e-ISSN 2320 –7876 www.ijfans.org
Vol.11, S Iss 1, 2022

UGC CARE Listed (Group -I) Journal

Implementing Smart Agriculture with IoT and Monitoring Plant Diseases with Regression Analysis

Nallusamy R[1*], Mohd. Shaikhul Ashraf[2], Ashok Kumar Koshariya[3], K.Harish[4], S. Asif Alisha[5], N. Lenin Rakesh[6], D R K Saikanth[7]

[1]Department of Computer Science and Engineering, Muthayammal College of Engineering, Rasipuram, Namakkal, Tamil Nadu, India

[2]Department of Botany, HKM Govt. Degree College Bandipora, Bandipora, Kashmir, (UT of Jammu and Kashmir), India

[3]Department of Plant Pathology, School of Agriculture, Lovely Professional University, Jalandhar, Punjab, India

[4]Department of Civil Engineering, Vinayaka Mission's Kirupananda Variyar Engineering College, Vinayaka Mission's Research Foundation (Deemed To Be University), Salem, Tamil Nadu, India.

[5]Department of Mathematical Sciences, Sree Vidyanikethan Degree College, Tirupati, Andhra Pradesh, India

[6]Department of Mechanical Engineering, Bharath Institute of Higher Education and Research, Chennai, Tamil Nadu, India.

[7]Department of Agricultural Extension, College of Agriculture, Rajendranagar, Hyderabad, India

***Corresponding mail** id: nallsam@rediffmail.com

ABSTRACT

Robots, automation, the Internet of Things (IoT), and its application based on precision agriculture are essential to reduce the burden of peoples in farming. Making this method more effective depends on the addition of machine learning-based leaf disease detection. The farmer may end up saving time and effort, increasing output, and increasing efficiency as a consequence. The usage of multiple electronic sensors and cloud-based services in agriculture may also help with quick processing and accurate measurement of any parameter. A prototype agricultural rover with ploughing, seeding, and separate autonomous irrigation and fertilizer sprinkling systems was developed to ensure appropriate farming. The rover is managed by a smartphone using a Wi-Fi module. The automated irrigation and fertilizer dispensing systems include characteristics that may be shown on an OLED display and a cloud-based IoT analytics service called thing talk. Machine learning-based logistic regression is used with a number of adjustments to improve the accuracy of the diagnosis of leaf disease.

e-ISSN 2320 –7876 www.ijfans.org
Vol.11, S Iss 1, 2022
 UGC CARE Listed (Group -I) Journal

Keywords: Plant disease, Smart irrigation, Logistic regression, IoT

1. Introduction

An autonomous farm robot prototype is shown. This robot is meant to do a variety of agricultural tasks such as planting, ploughing, fertiliser spraying, modifying watering schedules based on atmospheric conditions, and diagnosing possible plant issues [1]. Depending on the crop, it allows for successful seed planting at optimal depths and distances between crops and rows [2].

The Internet of Things (IoT) is used to monitor agricultural field metrics such as soil moisture, temperature, relative humidity, and light intensity, and the data is saved in the cloud for later access. Logistic regression is the most effective approach for testing a hypothesis on a dataset [3], [4]. Different leaf kinds need different ML approaches based on their physical features. In contrast to grayscale image segmentation, the CNN approach detects leaf disease using color-based properties [5]. The utility of identifying plant illnesses is being investigated. The status of automated and semi-automatic technologies is investigated. An introduction to optimization and an explanation of the gradient descent method behaves after numerous rounds [6].

The soil moisture, humidity, and temperature sensors will record information on the ambient temperature, relative humidity, and amount of wetness [7]. The sensor data may be sent to a cloud-based service called Thing Talk since the NodeMCU modules are Wi-Fi capable. By attaching an OLED to the NodeMCU, we can display this data, and we can get pertinent graphs from the website Thing Talk. The crop's need for water is determined by the humidity and moisture content of the air [8]. Similar systems are used for fertiliser application, where the crop's needs decide the amount of fertiliser to apply, which is subsequently applied using a DC motor pump [9].

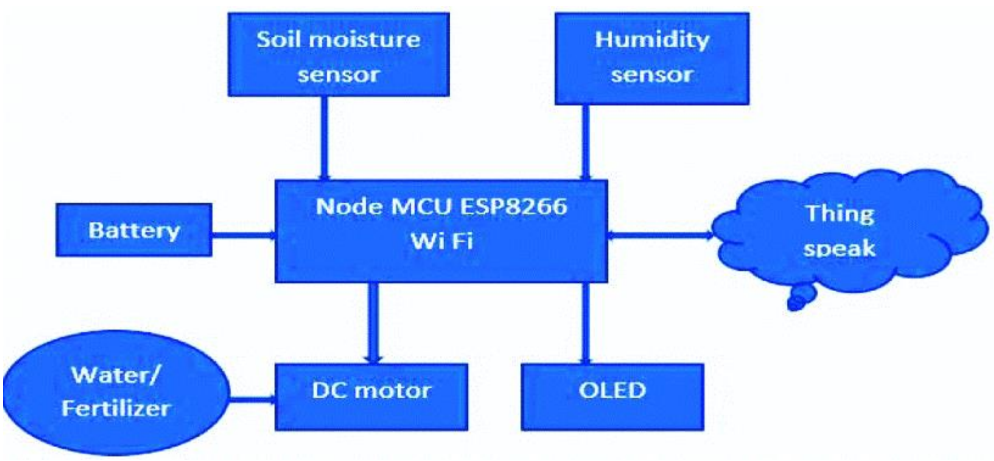

Fig. 1. Layout of irrigation system

 ,

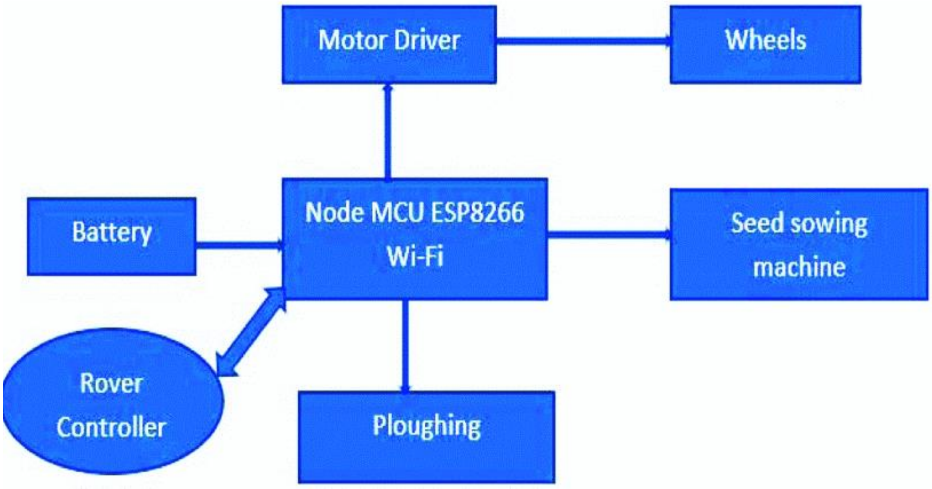

Fig. 2 Seed sowing layout diagram

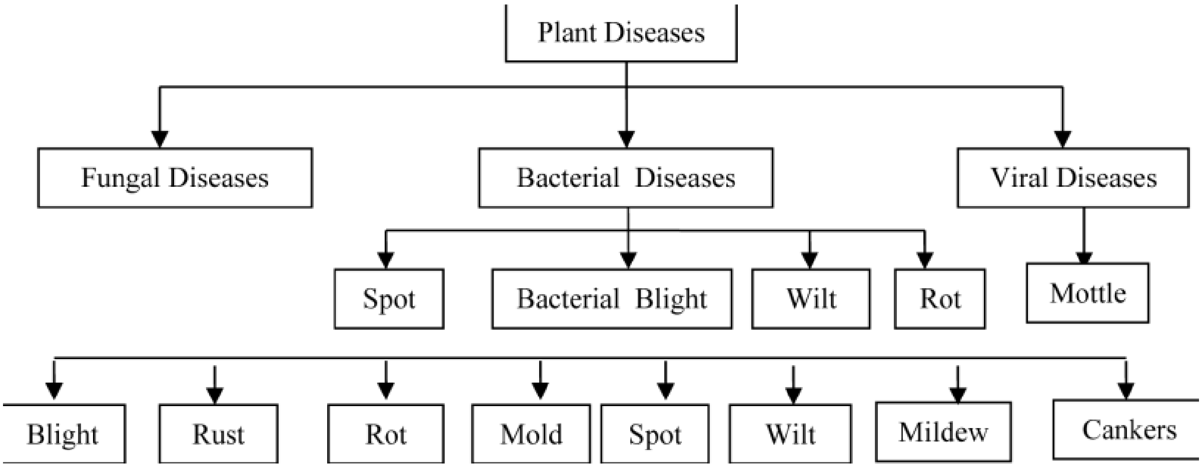

Fig. 3. Various plant diseases

The Node-MCU microcontroller simplifies data transfer via Wi-Fi. The rover is controlled using an Android smartphone. A piece of software is installed on the controller end. The smartphone comes with a pre-built Android application. This app has just a few buttons and a slider.

2. Disease detection system

Predicting plant illnesses during crop harvest is one of the most difficult undertakings since plants must be closely monitored from the start of cultivation. As a result, an automated illness detection system is required. Data mining and image processing methods might be used to create these systems. Machine learning makes it simple to classify big datasets. This critical task necessitates the employment of an accurate and efficient algorithm. The logistic regression, which we used in our work, is one of these developing classifiers. Plant leaf diseases are classified into three types based on the fungus, bacteria, and viruses that cause them. One of the study's features is testing the leaf to see whether it has a bacterial illness, namely the king Bacterial spot. Bacterial spots that develop patches on the leaves and fruits cause defoliation, sun-scalded fruit, and product loss.

To best capture the item feature of interest—in this example, a peach leaf—in a photograph, we may adjust the lighting system, choose the optimal wavelength range, and a variety of other parameters. Pre-processing is the operation of pictures at the most basic levels of abstraction, where both the input and output of images are based on intensities. Picture feature extraction divides features into two types dependent on the kind of image used: color-based features and texture-based features.

The features are initially sent into the logistic regression classifier, which then processes them after scaling them. We can then establish whether or not the leaf image has an illness based on the output of the system model.

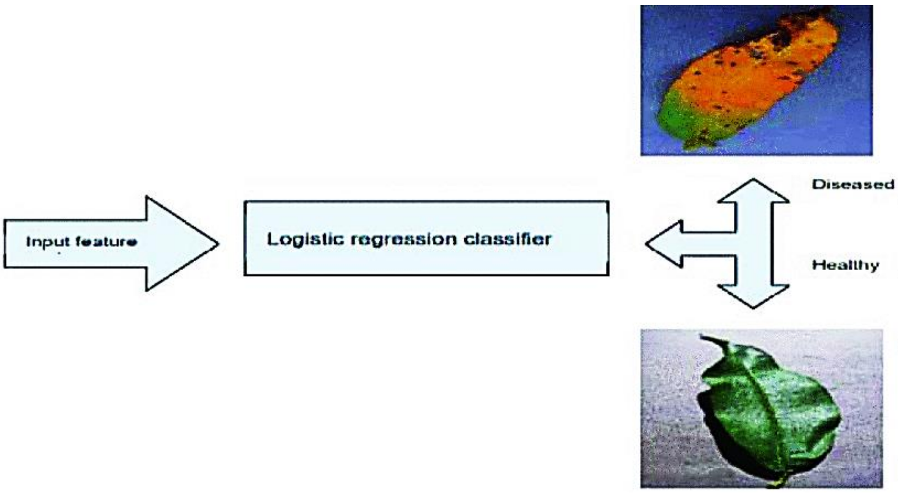

Fig. 4. Block diagram of regression analysis

A gradient is a vector-valued function derivative that represents the slope of a function's tangent. Gradient Descent is named for the fact that we begin at the needed point and advance in the opposite direction of the gradient of the specified function until we achieve the local minimum. The size of the step taken at each iteration is determined by the learning rate. It is picked at random. A low learning rate may entirely miss the minimum, but a respectable learning rate may take a long time to reach it. The epoch represents the number of rounds performed by the algorithm throughout the whole training dataset. The epoch and learning rate settings determine how many iterations are executed in total by the algorithm.

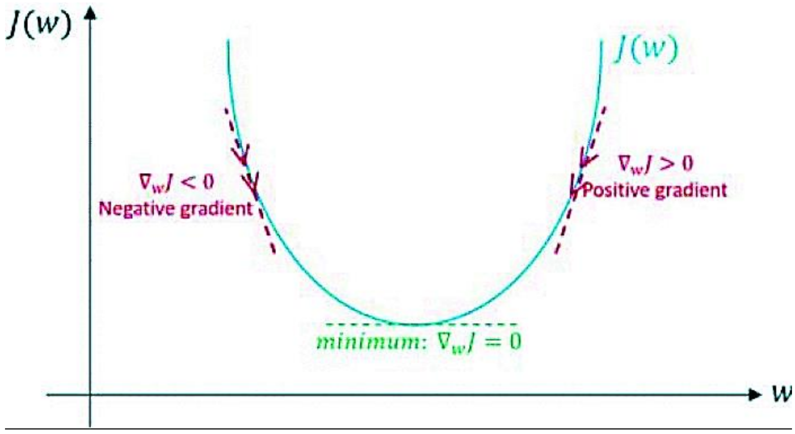

Fig. 5 Gradient algorithm graph

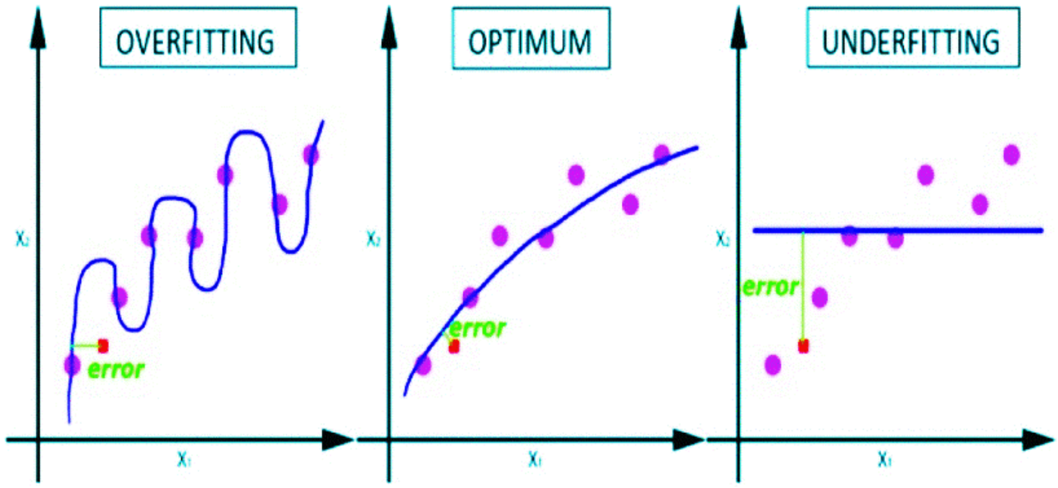

Fig. 6. Information of optimization

The size of the step taken at each iteration is determined by the learning rate. It is picked at random. A low learning rate may entirely miss the minimum, but a respectable learning rate may take a long time to reach it. The epoch represents the number of rounds performed by the algorithm throughout the whole training dataset. The epoch and learning rate settings determine how many iterations are executed in total by the algorithm. Chatbots are becoming more popular since they can automate a wide range of tasks. Bots are external programs that run on certain Telegram accounts. Sending it a query enables interaction as shown in figure 7. An automated irrigation and fertiliser sprinkling prototype is achieved using a node MCU, DC motor, and soil moisture sensor, as shown in Fig. 7.

 ,

Fig. 7 Chat box, irrigation system and robot

Fig. 8 Display of field data

Figure 8a depicts a device that gathers temperature, humidity, and soil moisture data from a location before transferring it to the thing speak cloud platform and presenting the results on an OLED. To help in planting and ploughing, a prototype agricultural rover that can be controlled by an Android smartphone was constructed. The basic seed sowing model and the ploughing framework are installed and linked as required on the rover. The original features of a picture are restored when it is transformed to grayscale, red, green, and blue channels, as seen in Fig. 14. Using the same preprocessing procedures on a series of photos, the dataset collected and represented in Fig. 10 is then assessed as being in excellent or poor health.

The dataset was normalised using Sklearn functions, and logistic regression was trained using the built-in Sklearn classifier, gradient descent, and Adam algorithms, as shown in Fig. 9. The project has grown to include the development of a Telegram chatbot that uses the combined Adam, Sklearn, and gradient descent algorithms to transmit photos to the cloud for feature extraction and sickness prediction. As a consequence, the chatbot gets the expected value.

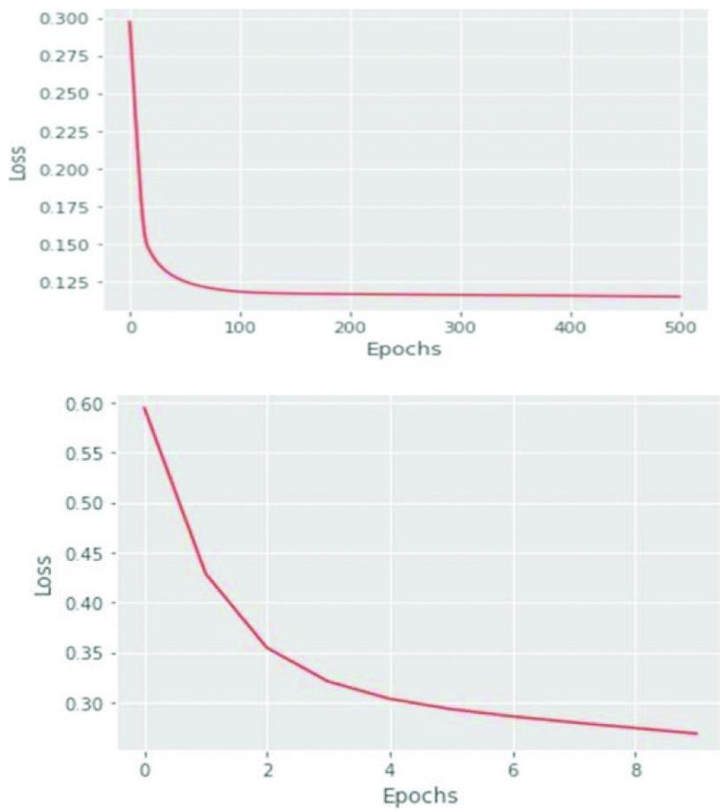

Fig. 9 Gradient and adam algorithm output plot

Fig. 10 Diseased Leaf

Conclusion

To guarantee suitable farming, a prototype agricultural rover with ploughing, sowing, and separate autonomous watering and fertiliser sprinkling systems was built. A smartphone controls the rover using a Wi-Fi module. The automated irrigation and fertiliser distribution systems contain characteristics that may be shown on an OLED display as well as thing speak, a cloud-based IoT analytics service. To increase the accuracy of the diagnosis of leaf disease, machine learning-based logistic regression is utilized with a variety of tweaks. India is dealing with a variety of issues, including a labor shortage, a lack of staff, and farmer suicides. The use of Agri robots in farming may minimize labor demand while increasing the use of water and fertilizers.

References

[1] R. Concepcion, S. Lauguico, E. Dadios, A. Bandala, E. Sybingco, and J. Alejandrino, “Tomato septoria leaf spot necrotic and chlorotic regions computational assessment using artificial bee colony-optimized leaf disease index,” *IEEE Region 10 Annual International Conference, Proceedings/TENCON*, vol. 2020-November, pp. 1243–1248, 2020, doi: 10.1109/TENCON50793.2020.9293743.

[2] N. Sajitha, S. Nema, K. R. Bhavya, P. Seethapathy, and K. Pant, “The Plant Disease Detection Using CNN and Deep Learning Techniques Merged with the Concepts of Machine Learning,” *2022 2nd International Conference on Advance Computing and Innovative Technologies in Engineering, ICACITE 2022*, pp. 1547–1551, 2022, doi: 10.1109/ICACITE53722.2022.9823921.

[3] V. Janani and N. M. S. Mangai, “Analysis and Classification of Rhizome rot Disease for Turmeric Plant using Artificial Intelligence,” *International Conference on Sustainable Computing and Data Communication Systems, ICSCDS 2022 - Proceedings*, pp. 411–414, 2022, doi: 10.1109/ICSCDS53736.2022.9760884.

[4] D. Ashourloo, H. Aghighi, A. A. Matkan, M. R. Mobasheri, and A. M. Rad, “An

Investigation Into Machine Learning Regression Techniques for the Leaf Rust Disease Detection Using Hyperspectral Measurement," *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, vol. 9, no. 9, pp. 4344–4351, 2016, doi: 10.1109/JSTARS.2016.2575360.

[5] R. Qasrawi, M. Amro, R. Zaghal, M. Sawafteh, and S. V. Polo, "Machine Learning Techniques for Tomato Plant Diseases Clustering, Prediction and Classification," *Proceedings - 2021 International Conference on Promising Electronic Technologies, ICPET 2021*, pp. 40–45, 2021, doi: 10.1109/ICPET53277.2021.00014.

[6] Z. Liu, R. N. Bashir, S. Iqbal, M. M. A. Shahid, M. Tausif, and Q. Umer, "Internet of Things (IoT) and Machine Learning Model of Plant Disease Prediction-Blister Blight for Tea Plant," *IEEE Access*, vol. 10, pp. 44934–44944, 2022, doi: 10.1109/ACCESS.2022.3169147.

[7] H. Wang, G. Li, Z. Ma, and X. Li, "Image recognition of plant diseases based on backpropagation networks," *2012 5th International Congress on Image and Signal Processing, CISP 2012*, no. Icnc, pp. 894–900, 2012, doi: 10.1109/CISP.2012.6469998.

[8] V. K. Vishnoi, K. Kumar, and B. Kumar, "Crop Disease Classification Through Image Processing and Machine Learning Techniques Using Leaf Images," *Proceedings of the 1st International Conference on Advances in Computing and Future Communication Technologies, ICACFCT 2021*, pp. 27–32, 2021, doi: 10.1109/ICACFCT53978.2021.9837353.

[9] F. A. Tsaqib Marwan and D. Rimantho, "Applying Image Classification for Detect Leaf Disease: Case Study for Porang Plant," *9th International Conference on ICT for Smart Society: Recover Together, Recover Stronger and Smarter Smartization, Governance and Collaboration, ICISS 2022 - Proceeding*, 2022, doi: 10.1109/ICISS55894.2022.9915203.