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AI-Driven Crop Diseases Detection and Plant Monitoring Using Image Processing and CNN

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Abstract - The study, in particular, examines the design of a total architecture of an Artificial Intelligence system that can automatically detect crop diseases and can monitor plants health. The system uses image processing techniques to prepare the crops images for feature extraction by specific disease algorithms. For classification, convolutional neural networks (CNNs) are used to maximize precision in recognizing the disease. The research emphasizes how AI can transform the agricultural sector by reducing waste and improving crop management techniques.

Key Words: AI, CNN, Image Processing, Agriculture, Diseases Detection.

Fig-1 Benefits of AI in Agriculture

1.INTRODUCTION

Herein, we present an advanced method for detecting crop diseases and monitoring plant health through the integration of Convolutional Neural Networks (CNNs). It process crop images to extract important features for determining whether the crop is diseased or healthy to ensure detection is with high accuracy and specificity. CNNs, Extremely efficient in image analysis and yet powerful enough for disease classification accelerating the early stages of disease treatment and preparation.

The integration of AI-driven tools in agriculture has the potential to transform farming practices. By automating diseases detection, this research seeks to minimize crop losses, improve yields, and contribute to sustainable farming. It underscore the importance of leveraging technology to address pressing challenges in agriculture and lays the foundation for a smarter, more resilient food production system.

2.LITERATURE REVIEW

Automated harvesting robot is a potential solution for many challenges in agriculture such as the explosively increasing global old-age population, labor cost increase, increasing demand for of produce and so on[1]. According to the Food and Agriculture Organization of the United Nations, the world population will reach over 9 billion by 2050. Rapid population growth, shrinking farmland, dwindling natural resources, erratic climate changes, and shifting market demands are pushing the agricultural production system into a new paradigm[2].

Being a major occupation of most Indians, significant developments in the field are strongly required to ensure higher yields and less crop damage[3].Agriculture is the major contributor for the Indian Economy. Major population in india depends on Agriculture for employment. Automation in crop reduction can reduce the loss of yield and hence will reduce a major problem for Indian Formers[4]Plant infection/disease is one of the ongoing challenges for farmers, which imposes a threat on their income and food security. Detecting infection in plants or crops is an onerous task because the analysis of each crop in large fields takes too much time, effort, work force and expertise[5].

3. Techniques in Artificial Intelligence for Identifying Agriculture Diseases

3.1 Image Processing

An image is transformed into a numerical matrix that computers can process efficiently. Various forms of image processing include enhancement, restoration, compression, and analysis. Image Stands out as it enables the extraction of precise information directly from an image. This analysis can focus on features such as image edges(edge extraction), color patterns(texture analysis), and motion detection observed between consecutive images. This process is breakdown into few fundamental phases.

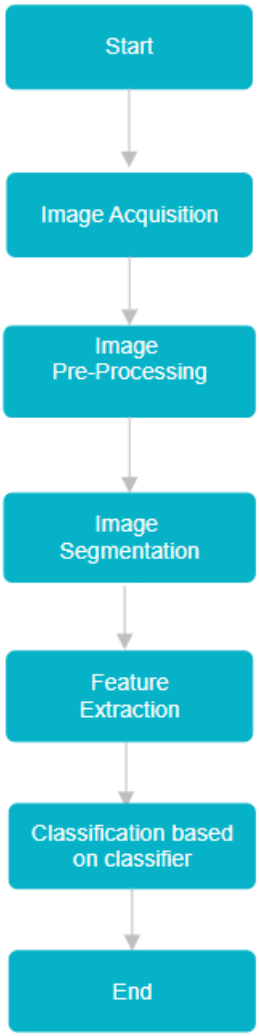
(a) Image Acquisition :- Images of the inflamed leaves are obtained. This database has specific varieties of plant sickness, and the pics are saved in JPEG format. These pics are then studied in MATLAB with the use of the study command.

(b) Image Pre-processing:- Image pre-processing is employed to remove noise from the photograph and exclude unnecessary elements using specific techniques. Image scaling is applied to convert the original image into thumbnails, as the image's pixel size is large and requires more time for processing. By reducing the image to thumbnail size, the pixel count decreases, significantly reducing the time needed to overall system.

(c) Image Segmentation:- Image segmentation is a widely utilized technique for accurately distinguishing pixels in images within a targeted application. It divides an image into multiple distinct regions, ensuring that pixels within each exhibit strong similarities, while maintaining significant dissimilarity between different regions.

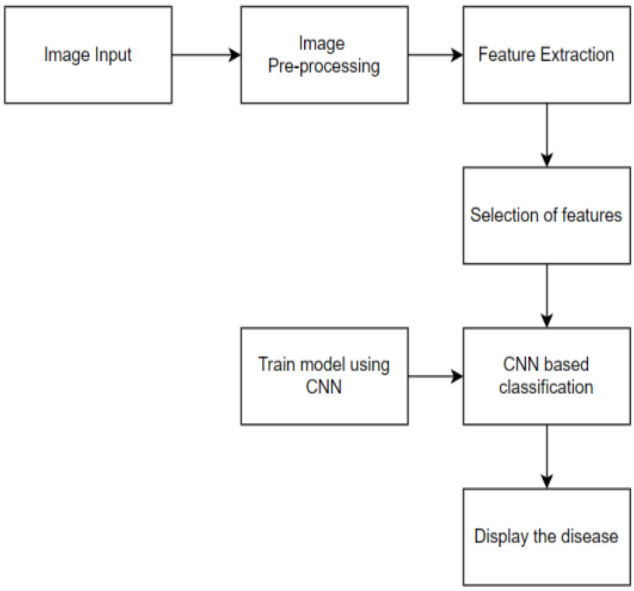
(d) Feature Extraction:- Feature extraction is a vital component in disease detection, playing a key role in object identification. It is utilized across various applications in image processing. Features such as color, texture edges, and morphology are instrumental in detecting diseases.

(e) Classification based on classifier:- The concluding stage involve detecting diseases and classifying plants by matching the identified diseases with those present in the given dataset, utilizing disease classification algorithms.

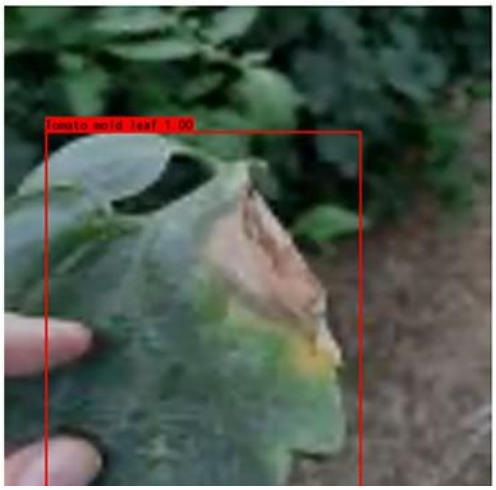


3.2 Convolutional Neural Network (CNN)

Deep learning-based convolutional neural network (CNNs) were developed using images of healthy and diseased plant leaves to detect and diagnose crop illnesses. The process begins when a user captures a leaf image through a mobile application, which is then transmitted to an AI system for analysis. The image undergoes preprocessing, feature extraction, and feature selection to isolate key patterns. A deep residual network architecture achieved 97.8% accuracy in identifying four insect species, demonstrating the efficiency of CNNs in agricultural pest management. These models are inherently flexible, capable, of processing diverse data formats such as images, audio, and text.



CNN is a type of deep, feed-forward artificial neural network (ANN) that has been effectively used in computer vision applications. CNN achieved great precision in the majority of the cases in which it was utilized, outperforming other prominent image-processing approaches.



(a)

(b)

(C)

Fig-2 Convolutional Neural Network for the automatic diseases detection

4.CONCLUSION

The primary goal of this research was t provide an overview of the use and existing techniques of artificial intelligence to help farmers achieve the desired output. The report also covers numerous pieces of literature that reflect various approaches to detecting agricultural diseases. In line with the literature, artificial intelligence is an extraordinary device for a country's agronomics. As a result, future researchers should compile a comprehensive dataset spanning all aspects of agriculture and improve present technology to boost primary sector production.

In this paper, a well-timed correct evaluation of plants is being finished with the assistance of Image Processing and CNN. This can result in development withinside the agriculture field. Data Augmentation in this situation has provided super results for the model as it reduced the overfitting.

5.REFERENCES

[1] L. Zhang, G. Gui, A. M. Khattak, M. Wang, W. Gao and J. Jia, "Multi-Task Cascaded Convolutional Networks Based Intelligent Fruit Detection for Designing Automated Robot," in IEEE Access, vol. 7, pp. 56028-56038, 2019, doi: 10.1109/ACCESS.2019.2899940.

[2] S. Y. Liu, "Artificial Intelligence (AI) in Agriculture," in IT Professional, vol. 22, no. 3, pp. 14-15, 1 May-June 2020, doi: 10.1109/MITP.2020.2986121.

[3] Dwari, A., Tarasia, A., Jena, A., Sarkar, S., Jena, S.K., Sahoo, S. (2021). Smart Solution for Leaf Disease and Crop Health Detection. In: Das, S., Mohanty, M.N. (eds) Advances in Intelligent Computing and Communication. Lecture Notes in Networks and Systems, vol 202. Springer, Singapore. https://doi.org/10.1007/978-981-16-0695-3_23

[4] S. N and J. S, "AI Based Automatic Crop Disease Detection System," 2021 IEEE International Conference on Electronics, Computing and Communication Technologies (CONECCT), Bangalore, India, 2021, pp. 1-6, doi: 10.1109/CONECCT52877.2021.9622700.

[5] M. Ahmed, T. Mahajan, B. D. Sharma, M. Kumar and S. K. Singh, "AI-based Detection of Pest Infected Crop and Leaf," 2021 3rd International Conference on Signal Processing and Communication (ICPSC), Coimbatore, India, 2021, pp. 402-406, doi: 10.1109/ICSPC51351.2021.9451698.

[6] Revanth. (n.d.). Towards future farming: How artificial intelligence is transforming the Agriculture Industry. Wipro. Retrieved August 4, 2022, from https://www.wipro.com/holmes/towards-futurefarming-how-artificial-intelligence-istransforming-the-agriculture-industry/

[7] Boulent, J., Foucher, S., Théau, J., & St-Charles, P.-L. (1AD, January 1). Convolutional neural networks for the automatic identification of plant diseases. Frontiers. Retrieved August 4, 2022, from https://www.frontiersin.org/articles/10.3389/fpl s.2019.00941

[8] Dwari, A., Tarasia, A., Jena, A., Sarkar, S., Jena, S. K., & Sahoo, S. (2021). Smart solution for leaf disease and crop health detection. Lecture Notes in Networks and Systems, 231–241. https://doi.org/10.1007/978-981-16-0695-3_23

[9] Ahmed, M., Mahajan, T., Sharma, B. D., Kumar, M., & Singh, S. K. (2021). AI-based detection of Pest infected crop and leaf. 2021 3rd International Conference on Signal Processing and Communication (ICPSC). https://doi.org/10.1109/icspc51351.2021.94516 98

[10] Liu, S. Y. (2020). Artificial Intelligence (AI) in agriculture. IT Professional, 22(3), 14–15. https://doi.org/10.1109/mitp.2020.2986121