depth, develop resistant crop varieties, and improve overall agricultural productivity.
3. **Global Food Security**: By minimizing crop losses due to diseases, deep learning technology plays a significant role in ensuring food security for growing populations around the world.

VI. CONCLUSION

CNN methods are widely used in the detection of plant diseases. It has solved the problems of traditional object detection and classification methods. In this study, we presented a detailed review of CNN-based research on plant leaf disease detection in crops over the last five years. A total of 100 publications were reviewed based on detection methods and model performance evaluation, comparison of popular CNN frameworks, detailed description of CNN applications in agricultural fields, dataset preparation, the problem and solution related to plant leaf disease detection, and publicly released datasets in the relevant field. We addressed highly related research articles to present a comparative analysis of various CNN models.

ACKNOWLEDGEMENTS

We would like to express our sincere thanks to Prof. Tushar Kafare project guide and project coordinator Prof. Vijay B. Baru, Department of E&TC, for him constant encouragement in the fulfilment of the project work. We would also like to express our sincere thanks to Dr. M. B. Mali, Head, Department of E&TC for his co-operation and useful suggestions. We would also like to thank Dr. S. D. Lokhande, Principal, Sinhgad College of Engineering. He always remains a source of inspiration for us to work hard and dedicatedly.

It is the love and blessings of our families and friends which drove us to complete this project work.

VII. REFERENCES

[1] Altieri, M.A. Agroecology: The Science of Sustainable Agriculture; CRC Press: Boca Raton, FL, USA, 2018.

[2] Gebbers, R.; Adamchuk, V.I. Precision agriculture and food security. Science **2010**, 327, 828–831.

[3] Carvalho, F.P. Agriculture, pesticides, food security and food safety. Environ. Sci. Policy **2006**, 9, 685–692.

[4] Mohanty, S.P.; Hughes, D.P.; Salathé, M. Using deep learning for image-based plant disease detection. Front. Plant Sci. 2016, 7, 1419.

[5] Miller, S.A.; Beed, F.D.; Harmon, C.L. Plant disease diagnostic capabilities and networks. Annu. Rev. Phytopathol. 2009, 47, 15–38.

[6] LeCun, Y.; Bengio, Y.; Hinton, G. Deep learning. Nature 2015, 521, 436–444.

[7] Najafabadi, M.M.; Villanustre, F.; Khoshgoftaar, T.M.; Seliya, N.; Wald, R.; Muharemagic, E. Deep learning applications and challenges in big data analytics. J. Big Data 2015, 2, 1–21.

[8] Szegedy, C.; Liu, W.; Jia, Y.; Sermanet, P.; Reed, S.; Anguelov, D.; Erhan, D.; Vanhoucke, V.; Rabinovich, A. Going deeper with convolutions. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, Boston, MA, USA, 7–12 June 2015; pp. 1–9.

[9] Abade, A.; Ferreira, P.A.; de Barros Vidal, F. Plant diseases recognition on images using convolutional neural networks: A systematic review. Comput. Electron. Agric. 2021, 185, 106125.

[10] Dhaka, V.S.; Meena, S.V.; Rani, G.; Sinwar, D.; Ijaz, M.F.; Woźniak, M. A survey of deep convolutional neural networks applied for prediction of plant leaf diseases. Sensors 2021, 21, 4749.