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# A REVIEW ON FENUGREEK LEAF DISEASE DETECTION USING THE INTERNET OF THINGS

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## ABSTRACT

In agriculture, one of the main roles of the human diet is green vegetables. The farmer sows the seeds of plants into the soil, provides water to plants from time to time, and also takes care of plants, but for some reason, the productivity of fenugreek plants is decreased, so one of the most important reasons for this is plant leaf disease and farmers don't know the plant leaf disease easily with the naked eye. So, using this paper to study the functionalities of plant disease using the Internet of Things (IoT) Arduino and Sensors to identify if the plant is healthy or a disease for increasing the productivity of plants.

**Keywords:** Internet Of Things (Iot), Plant, Leaf Disease, Arduino, Sensor.

## I. INTRODUCTION

In India, agriculture is the most important source of economic development and produces approximately 70% of the Indian economy. So, damage to the plants would cause a huge loss in productivity and might affect the economic system.

Plant leaves are the maximum sensitive part of vegetables that show disease signs and symptoms at the earliest. The vegetables need to be monitored against plant disease from the early stage of their lifecycle to the time they are ready to be harvested. In the early stage of the plant, this method used to monitor disease through the naked eye is not sufficient to detect whether a plant is healthy or not. So, this requires expert techniques to monitor the plant leaves.

In the current years, several strategies have been developed. Those systems give fast results, with less expensive, and are more accurate than the traditional technique of manual observation by farmers. These researchers want to invoke to development of smart technological techniques for plant disease detection which do now not require human interference.

The objective of this paper is to review the various strategies of plant leaf disease detection and discuss the various techniques of plants. The first phase discusses the existing work process recently in plant disease and also reviews the used strategies. Phase second consists of the basic methodology used for developing a disease detection system. The final third phase concludes this paper along with future directions.

## II. LITERATURE REVIEW

Houda Orchi et. al. [1]. They present a contemporary overview of research based on previous disease identification of different crops using machine learning, deep learning, Image processing techniques, the Internet of Things, and hyperspectral image analysis. In this paper, they used image processing algorithms like the k-means clustering algorithm, and convolutional neural network (CNN). They cannot define any accuracy for identifying the diseases.

Sunil S.Harakannanavar et.al. [2] It has been used to detect leaf diseases in the tomato plant using f machine learning and image processing algorithm like Support Vector Machine (SVM), Convolutional Neural Network (CNN) and K-Nearest Neighbor (K-NN) also resize the tomato leaves images 256 × 256 pixels. They design proposed model testing using SVM with 88% accuracy, K-NN with 97% accuracy, and CNN with 99.6% accuracy on tomato disease samples.

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Abu Sarwar Zamani et.al. [3] They used image acquisition, image processing, image segmentation, feature extraction, and machine learning techniques using RBF-SVM, SVM, random forest, and ID3 algorithms for the leaf disease detection system. It will design one framework for detecting leaf illness, first of all, it will take pictures of leaves then remove noise from pictures then perform image processing algorithms and it shows the accuracy level graphs of machine learning using RBF-SVM, SVM, random forest, and ID3.

Hesham Tarek, et.al. [4] It has been used for Tomato Leaf Disease Detection using Deep learning pre-trained models based on the ImageNet dataset that is ResNet50, MobileNetV1, InceptionV3, MobileNetV2 AlexNet, and MobileNetV3. By using small areas MobileNetV3 model gets 98.99% accuracy and the Large areas MobileNetV3 model gets 99.81% accuracy using Raspberry Pi 4.

Javaid Ahmad Wani, et.al. [5] It has been used Machine Learning and Deep Learning methods to identify initial-stage diseases of Tomato, Rice, Potato, and Apple, they used K-Means Clustering, Otsu Threshold, K-Nearest Neighbors (K-NN), Genetic Algorithm, SVM, CNN, ANN algorithm of Machine learning and Deep Learning. They discuss the various disease classification accuracy year-wise from 2007 to 2020.

Ashwin KS, et.al [6] developed an automatic system to see whether the plant is healthy or unhealthy. It uses conventional growth of the plants and detecting tormented by disease also detects the presence of illness within the plant. It will only develop an automatic illness detection system using sensors like temperature, humidity, and color-supporting variations in plant leaf health conditions, but this paper does not provide any accuracy for identifying the diseases. This system is also very expensive, so farmers can't afford this system.

Arathi Nair, et.al [7]. It will develop plant disease detection using a Node MCU device with temperature, humidity, and soil moisture sensor with machine learning, CNN, and WiFi module to retrieve data and a built-in Kaggle dataset. Nair used Amazon Web Services to retrieve datasets, but actually, they used the public Kaggle Dataset and the accuracy level is only 78% for detecting diseases.

Gayathri Nagasubramanian, et.al. [8] has been developed as a proposed method for ECPRC, Machine Learning techniques, such as support vector machine, naïve Bayes, and K-nearest neighbors, and convolutional neural network, will show accuracy using SVM 75%, CNN 80.1%, and K-nearest 74.6% and also calculate the performance matrix based on Machine Learning Algorithms.

G Ramkumar et.al. [9] has been used to detect potato leaf disease using a deep learning network with the Internet of Things using feature extraction and classification algorithm process of Image processing and they proposed the method with 99% accuracy using Image Processing. There are not used practical approaches or strategies for detecting the leaf disease of plants.

Jingyao Zhang et.al. [10] has developed to identify cucumber leaf diseases with the help of convolutional neural network and SVM algorithms and the accuracy level of identifying the cucumber leaf disease of raw field images is 90.67% to data sets of the lesion is 96.11% using dataset. They discuss the comparative study using CNN algorithms.

Debasish Das, et.al. [11] It has been used in tomato leaf disease detection systems. They identified affected areas of tomato leaf disease using the algorithm of Haralick is one algorithm used for extracting the most optimal texture features from digital images. This paper used various algorithms of machine learning, i.e. random forest, logistics regression, and Support Vector Machine have been used to organize the various extracted tomato leaf disease features.

Yushan Zhao et.al. [12] It has developed crop disease recognition in the wild by using the Convolutional Neural Network and deep learning a novel approach Multi-Context Fusion Network (MCFN). They show an identification of disease using MCFN with the deep fusion model accuracy is 97.5%. They used Tomato, rice, apple, and Pepper plants disease recognitions.

Paramasivam Alagumariappan et.al [13] It has been used Raspberry Pi with a camera module and ELM, an SVM algorithm for feature extraction with the help of a machine learning algorithm and shows the accuracy of 95% with the real-time decision support system, but they are not showing any actual methodology used.

Fazeel Ahmed Khan et.al. [14] They used Arduino uno microcontroller, DHT11 Humidity and Temperature Sensor, water flow sensor, Soil moisture sensor, VGA Camera, Relay with Digital Image Acquisition, Image pre-processing, Image segmentation, and K-Means Clustering algorithm using Image Processing Techniques. They

specify 100 leaves taken and the based learning rate is 0.0010 sec for 1 leaf and also all 100 leaves based learning rate is 0.0010 sec. which means the same time is required for all 100 leaves datasets.

Bin Liu et.al. [15] It will detect grape leaf pests and diseases like Anthracnose, brown spot, mites, black rot, downy mildew, and leaf blight by using CNN with Image Processing Algorithm, They created 107,366 Graphs of leaf images from 7,669 images collected through datasets where images are created via image augmentation. They Implement various Image Processing algorithms and conclude 97.22% of accuracy to identify the graph leaves diseases, but can not specify any IoT devices.

Manisha Kumaran, et.al. [16] It has used a Water Level Detector and Controller, Temperature and humidity sensor, soil moisture, and Ultrasonic Sensor for Smart Agriculture to detect the Color Histogram, Septoria plant disease, etc. with the help of Arduino, and Thingspeak cloud. The experimental accuracy level of this system is 87%. The problem with this system is that it will only show graphical representations of results and doesn't have any power switch for on-off for emergencies.

Shantanu Kumbhar et.al. [17] It has been developed Web Based on Cotton Leaf Disease Detection Using Neural Networks and CNN. The accuracy of training is 80% and the accuracy of testing is 89% in cotton disease identification using Image Processing. They implement hardware using IOT for Image capturing but cannot specify which hardware they are using for the identification of the cotton leaves diseases.

Sammy V. Militante et.al. [18] It will develop to detect and recognize varieties of apple, corn, grapes, potato, sugarcane, and tomato plant diseases. They used Image Processing with CNN Algorithms to detect plant diseases. They used a trained model with 96.5% accuracy and 100% accuracy in detecting and recognizing plant diseases but cannot specify the actual hardware used for capturing the plant leaf images.

Vimal K. Shrivastava et.al. [19] It will identify rice leaf disease using SVM, a pre-trained deep CNN algorithm by using Image Processing. They identify rice plant diseases like Rice Blast, Bacterial Leaf Blight, Sheath Blight, and Healthy Leave. It will predicate the 91.3% accuracy of their proposed model based on 80% to 20% of the Training and Testing dataset.

Rajesh Yakkundimat H., et.al. [20] They used DHT11, TCS3200 light-to-frequency converter, Arduino UNO, and Arduino IDE models with temperature, humidity, and color sensors for collecting data from plant leaves parameters. Plant Disease Detection using IoT. This technique is designed through Python and Arduino. The accuracy of Plant Disease is the humidity is 82%, the temperature is 86%, and the color 88% using their sensors. It has Limited Leaf sample result predictions.

Sona Pawara, et.al. [21] It will use GPRS, Hidden Markov Model, temperature, humidity, leaf condition amount, SIM800C GSM module with the fruit spot disease, Bacterial blight disease, fruit rot disease, leaf spot disease, etc. parameters strategy. In this paper Arduino, and Thingspeak cloud are used to design these systems. The approximate level of result is 92%. It is used only by the Pomegranate plant and no prevention system is provided for this system.

S. Sachin, et.al. [22] It will apply k-means and SVM algorithms and servo motor to control the camera for Gray-level Co-occurrence Matrix, standard deviation, mean, entropy, RMS, contrast, correlation, smoothness, energy, homogeneity, and IDM are parameters used to design this system. The accuracy level of the number of identified leaf diseases is 96.77%. This paper will not provide any techniques for identifying physical damage leaf images.

Adhao Asmita Sarangdhar, et.al. [23] It presents the SVM algorithm for regression technique to detect cotton leaf disease. They suggested to the farmer's various medications for infected diseases to control them. They can also develop android apps to display various diseases and various sensor information alert systems. Using this app they handle the whole farm area from a remote place. The accuracy level of this disease detection is 83.26%.

Senthil Kumar Thangave, et.al. [24] They applied a remote monitoring system, temperature sensor, humidity sensor, Soil Moisture Sensing, and USB port Camera techniques for Tea Leaves images. It will identify brown color spots and yellow color on leaves using a color sensor, Droplet of Leaf in the premature stage. The decline in growth of leaf parameters strategy is used and it will use Raspberry PI, and Python to implement this technique. Performance-based on the experiment on several leaves and Experimental Accuracy level is approximately 56 to 73%. The drawbacks of this technique are that the night vision images cannot be taken

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from the camera, or if sunlight is too sharp for the captured image then the reflected color of the leaf is not recognized.

Patrick K. Toroitich, et.al. [25] Applied SHT-10 soil probe, GPS, and GSM techniques for Monitoring Crop Disease detection in Real-Tim. Prediction late blight model, some historical weather information, variety of potato's tolerance on late blight disease, the DHT11 temperature, humidity probe, and Android Mobile device are parameters and sensors used. The experimental accuracy level of this system is 94%. The main drawback is the need for computer knowledge for the farmers to setup systems.

## III. MATERIALS AND METHODOLOGY

The proposed work is done using an Arduino which includes a temperature and humidity sensor using a DHT11 sensor and plant leaves color using a color sensor for taking information from plant leaves dependent on variation in temperature, humidity, and color. The information taken from the leaves comprises current environmental variables like temperature, humidity, and color. The development of plant experiments is held by the temperature and humidity DHT11 sensor, the color of leaves is caught by the color sensor and dissected with the Arduino programming. The information taken with temperature, humidity as well as the color sensor is specified for the Arduino Uno unit after that data remains conveyed to the farmer. This work used OLED Display to show real-time information. After the taken information to identify whether the plant is healthy or diseased. The Figure 1. Shows the proposed work chart and step-by-step explanation of figure 2.

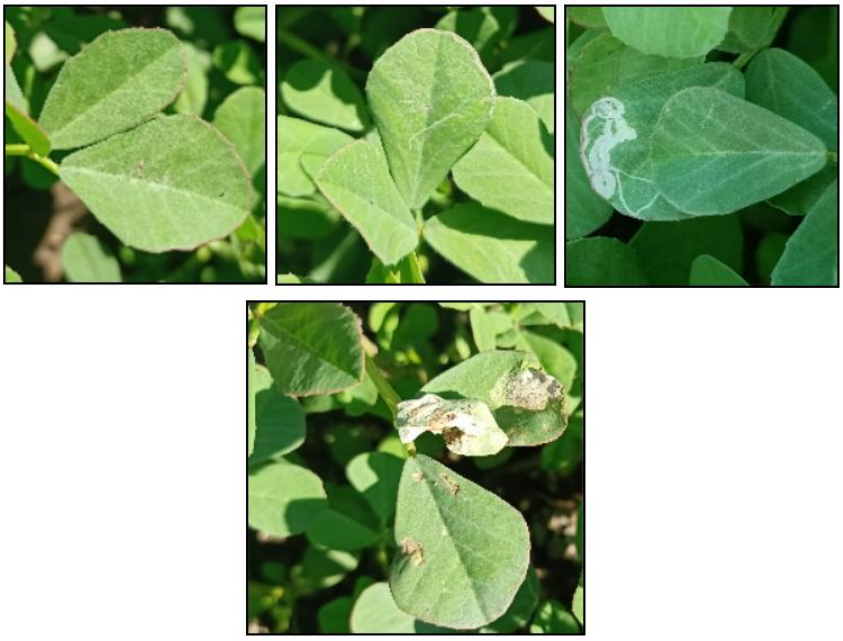

**Figure 1:** Fenugreek Plant Leaves caused by disease.


**Figure 2:** Proposed Methodology

### 1. Information gaining

Here check the green plant leaves images as the information. These leaves are then read by sensors to determine various parameters depending on whether leaves are healthy or diseased.

### 2. Temperature and Humidity sensors

The DHT11 is a digital sensor that shows humidity and temperature. The capacitive humidity sensor and the thermistor measure the surrounding air and give the digital signal through the data pin. Inside Chip is used for Analog to Digital conversion and then transfer to a digital signal with the temperature and humidity. The digital

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signal is easy to read using Arduino UNO as a microcontroller. It is available at a low cost and it requires 3V to 5V Power Supply for Input and Output. It used 2.5mA max current for conversion of Analog Signal to Digital Signal Conversion.

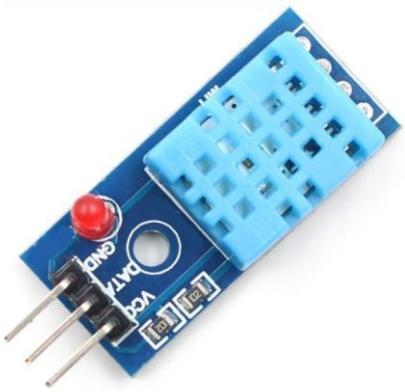


**Figure 3:** DHT11 Sensor

### 3. Color Sensor (TCS3200)

The TCS3200 is a color light-to-frequency converter or programmable sensor. The sensor is a self-contained solid CMOS integrated circuit that combines a configurable silicon photodiode and a current-to-frequency converter. The light-to-frequency signal converter reads an 8 x 8 array of photodiodes. 16 photodiodes use blue filters, 16 photodiodes are used green filters, 16 photodiodes use red filters, and 16 photodiodes are used clear with no filters. The four color types of photodiodes are integrated to minimize the effect of the inconsistency of incident irradiance. All same color 16 photodiodes are connected in parallel and the device selects which type of photodiode is used for operation is dependent on the selected pin.


**Figure 4:** Color Sensor

### 4. Arduino UNO

The Arduino UNO is an ATmega328P-based microcontroller board developed by Arduino. cc. The board is equipped with sets of Analog and Digital I/O pins that are interfaced with various expansion boards and circuits. The Arduino UNO has Analog input pins, a power jack, 14 digital pins, a USB connector, and an ICSP (In-Circuit Serial Programming) header. It is programmed based on an integrated development environment (IDE), this can be working through the cloud (online) as well as offline mode.

**Figure 5:** Arduino UNO

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**5. OLED Display**

The OLED (Organic Light-Emitting Diode) display is super-light, almost viewed as paper-thin flexible, and produces brighter and crisper textures (Text and Picture). The OLED display does not need a backlight for displaying outputs, there results in a very nice contrast in dark atmospheres. Its pixels consume energy only when their power is on, so the OLED display consumes less energy as compared to other displays.


**Figure 6:** OLED Display

## IV. CONCLUSION

In this work, a system is developed to determine the quality of the fenugreek leaves. The proposed method uses Arduino UNO devices and their sensor to detect the plant factors like temperature, humidity, and color of the plant leaves, which then shows the information on an OLED Display. The proposed mythology can be used in different areas of the farm. The possibilities of further work in this area used IoT techniques along with the proposed method to make it more efficient and also make it accurate to determine the plant parameters and to define whether the plant leaves are healthy or diseased. To develop an extended version of the system, we can use the IoT technique that detects the disease of plant leaves which is affected by the different leaves. Here, automated systems have been developed that help with large-scale production and also help for early detection of disease. This allows farmers to improve performance and increase yields.

The proposed system detects whether the plant leaf is healthy or diseased. This can be further carried out for distinguishing the kind of diseases in the leaves and the classification of those diseases. We have focused our work only on the temperature, humidity, and color sensor properties with the OLED Display of the leaves. This can be further extended by applying other IoT sensors.

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