Monitoring Nutritional Deficiencies In Plants Using IoT

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Abstract- *The term "nutrition" refers to a soil's ingrain capability to give nutrients to shops in sufficient amounts and in the right proportions. The term" nutrition" refers to the series of connected processes through which a living thing assimilates food and utilises it for towel form and growth. In the history, soil fertility or how important fertiliser should be put to raise the quantum of mineral factors in the soil was considered of as a factor in factory development. A deeper knowledge of factory nutrition has redounded from the use of soilless composites, bettered study of nutrient societies and hydroponics, advancements in factory towel analysis, and operation of soil composites. This commerce comprises a complicated balance of mineral rudiments that are necessary and profitable for the stylish possible factory development.*

Keywords- Nutrition level of plant, leaf colour, monitoring soil, internet of things, convolutional neural network, agriculture, save time and labor, k-nearest neighbors.

I. INTRODUCTION

The "Internet of things" (IoT) is a phrase used to describe physical objects that are outfitted with sensors, processing power, software, and other technologies that may exchange data with one another through the Internet or other communications networks. Since devices only need to be individually accessible and connected to a network, not the public internet, the phrase "internet of things" has drawn criticism. The term "Internet of things" (IoT) refers to physical items equipped with sensors, computing power, software, and other technologies that communicate with one another and exchange data through the Internet or other communications networks. The term "internet of things" has been criticised since gadgets only need to be individually accessible and connected to a network, not the public internet.

II. LITERATURE REVIEW

Plant Leaf disease classification is an important task in the agriculture industries. In recent years, the use of IoT sensors are highly enhanced, particularly k-nearest neighbor and convolutional neural network has gained popularity for leaf disease classification due to their ability to automatically result out the raw data .

A study by Prathamesh Kiran Pawar in irjet article(2022)proposed a “Plant Monitoring System” based on IoT which employs the NodeMCU microcontroller. NodeMCU has an integrated ESP8266 WiFi module that uses WiFi to link our system to the Blynk app. The Arduino IDE, an environment that connects code with the hardware, is used to feed the microcontroller with the programme that governs how the entire system functions. The Virtual LCD widget on the Blynk app uses a soil moisture sensor to continually measure the amount of moisture in the soil and show it.

Similarly, in a study by Mohammed Rashiq, Jagan G Mohan, Muhammed Javith, Divya, and Sivamani,In irjet article “Smart plant monitoring system” (2021),theproposed system is for temperature and humidity, a DHT11 sensor, a soil moisture sensor, and a relay circuit to operate the water pump are utilised. The DHT11 and MCU sensor are synchronised using a single bus data format. A single transmission takes roughly 4 milliseconds. Decimal and integral components make up data. A 32-bit full data transmission is sent, with the higher data bit sent first by the sensor. 8-bit integral humidity data, 8-bit decimal humidity data, 8-bit temperature data, and an 8-bit check sum (error bits) make up the data format. The last 8 bits of "8bit integral humidity data + 8bit decimal humidity data + 8bit integral temperature data + 8-bit decimal temperature data" should be the check-sum if the data transfer was successful. These sensors are all connected to an ESP8266 open source Node-MCU which will serving as a microcontroller.

In another study, A.Pravin, T.Prem Jacob and P.Asha,In ijas article (2018) “Enhancement of Plant Monitoring Using IoT” proposed system are many types of sensors that can be employed include temperature, light, and soil monitoring sensors. Different sensors for information gathering The soil monitor sensor may be used to measure the water content in the soil, KNN classification is used to image classification the temperature sensor will provide information about the current temperature, and the light sensor will measure the intensity of the field light. The sensors get the initial data from the agricultural field.

Nivesh Patil, Shubham Patil, Animesh Uttekar, A.R Suryawanshi, In ijas article "Monitoring of hydrophonics system using IoT technology" (2022) The controlling of whole system is automated using NodeMCU (Controller) and IoT. In the event that an internet connection is not available, manual control options are available via a mobile app and LAN connection. The nutrients are combined with the water in the dispenser. The water containing nutrients is passed to the pipes with help of submersible pumps.

Gerald K. Ijemaru, Augustine O. Nwajana, Emmanuel U. Oleka, In beei article "Image processing system using MATLAB-based analytics" (2021) A digital camera or a preloaded picture from a memory source is often used for the suggested image capture in the image processing activity. Image augmentation or the erasure of certain functional data from an image are two examples of operations that may be performed on a picture using an image processing approach. Signal processing techniques are used in image processing to improve the quality and extract relevant information from the incoming picture data.

Overall, these studies show that CNN-based approaches can achieve high accuracy on making analysis and **[2]** KNN is sensitive to distance meter in image classification, IoT sensors are used for the process to monitor the soil humidity, temperature and moisture.

III. EXISTING SYSTEM

There are significant shortcomings with the present approaches for classifying leaf diseases. One such way is manual inspection by people, which is labour time-intensive and raises the cost of production for farmers and producers. Additionally, this approach is susceptible to mistakes, creating a high risk of misclassifying the plant nutrition level.

An internet connection through a wireless access point, a service system platform, an IoT-based chlorophyll metre, and a smart device for remote monitoring make up the components of the IoT-based service system platform architecture. Additionally. using only basic algorithm like CNN it not be sufficient to capture the complexity and diversity of leaf characteristics, leading to lower accuracy in classification.

Finally, systems that require high-end hardware sensor or chlorophyll meter may not be practical or affordable for small farmers or producers, further limiting the availability and adoption of such systems.

IV. PROPOSED SYSTEM

In this paper, we propose a custom KNN model for leaf disease in mat-lab quality assessment and classification. The leaf in the dataset are the first segmented and labeled as healthy, unhealthy, or bacterial affect. The dataset is then split into various bactorial defect sets: a training set, a validation set, and a testing set, sourced from various resources. The proposed model uses color, and leaf colour to extract features and classify plant disease.

The research methodology comprises five main components: image input, preprocessing, segmentation, feature extraction, and classification. Experimental findings suggest that the proposed model accurately classifies leaf species, reducing the need for manual classification labor. The proposed model has IoT monitoring sensors such the way temperature, humidity and moisture are the potential to enhance the use of digital horticulture resources for farming, improving farm sustainability by reducing labor costs and increasing productivity.

V. DATA COLLECTION

When gathering data, it's crucial to make sure it's objective and that there's enough of it to reliably forecast how well the system will function. Algorithms are typically more accurate when there is more data available. Insufficient training data for the suggested system might prevent it from supporting the requisite model complexity to address the issue. The accuracy and prediction power of machine learning models can be decreased by improper data collecting. A total of 100 photos, 80 of each healthy, ill, and defective leaf, were utilised in this investigation to classify the leaves. The choice of the implemented network and model training methodologies was impacted by the comparatively modest dataset size. A training set with 70% of the data was created from the dataset.

VI. DATA PREPROCESSING

(126 images), a validation set consisting of 15% of the data (27 images), and a testing set consisting of 15% of the data (27 images).

Figure1: Data set

LEAF CLASSIFICATION WITH KNN AND K MEANS CLUSTERING

The first approach was to create and train a custom from scratch KNN. Multiple combinations have been tried, in order to achieve the highest possible accuracy, while reducing the loss.

The final configuration of the network consists of:

- 4 layers
- HSV: classification layers with 0.02, 0.06, 0.1 filters, respectively.
- Sensor value: Max temperature seen in display (25-100).
- Moisture: A layer that cool or hot shows the output of the soil value (0-100).
- Humidity: DHT11 sensor which shows specific value 0.5, 0.3, and 0.2, respectively.
- Activation: Leaf Disease Classification on part of the image clustering process and image extraction with grey scale.
- The model is compiled with the Adam optimizer, a learning rate of 0.001, and categorical cross-entropy loss.
- During training, the model is fed augmented image data generated by Image Data Generator, with various transformations such as rotation, shift, shear, and flip applied.

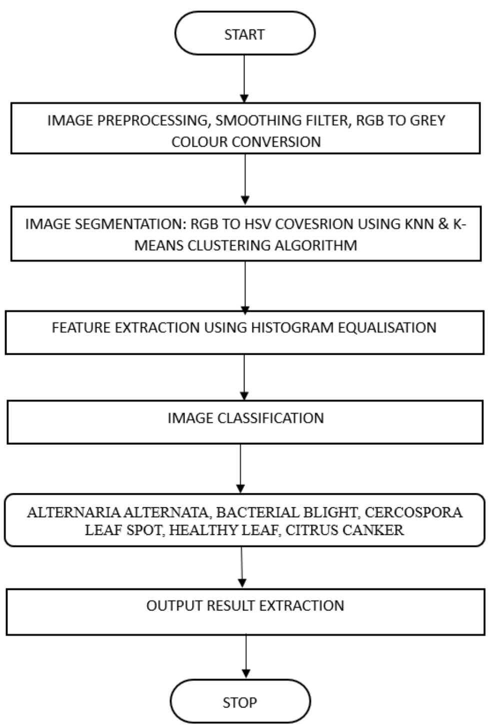

Figure 2: Flow chart diagram

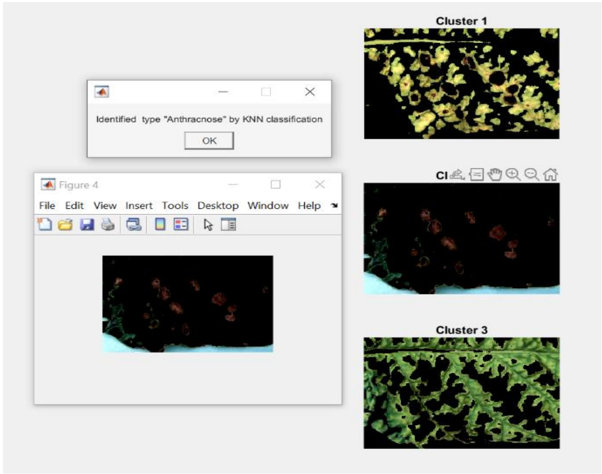

Figure3:Anthracnose Affect

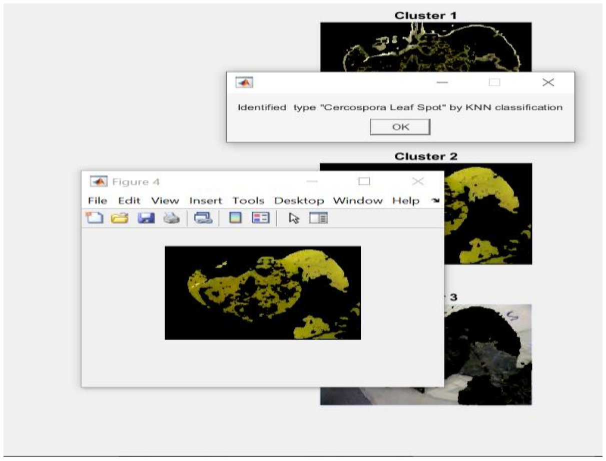

Figure 4: Cercospora Leaf Spot

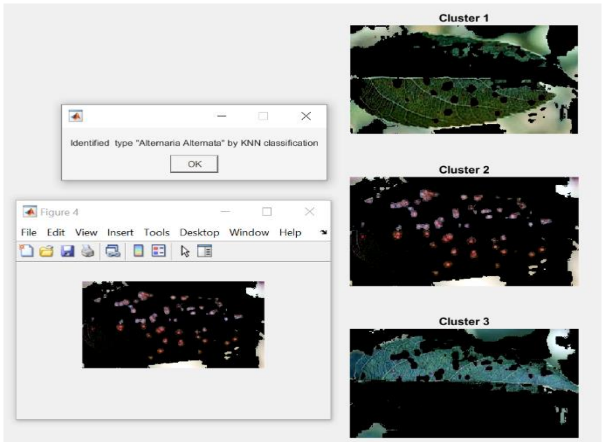

Figure5: Alternaria Alternata

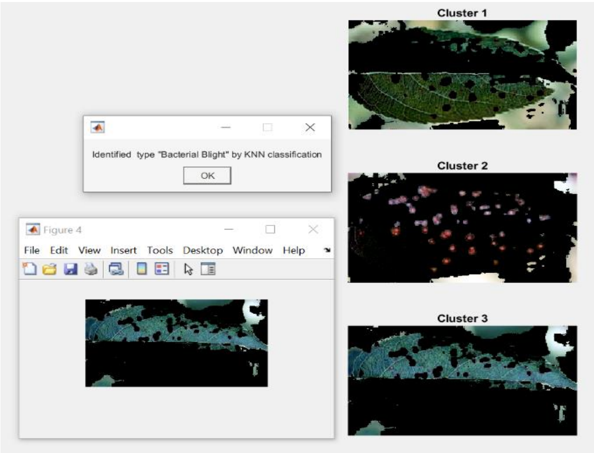

Figure 6: Bacterial Blight

IOT SENSORS

The sensors are based on the soil monitor it can be notify each reaction as of the way as the soil temperature, humidity and moisture the values which be transmitted through NodeMCU which is an integrated wifi module the data will stored in cloud platform and able to visible for live tracking.

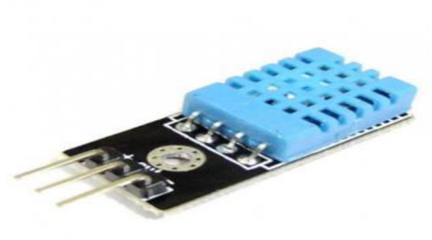

Figure 7: DHT11 Sensor

[3]

A simple, very inexpensive digital temperature and humidity sensor is the DHT11. It utilises a thermistor and a capacitive humidity sensor to monitor the air's humidity and delivers a digital signal on the data pin without the need for analogue input connections. Although it is quite simple to use, data collecting requires careful scheduling
g.

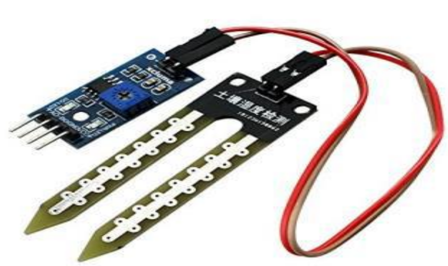

Figure 8: Moisture Sensor

[4]

Soil moisture sensors calculate the soil's volumetric water content. The volumetric water content is measured by soil moisture sensors indirectly by utilising another soil characteristic as a surrogate, such as electrical resistance, the dielectric constant, or interaction with neutrons. As a sample must be taken, dried, and weighed in order to detect free soil moisture directly using a gravimeter.

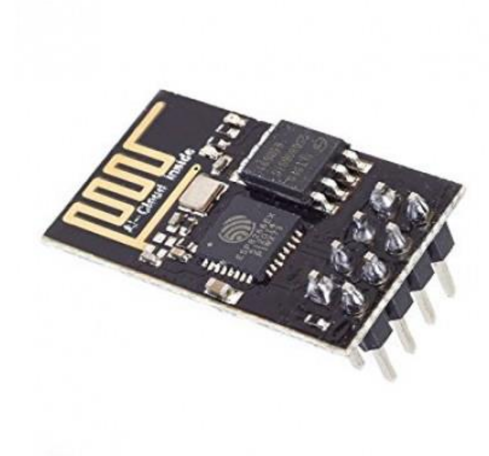

Figure 9: NodeMCU

There are open source prototype board designs for the Node-MCU open source firmware. A circuit board acting as a dual in-line package (DIP) that incorporates a USB controller with a smaller surface-mounted board holding the MCU and antenna is the prototype hardware that is frequently utilised.

CONVOLUTIONAL NEURAL NETWORK (CNN)

A convolutional neural network may comprise tens or even hundreds of layers, each of which may be trained to recognise various aspects of an image. The output of each convolved picture is utilised as the input to the following layer after filters are applied to each training image at various resolutions. The filters can start with relatively basic criteria, such brightness and edges, and go more complicated until they reach features that specifically identify the item.

K-NEAREST NEIGHBOR (KNN)

The number of nearest neighbors and the distance measure may both be changed in the nearest neighbor classification model Classification KNN. You may use the model to calculate re-substitution predictions since a Classification KNN classifier maintains training data.

K-MEANS CLUSTERING

A partitioning technique is k-means clustering. Data is divided into k mutually exclusive clusters using the function k-means, which then provides the index of the cluster to which each observation was assigned. Each observation in your data is treated by k-means as if it were an object with a spatial position.

VII. CONCLUSION

Based on the experimental results, KNN was employed to classify different classes of plant leaf disease, based on their Nutritional maturity level. These plants leaf were different from the ones used for training and validation. The accuracy for affectted and healthy, leaf was around95%.

REFERENCES

[1] Thangadurai K, Padmavathi K (2014) Computer Vision Image Enhancement for Plant Leaves Disease Detection. World Congress on Comp and communication tech

[2] Tanmay Baranwa , Nitika Pushpendra Kumar Pateriya, "Developmentof IoT based Smart Security and Monitoring Devices for Agriculture" in6th International Conference - Cloud System and Big Data Engineering,IEEE, pp. 978–1-4673-8203-8/16, 2016.

[3] Arun Kumar, Abhishek Kumar, Akash De, Shashank Shekhar, Rohan Kumar Singh." IoT Based Farming Recommendation System Using Soil Nutrient and Environmental Condition Detection". International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue-11, September 2019.

[4] Nivesh Patil, Shubham Patil, Animesh Uttekar, A.R Suryawanshi (2020) 'Monitoring of hydrophonics system using IoT technology', International Research Journal of Engineering and Technology, Volume: 07, issue: 06.

[5] Vaibhav Ingale, Rashmi Vaidya, Amol Phad, Pratibha Shingare, "A Sensor Device for Measuring Soil Macronutrient Proportion using FPGA", IEEE, 2016.

[6] Ali AM, Ibrahim SM, Bijay-Singh. Wheat grain yield and nitrogen uptake prediction using atLeaf and GreenSeeker portable optical sensors at jointing growth stage. Inf Process Agric 2020;7(3):375–83.

[7] Anand M, Byju G. Chlorophyll meter and leaf colour chart to estimate chlorophyll content, leaf colour, and yield of cassava. Photosynthetica 2008;46(4):511–6.

[8] Sahota H, Kumar R, Kamal A. A wireless sensor network for precision agriculture and its performance. Wirel Commun Mob Comput 2011;11(12):1628–45.

[9] Andrianto H, Suhardi, Faizal A. Detection of chlorophyll content based on spectral properties at leaf level : a meta analysis.In: International Conference on Information Technology Systems and Innovation. Bandung, Indonesia: IEEE; 2018. p. 364–9.

[10] Francis DD, Piekielek WP. Assessing crop nitrogen needs with chlorophyll meters. Site-Specific Management Guidelines. The Potash & Phosphate Institute (PPI) 2016.

[11] Musat GA, Colezea M, Pop F, Negru C, Mocanu M, Esposito C, et al. Advanced services for efficient management of smart farms. J Parallel Distrib Comput 2018;116:3–17.

[12] Abdolvahab Ehsanirad,Sharath Kumar Y.H.,2010,Leaf recognition for plant classification using GLCM and PCA methods,3,pp.31-36,2010.

[13] Goodridge, W., Bernard, M., Jordan, R., Rampersad, R. (2017). Intelligent diagnosis of diseases in plants using a hybrid Multi-Criteria decision making technique, Computers and Electronics in Agriculture, 133, p. 80-87.

[14] Ashwini A. Chitragar, Sneha M. Vasi, Sujata Naduvinamani, Akshata J. Katigar and Taradevi I. Hulasogi "Nutrients Detection in the Soil". International Journal on Emerging Technologies (Special Issue on ICRIET2016) 7(2): 257-260(2016)

[15] Arun M. Patokar, Dr. Vinaya Vijay Gohokar. "Automatic Investigation of Micronutrients and fertilizer dispense System using Microcontroller". (ICRIEECE) 2018.