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# Agricultural Crop Disease Prediction Using Data Science Enabled Framework

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**Abstract:** Agricultural countries like India suffer from crop diseases that eventually lead to threatening food security besides causing huge financial losses to farmers. Most of the time, diseases prevail due to lack of infrastructure and necessary mechanisms to diagnose plant diseases at the earliest. Rapid identification of plat diseases in agriculture sector with technology innovations should be made possible. With the proliferation of smart phone technologies, remote image capturing equipment, computer vision applications and advanced machine learning techniques we are heading towards precision agriculture. However, there is still lot to be desired. In this paper we proposed a deep learning based method known as Convolutional Neural Network based Crop Disease Prediction (CNN-CDP). It has provision for improved feature selection and performance improvement with advanced configurations.

**Keywords –** Data Science, Machine Learning, Agriculture, Crop Disease Prediction

## I. INTRODUCTION

Agriculture plays an important role in the lives of people across the globe. Particularly large population of India depend on the agriculture. Farmers do have many problems in agriculture due to lack of technological innovations and use of technology for their agricultural decisions. In this context, the technologies like IoT and precision agriculture are largely used by agricultural departments and governments to have statistics for strategic decision making. There is lack of technology usage from the stand point of farmers. Technological innovations are not reaching farmers. In other words, it is found that farmers still suffer from the lack of support with technologies. However, there has been a sufficient effort towards precision agriculture that makes use of IoT and data analytics.

Perakis*et al*. [3] used data science approach with big data analytics in order to achieve precision agriculture. Serrano *et al*. [4] proposed IoT based approach with sensors and data analytics towards precision farming. Aziz *et al*. [5] used IoT and ML for livestock monitoring in agriculture. Shah *et al*. [6] proposed a crop advisory system using data analytics. Keswani *et al*. [7] used IoT and big data for making an irrigation control scheme in agriculture. Khattab *et al*. [8] proposed a cognitive monitoring system for early plant disease forecast. Jung *et al*. [13] investigated on the remote sensing and AI for resilience in agricultural production systems. Ojha *et al*. [14] studied the need for wireless sensor networks in agriculture. Lew *et al*. [15] proposed analytical tools for technology driven agriculture. Kim *et al*. [16] proposed IoT based disease prediction system towards smart farming. Mahlein *et al*. [17] used imaging sensors for precision agriculture and plant disease detection.From the literature, it is understood that there is great deal of improvements in technology driven agriculture. However, there is room for data science approach towards precision agriculture. In this regard, this paper is step forward for improving crop disease prediction automatically. Our contributions in this paper are as follows.

1. We proposed a ML framework for prediction of sentiments or opinions from student feedback in the form of reviews in academic institution.
2. We implemented different ML models along with a strong pre-processing and feature selection for improving performance.
3. A prototype application is built in order to evaluate the framework with the underlying models.

The remainder of the paper is structured as follows. Section 2 reviews literature on the existing methods used for student feedback analysis. Section 3 presents the proposed ML based framework. Section 4 presents results of empirical study. Section 5 concludes the paper and gives directions for future work.

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## II. RELATED WORK

This section reviews literature on existing methods on the crop disease detection in agriculture domain using data science approach. Devi *et al.* [1] proposed an IoT based methodology for efficient detection and classification of plant diseases leveraging agricultural applications. Elijah *et al.* [2] explored the technology driven approaches towards agriculture and data analytics for improving productivity. Perakis *et al.* [3] used data science approach with big data analytics in order to achieve precision agriculture. Serrano *et al.* [4] proposed IoT based approach with sensors and data analytics towards precision farming. Aziz *et al.* [5] used IoT and ML for livestock monitoring in agriculture. Shah *et al.* [6] proposed a crop advisory system using data analytics. Keswani *et al.* [7] used IoT and big data for making an irrigation control scheme in agriculture. Khattab *et al.* [8] proposed a cognitive monitoring system for early plant disease forecast. Trivedi *et al.* [9] focused on the enhancement of microbiomes for ensuring sustainable agriculture. Surender *et al.* [10] used data science and AI approach for Indian agriculture and carbon footprints. Woodard *et al.* [11] used data science and management towards empirical applications with scalability in agriculture. Sharma *et al.* [12] focused on the review of literature on sustainable agricultural practices.

Jung *et al.* [13] investigated on the remote sensing and AI for resilience in agricultural production systems. Ojha *et al.* [14] studied the need for wireless sensor networks in agriculture. Lew *et al.* [15] proposed analytical tools for technology driven agriculture. Kim *et al.* [16] proposed IoT based disease prediction system towards smart farming. Mahlein *et al.* [17] used imaging sensors for precision agriculture and plant disease detection. Morais *et al.* [18] explored precision agriculture practices for data management and productivity in agriculture. Gayathri *et al.* [19] proposed an IoT based ensemble classification for automatic crop monitoring. Yang *et al.* [20] explored state of the art in visual perception based industry intelligence with prospects and challenges. From the literature, it is understood that there is great deal of improvements in technology driven agriculture. However, there is room for data science approach towards precision agriculture. In this regard, this paper is step forward for improving crop disease prediction automatically.

## III. PROPOSED SYSTEM

Essentially, it is based on a deep learning model as deep learning has potential to improve performance of computer vision applications. Particularly, the proposed approach is based on the CNN model with specific configurations presented in Figure 1. It has convolutional and map pooling layers appropriately configured with empirical study. The convolutional layers act on different number of parameters and meant for learning features in the input image while max pooling layers reduce feature maps by down sampling.

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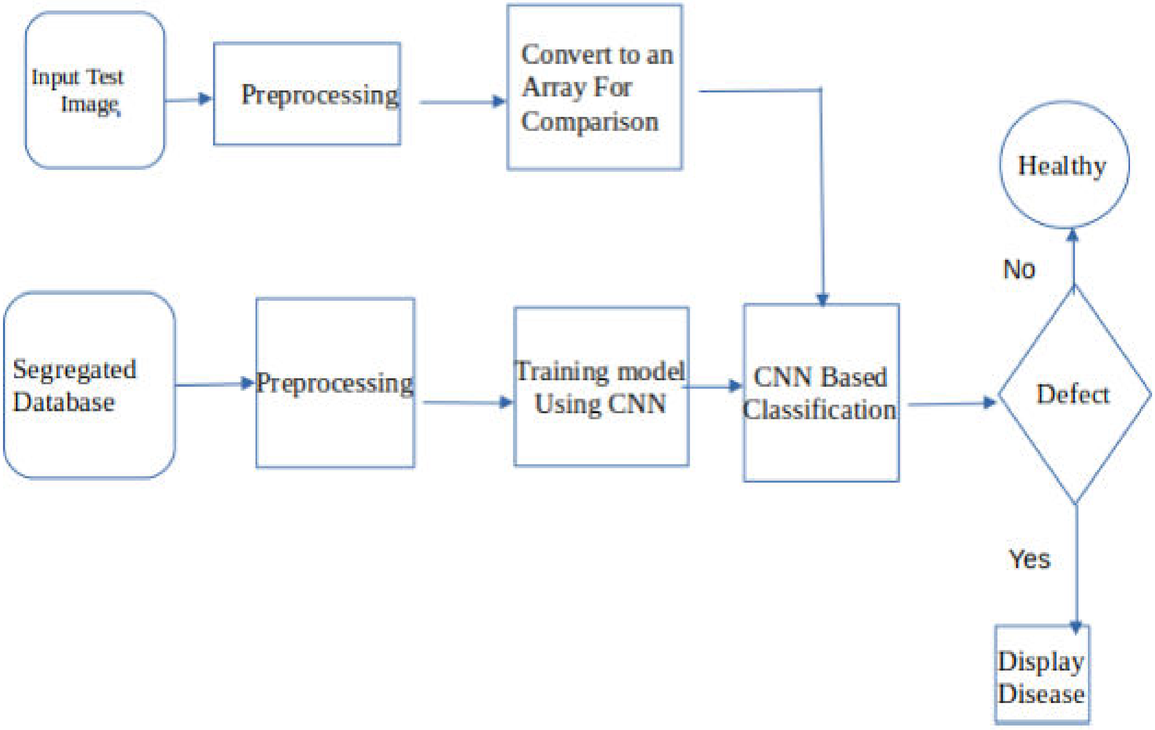


**Figure 1:** Proposed system overview

As presented in Figure 1, it has provision for different operations and CNN based training and classification for improving prediction performance.

**Algorithm:** Convolutional Neural Network based Crop Disease Detection (CNN-CDP)
Inputs: Plant village dataset D, no. of epochs e, batch size b
Outputs: Detection results P and evaluation results R

1. Start
2. (T, V) ← PreProcess(D)
3. F1 = ApplyConv2D1Layer(T1)
4. F1 = MaxPooling2D1Layer(F)
5. F2 = ApplyConv2D2Layer(T1)
6. F2 = MaxPooling2D2Layer(F)
7. F3 = ApplyConv2D3Layer(T1)
8. F3 = MaxPooling2D3Layer(F)
9. Add Flatten Layer to convert 3D Array to 1D Array.
10. Add Dense Layers with activation function ReLU
11. Add Dropout layer
12. Add Dense Layers activation function ReLU
13. Add Output Layer with Activation function Softmax.
14. F←FinalFeautres(F1, F2, F3)
15. *M* = TrainModel(*F*)
16. For each epoch *e* in *n*
17.     For each batch *b* in *m*
18.         Update M
19.     End For
20. End For

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21. *M'* = FitModel(*M*)
22. *P* = Detect(*M'*)
23. Print *P*
24. **End For**
25. **End**

**Algorithm 1:** Proposed algorithm

As presented in Algorithm 1, the algorithm takes PlantVillege dataset and different layers in the model. The model has different layers configured for performance improvement. The iterative process in the algorithm work different epochs and the model gets updated from time to time.

## IV. EXPERIMENTAL RESULTS

Experimental results are made with a prototype application and observations are made in terms of crop disease prediction and prediction accuracy. The proposed method is compared with different existing deep learning models.

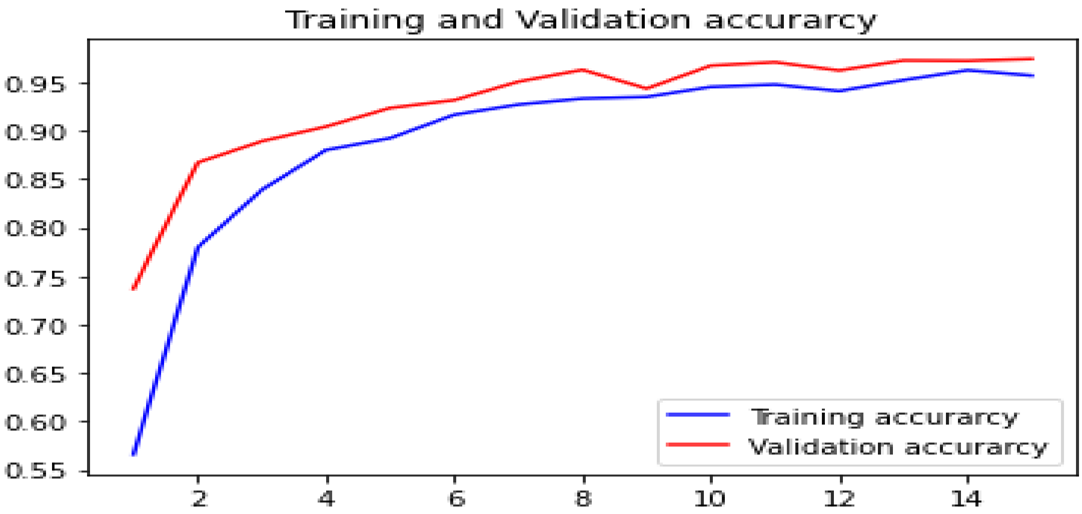


**Figure 2:** Shows training and validation accuracy against number of epochs

As presented in Figure 2, the training and validation accuracies are provided. As the number of epochs is increased the both training accuracy and validation accuracy are increased gradually.

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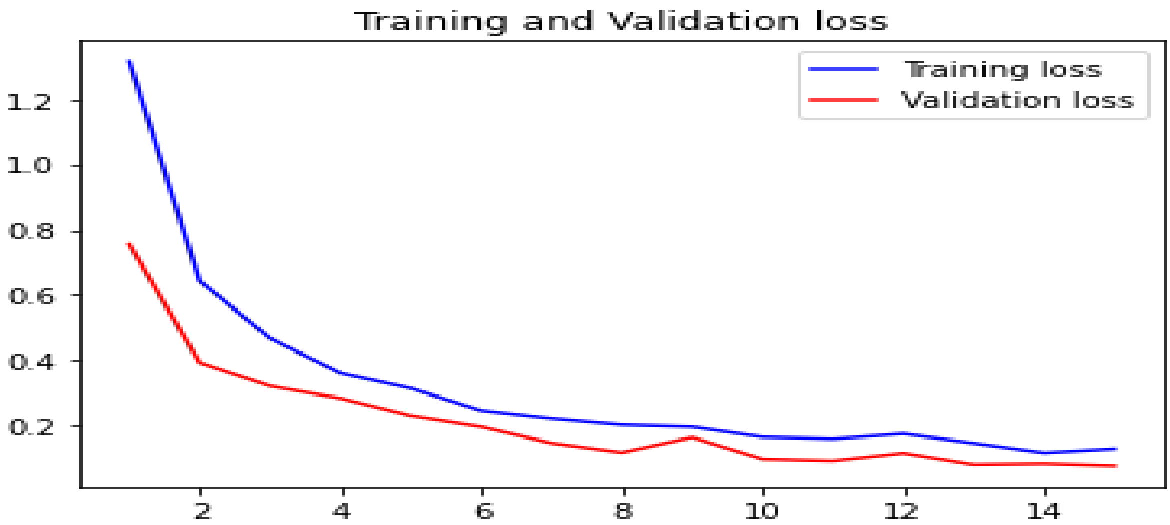



**Figure 3:** Shows training and validation loss against number of epochs

As presented in Figure 3, the training and validation loss are provided. As the number of epochs is increased the both training loss and validation loss are decreased gradually.

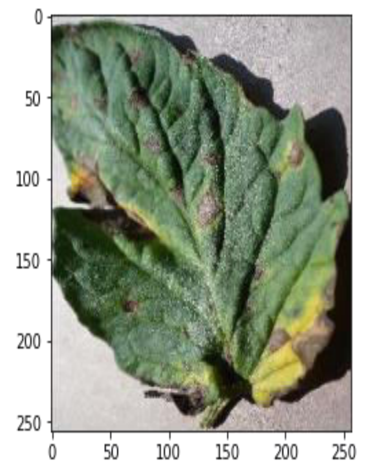
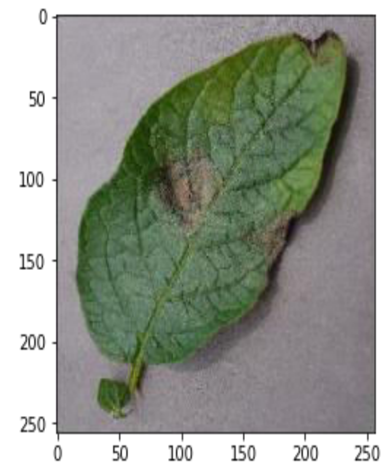
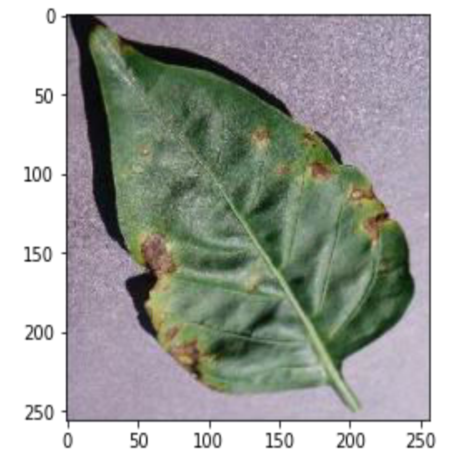
| Tomato_Early_Blight | Potato_Late_blight | Pepper_bell_Bacterial_spot |
|---|---|---|
|  |  |  |

**Figure 4:** Shows the results of correct crop disease prediction

As presented in Figure 4, it is evident that the test leaf images given from the PlantVilege dataset are tested and the disease is predicted correctly.

| Lead Disease Prediction Model | Accuracy (%) |
|---|---|
| Logistic regression | 91.95 |
| Random forest | 92.26 |
| Decision tree classifier | 85.54 |
| SVM | 91.56 |
| CNN-LDD | 94.89 |

**Table 1:** Shows performance comparison

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As presented in Table 1, the accuracy of different prediction models is provided and it is observed that each prediction model has different accuracy levels.

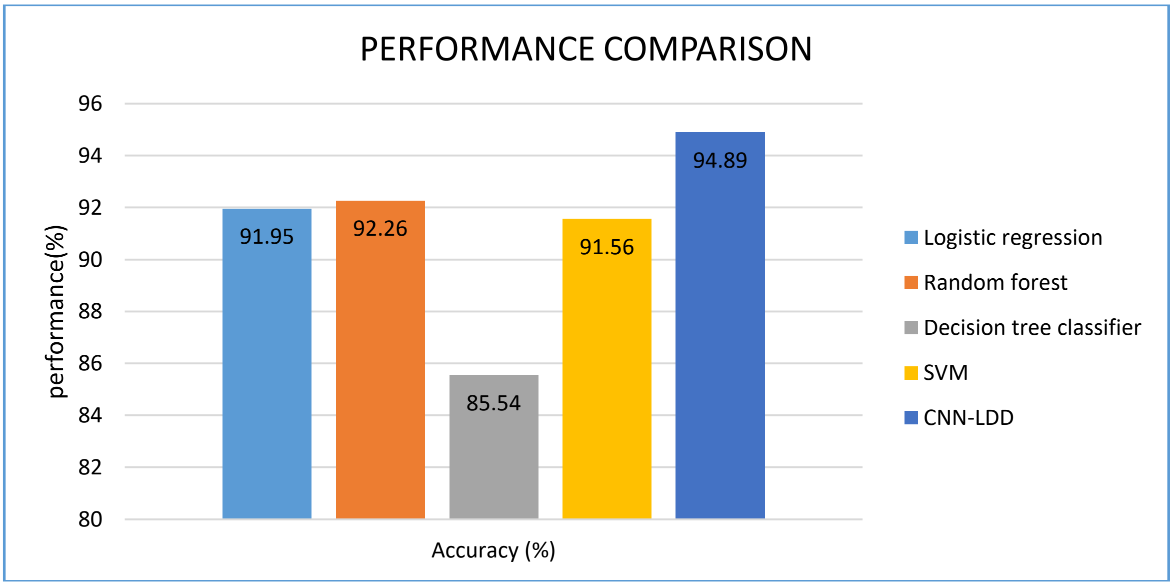


**Figure 5:** Shows performance comparison

As presented in Figure 5, the performance among different prediction models is provided. The accuracy is provided for each model. Each model has different performance in terms of accuracy. The highest performance is provided by the proposed model CNN-CDP.

## V. CONCLUSION AND FUTURE WORK

In this paper we proposed a deep learning based method known as Convolutional Neural Network based Crop Disease Prediction (CNN-CDP). It has provision for improved feature selection and performance improvement with advanced configurations. The proposed model is compared with different prediction models. The existing models Logistic regression, Random forest, Decision tree classifier and SVM. Each model has different performance in terms of accuracy. The highest performance is provided by the proposed model CNN-CDP. In future, we intend to improve the proposed system with different pre-trained deep learning models.

## REFERENCES

[1] Devi, R. Deepika; Nandhini, S. Aasha; Hemalatha, R.; Radha, S. (2019). [IEEE 2019 International Conference on Wireless Communications Signal Processing and Networking (WiSPNET) - Chennai, India (2019.3.21-2019.3.23)] 2019 International Conference on Wireless Communications Signal Processing and Networking (WiSPNET) - IoT Enabled Efficient Detection and Classification of Plant Diseases for Agricultural Applications. , p447–451.

[2] Elijah, Olakunle; Rahman, Tharek Abdul; Orikumhi, Igbafe; Leow, Chee Yen; Hindia, MHD Nour (2018). An Overview of Internet of Things (IoT) and Data Analytics in Agriculture: Benefits and Challenges. IEEE Internet of Things Journal, p1–17.

[3]Perakis, Konstantinos; Lampathaki, Fenareti; Nikas, Konstantinos; Georgiou, Yiannis; Marko, Oskar; Maselyne, Jarissa (2019). CYBELE – Fostering Precision Agriculture & Livestock Farming Through Secure Access to Large-Scale HPC Enabled Virtual Industrial Experimentation Environments Fostering Scalable Big Data Analytics. Computer Networks, p1-21.

[4] Serrano C., Jairo E.; Martínez-Santos, Juan Carlos (2018). [Communications in Computer and Information Science] Advances in Computing Volume 885 (13th Colombian Conference, CCC 2018, Cartagena, Colombia,

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September 26–28, 2018, Proceedings) ‖ Towards a Smart Farming Platform: From IoT-Based Crop Sensing to Data Analytics. , 10.1007/978-3-319-98998-3(Chapter 19), p237–251.

[5] Abdul Aziz Chaudhry;RafiaMumtaz;Syed Mohammad Hassan Zaidi;Muhammad Ali Tahir;Syed Hassan Muzammil School; (2020). Internet of Things (IoT) and Machine Learning (ML) enabled Livestock Monitoring . 2020 IEEE 17th International Conference on Smart Communities: Improving Quality of Life Using ICT, IoT and AI (HONET), p1-5.

[6] Shah, Purnima; Hiremath, Deepak; Chaudhary, Sanjay (2016). [IEEE 2016 IEEE 23rd International Conference on High Performance Computing Workshops (HiPCW) - Hyderabad, India (2016.12.19-2016.12.22)] 2016 IEEE 23rd International Conference on High Performance Computing Workshops (HiPCW) - Big Data Analytics Architecture for Agro Advisory System., p43–49.

[7] Bright Keswani, Ambarish G. Mohapatra, PoonamKeswani, Ashish Khanna, Deepak Gupta & Joel J P C Rodrigues. (2020). Improving weather dependent zone specific irrigation control scheme in IoT and big data enabled self driven precision agriculture mechanism. ENTERPRISE INFORMATION SYSTEMS., p1-23.

[8]Khattab, Ahmed; Habib, Serag E.D.; Ismail, Haythem; Zayan, Sahar; Fahmy, Yasmine; Khairy, Mohamed M. (2019). An IoT-based cognitive monitoring system for early plant disease forecast. Computers and Electronics in Agriculture, 166, p1-13.

[9]PankajTrivedi;ChakradharMattupalli;KellyeEversole;Jan E. Leach; (2021). Enabling sustainable agriculture through understanding and enhancement of microbiomes .New Phytologist, p1-19.

[10]SurenderMor;SonuMadan;KumarDharmendra Prasad; (2021). Artificial intelligence and carbon footprints: Roadmap for Indian agriculture .Strategic Change, p1-12.

[11] Woodard, Joshua D. (2016). Data Science and Management for Large Scale Empirical Applications in Agricultural and Applied Economics Research: Table 1..Applied Economic Perspectives and Policy, p1-16.

[12] Sharma, Rohit; Kamble, Sachin S.; Gunasekaran, Angappa; Kumar, Vikas; Kumar, Anil (2020). A Systematic Literature Review on Machine Learning Applications for Sustainable Agriculture Supply Chain Performance.Computers & Operations Research, p1-47.

[13] Jung, Jinha; Maeda, Murilo; Chang, Anjin; Bhandari, Mahendra; Ashapure, Akash; Landivar-Bowles, Juan (2021). The potential of remote sensing and artificial intelligence as tools to improve the resilience of agriculture production systems.Current Opinion in Biotechnology, 70, p15–22.

[14]Ojha, Tamoghna; Misra, Sudip; Raghuwanshi, Narendra Singh (2015). Wireless sensor networks for agriculture: The state-of-the-art in practice and future challenges. Computers and Electronics in Agriculture, 118, p66–84.

[15] Lew, Tedrick Thomas Salim; Sarojam, Rajani; Jang, In-Cheol; Park, Bong Soo; Naqvi, Naweed I.; Wong, Min Hao; Singh, Gajendra P.; Ram, Rajeev J.; Shoseyov, Oded; Saito, Kazuki; Chua, Nam-Hai; Strano, Michael S. (2020). Species-independent analytical tools for next-generation agriculture. Nature Plants,p1-10.

[16] Kim, Sehan; Lee, Meonghun; Shin, Changsun (2018). IoT-Based Strawberry Disease Prediction System for Smart Farming.Sensors, 18(11), p1-17.

[17]Mahlein, Anne-Katrin (2016). Plant Disease Detection by Imaging Sensors – Parallels and Specific Demands for Precision Agriculture and Plant Phenotyping. Plant Disease, 100(2), 241–251.

[18]Morais, Raul; Silva, Nuno; Mendes, Jorge; Adão, Telmo; Pádua, Luís; López-Riquelme, J.A.; Pavón-Pulido, N.; Sousa, JoaquimJoão; Peres, Emanuel (2019). mySense: A comprehensive data management environment to improve precision agriculture practices. Computers and Electronics in Agriculture, 162, p882–894.

[19]GayathriNagasubramanian;Rakesh Kumar Sakthivel;RizwanPatan;MuthuramalingamSankayya;MahmoudDaneshmand;Amir H. Gandomi; (2021). Ensemble Classification and IoT-Based Pattern Recognition for Crop Disease Monitoring System.IEEE Internet of Things Journal, p1-8.

[20] Yang, Jiachen; Wang, Chenguang; Jiang, Bin; Song, Houbing; Meng, Qinggang (2020). Visual Perception Enabled Industry Intelligence: State of the Art, Challenges and Prospects. IEEE Transactions on Industrial Informatics, p1–16.



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