iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 Issue: IV Month of publication: April 2023

DOI: https://doi.org/10.22214/ijraset.2023.50689

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue IV Apr 2023- Available at www.ijraset.com

# Plant Nutrient Deficiency Detection by using AI

Namrata Baraskar[1], Sakshi Tekade[2], Tanvi Akarte[3], Sakshi Hadole[4], Shreya Pusadkar[5], Prof. S. W. Wasankar[6], Dr. A. A. Khodaskar[7]
*Sant Gadge Baba Amravati University*
*Sipna College of Engineering And Technology Amravati-444601*
*Department Of Computer Science And Engineering*

***Abstract: The Indian economy heavily relies on agriculture, which involves the cultivation of various plants for food and other products, as well as the raising of domesticated animals. Nutrients are crucial for agriculture and crop production, and nutrient deficiency is one of the many factors that can cause a decrease in crop yield.***

***Detecting nutrient deficiency and determining theappropriate fertilizer to address it is a major challenge faced by farmers. To enhance productivity, agricultural automation has made significant advancements in recent years. One such automated technique is the use of Convolutional Neural Networks (CNN) to process captured images of crops. By comparing these images to an existing dataset, the CNN can identify nutrient deficiencies in crops and indicate the percentage of deficiency. The LCD display will show the name of the disease associated with the nutrient deficiency and the appropriate amount of fertilizer required. This technology can alleviate the burden of manual nutrient deficiency detection faced by farmers and can help optimize fertilizer use to enhance crop yield.***

## I. INTRODUCTION

Technologies have a crucial role to play in all sectors, particularly in developing countries. In the developing world, agriculture is a vital sector as human survival depends on it.

However, many farmers still use traditional methods in their agricultural practices. Identifying nutrient deficiencies in crops using ancient methods can be time-consuming, labor-intensive, and costly. Moreover, incorrect identification can lead to loss of crop yield, time, and money. Therefore, itis essential to leverage modern technologies to identify nutrient deficiencies accurately and efficiently in crops.

Nutrient deficiencies in crops are typically identified through agricultural laboratories or experienced individuals such as farmers. However, manually predicting nutrient deficiencies can be prone to errors due to environmental conditions. Deficiencies can appear in various parts of the plant, such as the leaves, stem, flowers, or fruits. Leaves are commonly used to identify nutrient deficiencies in crops.

A plant requires approximately twelve nutrients for efficient growth, including Nitrogen, Phosphorus, Potassium, Magnesium, Sulfur, Molybdenum, Zinc, Boron, Copper, Calcium, Iron, and Chloride, which can be classified into micronutrients and macronutrients. Micronutrients include Molybdenum, Zinc, Boron, Chloride, Copper, and Iron, while macronutrients include Nitrogen, Phosphorus, and Potassium.

Deficiencies in these nutrients can cause various diseases in crops, ultimately affecting the yield rate. Symptoms of nutrient deficiencies are typically observed in the leaves, such as a reduction in leaf size, distorted edges, necrosis, black spots, and other abnormalities.

To identify the appropriatenutrient deficiencies, farmers typically need to uproot the entire plant and test the affected plant in the corresponding laboratory.

### *A. Components Of Nutrient Deficiency Diagnostic System*

The proposed diagnostic system for identifying nutrient deficiencies in crops using imageprocessing techniques would consist of the following components:

1) Measuring the leaf area
2) Segmenting the edges and veins of the leaf
3) Determining the shape of the leaf
4) Extracting color features of the leaf.

 

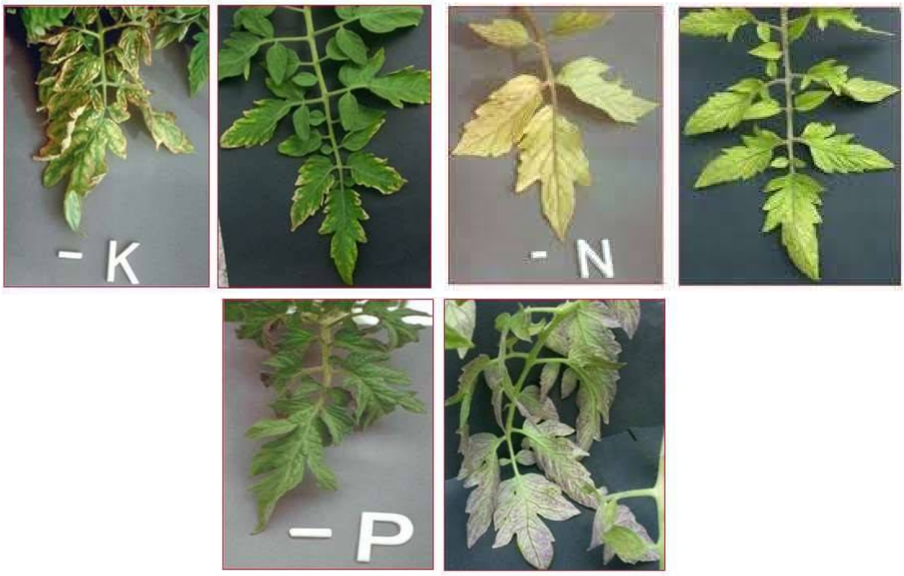


Fig.1. Visual symptoms shown on Plant/Crop Leaves for various mineral deficiencies

## II. LITERATURE SURVEY

Extensive research has been conducted to identify nutrient deficiencies in plants, witha particular focus on using leaves as indicators

1) A study by Pavit Noinongyao, Chaiwat Wattanapaiboonsuk, Puriwat Khantiviriya, and Sutsawat Duangsrisai titled "Identification of Plant Nutrient Deficiencies Using Convolutional Neural Networks" presented an image analysis method for identifying nutrient deficiencies in black gram plants (Vigna mungo) based on their leaves, using Convolutional Neural Networks. The authors studied five types of nutrient deficiencies (Ca, Fe, K, Mg, and N) and a group of healthy plants, collecting a dataset of 3,000 leaf images for experimentation. The results indicate that the proposed method outperforms trained humans in identifying nutrient deficiencies.
2) The study titled "Identification Of Maize Leaf Diseases Using Improved Deep Convolutional Neural Networks" was conducted by Xihai Zhang, Yue Qiao, Fanfeng Meng, Chengguo Fan, and Mingming Zhang. The report proposed an improved method for accuratelyidentifying maize leaf diseases using deep convolutional neural networks. To achieve this, the researchers introduced modifications to the GoogLeNet and Cifar10 models, which resulted ina reduction in the number of network parameters.
3) Amrutha A, Lekha R, and Sreedevi A proposed a research project called "Automatic Soil Nutrient Detection and Fertilizer Dispensary System" that aims to restore the levels of Nitrogen, phosphorous, and potassium in soil by measuring the nutrients present in it. Chemical processes are used to determine the presence of nutrients and sensors are used to quantify them. An automated system has been developed for controlled addition of fertilizers to avoid over- or under-fertilization of soil. The system works in three steps: Soil sample preparation, estimation of nutrient levels, and dispensing the estimated amount of fertilizers to the soil. The proposed system can provide results within 30 minutes. The soil test results are given to sensors, and the microcontroller analyzes the results in just a few seconds. The entire process of soil testing and fertilization can be completed in a maximum of 30-40 minutes, afterwhich the field can be fertilized.
4) The authors of "Plant Disease Diagnostic Capabilities and Networks," S. A. Miller, F. D. Beed, and C. L. Harmon, aimed to improve the accuracy and speed of disease diagnostics and pathogen detection in their publication in the Annual Review of Pathology. The challenge of safeguarding plant health worldwide is heightened by emerging, re-emerging, and endemic plant pathogens. Factors such as globalization, weather changes, human mobility demands, pathogen and vector evolution contribute to the increased spread of invasive plant pathogens. Accurate diagnoses and pathogen surveillance on local, regional, and global scales are crucial to predicting outbreaks and allowing time for the development and application of mitigation strategies. Plant disease diagnostic networks have been developed worldwide to address these problems and facilitate efficient and effective disease diagnosis and pathogen detection, encouraging cooperation between institutions.

5) Sridevy and Vijendran developed an expert system that uses image processing techniques to detect nutrient deficiency in maize plants. They converted RGB images into HSV color space and extracted the infected regions of the leaf by masking green colored pixels using the Otsu method. They adjusted the contrast of the image using Histogram Equalization and extracted Eigen matrices using Independent Component Analysis. They also extracted Energy and Entropy features from the leaf image. They used Multivariate Image Analysis and Multivariate Partial Least Square methods for classifying the type of nutrient deficiency in maize leaves.

## III. PROPOSED SYSTEM

The system generates the output in terms of the name of the nutrient deficiency along with the percentage and the required amount of fertilizer. The extracted features from the image are compared with the trained dataset to determine if the plant is healthy or nutrient deficient. If the test image is identified as nutrient deficient, the system provides the output of the nutrient deficiency name along with the corresponding fertilizer amount. The proposed system's flow diagram is shown in Figure 2.

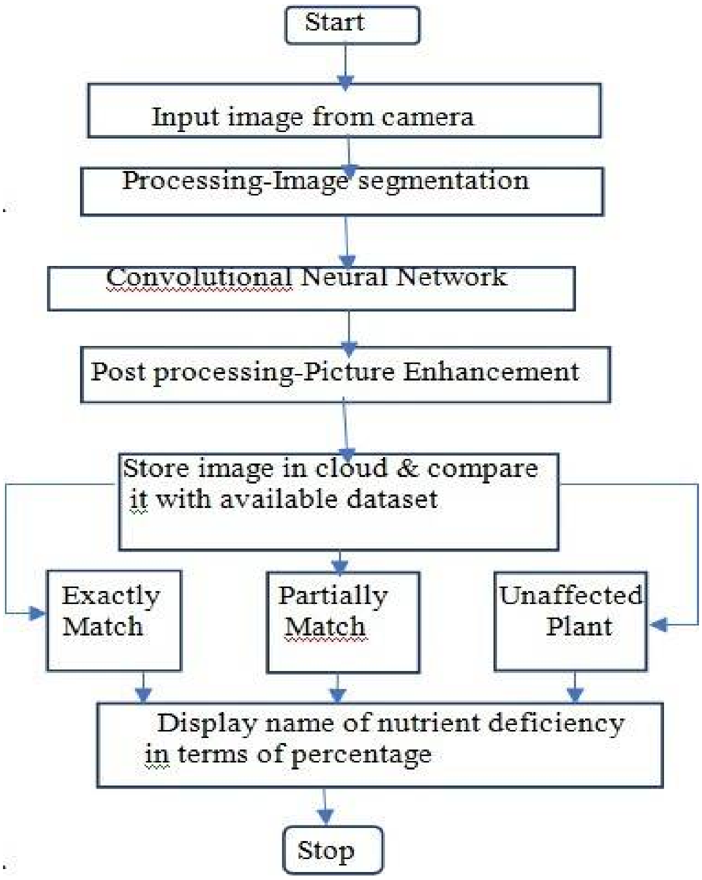


Fig. 2.: Flow diagram of the submitted system

## IV. METHODOLOGIES

The methodologies used for the final result of nutrientdeficiency in the crops are:
1) Image Pre-processing.
2) Image segmentation.
3) Convolutional Neural Networks.
4) Post processing-Image enhancement.
5) Matching techniques.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue IV Apr 2023- Available at www.ijraset.com

The most significant aspect of an image is its features, such as edges, corners, ridges, and blobs, which are used to differentiate images. The features are extracted from images in thetrained dataset to identify threshold values for various nutrient deficiencies. Once the features are detected, a feature descriptor can be extracted by taking a local image patch around the feature. Feature extraction is performed by measuring values and building derived values to be informative.

The learning of features can be supervised or unsupervised. The supervised method involves learning features from labeled data and enables the system to compute the error degree to fail and use it as feedback to correct the learning process, with neural networks beinga good example. The unsupervised method involves learning features from unlabelled data, which helps identify the low-dimensional structures underlying high-dimensional structures, with K-means clustering being an example of this approach.

## V. IMAGE DATASET

The images for training the model are collected from various plant over different places. The collected leaf images are divided into two sets: Test and train dataset. The trained dataset contains the images collected over all areas. These images include healthy and nutrient deficiency leaves. The images of deficiency of three nutrients along with the healthy leaf images are trained to the model. The test dataset contains the input images, which are captured by the camera of the mobile. These input images are then compared with the testing image and gives the result in terms percentage of the deficiency.

## VI. EXPERIMENTAL RESULTS

The system which gives the result based on the images captured by the camera. The boundary, corner, edges and contour can be detected for various images and predicted whetherthe captured image is healthy or deficient.

If it is a deficient one, then the major nutrient deficiency is determined and will be displayed in the displayof the system.

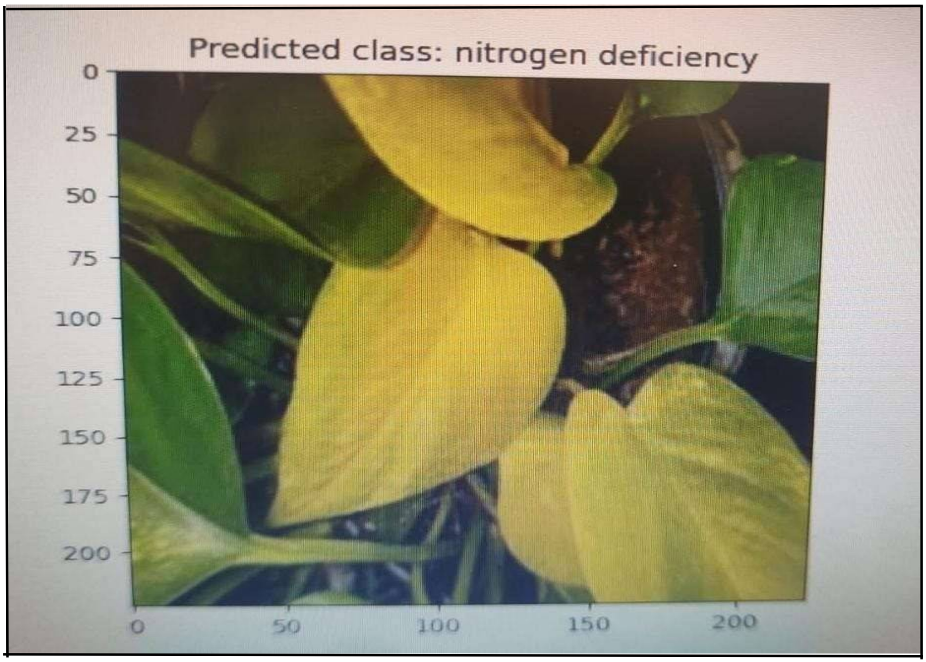


Fig.3: Nutrient Deficiency in money Plant

## VII. CONCLUSION & FUTURE WORK

The system uses a convolutional neural network algorithm to identify nutrient deficiencies, and the results are displayed within the system. Future work involves thedevelopment of an automatic fertilizer dressing mechanism for the field. Various sensors such as soil moisture, humidity, temperature, and pH are used to determine the amount of fertilizer needed. The system can automatically apply fertilizer using a sprinkling mechanism, and the fertilizer tank can also be used for irrigation. Additionally, a weed remover can be attached to the system for weed removal, which can be adjusted or replaced with a driller for drilling or a cutter for harvesting. This integration of agricultural work intoa single system is a promising development.

## REFERENCES

[1] Pavit Noinongyao, Chaiwat Wattanapaiboonsuk, Puriwat Khantiviriya, "Identification ofPlant Nutrient Deficiencies Using Convolutional Neural Networks" IEEE Conference paper, Apr. 2018.
[2] Xihai Zhang, Yue Qiao, Fanfeng Meng, Chengguo Fan, Mingming Zhang, "Identification of Maize Leaf Diseases Using Improved Deep Convolutional Neural Networks", IEEE journal, volume 6,2018.
[3] Amrutha A, Lekha R, Sreedevi A "Automatic Soil Nutrient Detection and Fertilizer Dispensary System", International Conference on Robotics: Current Trends and Future Challenges (RCTFC), 2016.
[4] S. A. Miller, F. D. Beed, C. L. Harmon "Plant Disease Diagnostic Capabilities and Networks", Ohio Stae university, 2017.
[5] S. Sridevy and Anna Saro Vijendran, "An Evolving Expert System for Maize Plant Nutrient Deficiency using Image Processing Techniques", International Journal of Science and Research, Vol. 5, No. 2, pp. 70-77, 2016.
[6] Sivagami S, Mohanapriya S, "Automatic Detection of Tomato Leaf Deficiency and its Result of Disease Occurrence through Image Processing", International Journal of Innovative Technology and Exploring Engineering (IJITEE), ISSN: 2278-3075, Volume-8 Issue- 11, September 2019.