Leaf disease detection & Soil Nutrients Deficiency recognition system

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Abstract **A Plant diseases and soil nutrient deficiencies are major issues affecting the productivity and yield of crops. The early detection of these problems can help farmers take necessary measures to prevent further damage. This paper proposes a system for plant disease detection and soil nutrient deficiency recognition using VGG19, Python IDLE, Arduino Uno, temperature sensor, pH sensor, soil moisture sensor, and a GSM module for real-time information recording and transmission. The proposed system uses machine learning algorithms to analyze images of plants and provide early warning signals for diseases, and it also monitors soil conditions to detect nutrient deficiencies. The proposed system provides a cost-effective and efficient solution for farmers to enhance crop yields and productivity.**

***Index Terms*— Arduino, PH sensor, moisture sensors, temperature and humidity sensor, GSM module.**

I. INTRODUCTION

The agricultural sector plays a significant role in the development of the whole economy of any country. India is an agricultural country where in most of the population depends on agriculture. Agriculture is basic culture of India. In order to meet the growing demand for food, it is crucial to optimize agricultural practices and ensure that crops are grown efficiently and sustainably. Agriculture is a major of livelihood for most of the population. All these problems originate at one point i.e., the less yield of the crop, which is directly related to plant leaf diseases and deficiency in soil nutrients. A traditional method takes a lot of time for inspection, investigation and analyzing the condition of the Soil and Leaf. Crop production is heavily dependent on the quality of the soil and the health of the leaves. The soil provides the necessary nutrients and minerals for the plants to grow, while the leaves are responsible for photosynthesis, which is essential for plant growth and development. It is crucial to maintain healthy soil and leaves to ensure optimal crop yields.

Soil monitoring is a basic procedure which is required for farming. A proper soil testing will help to decide the amount of fertilizer to get the proper results of the crop based on the nutrients already present in the soil. A complete nutrient management plan is done by using the soil testing. The soil minerals can be determined via soil testing, either in a lab or by using sensors. In order to have better crop production, the factors influencing it are soil properties, weather conditions, availability of water, soil temperature, sunlight, wind, pollution level, etc .Here we used Ph sensors, Temperature sensors and Soil Moisture sensors. Therefore, by using sensors, soil properties are to be collected for pH value, temperature, moisture. The use of various sensors allows for the collection of real-time data. All these data are sent to owner via SMS.

Leaf diseases represent one of the most serious threats to food security because disease on plant leaf leads to the significant reduction in both the quality and quantity of agricultural product. These diseases are caused by pathogens, fungi, bacteria and viruses, and due to adverse environmental conditions. Farmers require continuous monitoring of experts who might be prohibitively expensive and time consume. Farmers require continuous monitoring of experts which might be prohibitively expensive and time consuming.

Nowadays the image processing methods are suitable, efficient and reliable field for disease detection with help of plant leaf images. This project reports approach for detection and identification of leaf disease by using advanced algorithm VGG19. Tomato and Brinjal are most common food crop grown in India. Tomato is cultivated in all the seasons but typically during winter and summer seasons. Its Botanical name is Solanum Lycopersicon. Tomato is the most delicious vegetable. It contain vitamins like vitamin A, potassium, vitamin C, folate, and vitamin

K. Brinjal is one of the major category in agriculture which decides economy of the nation. It's botanical name of Brinjal Solanum. It is a versatile crop adapted to different agro climatic regions and can be grown throughout the year. There are numbers of diseases that occurred in these crops that affects growth of the plants. At last the information will be send to the user through SMS using GSM module.

We developed a system which detects the leaf is healthy or unhealthy and testing of soil. Hence, the proposed work has considered the detection of plant disease present on leaves and also soil testing and informs the user or the owner via SMS.

II. METHODOLOGY

The proposed Leave Disease Detection & Soil Testing Recognition System consists of software and hardware components. The software utilizes the VGG 19 algorithm to classify leaf images as healthy or unhealthy based on a trained model. The system captures and processes leaf images, sending messages indicating the health status accordingly. Additionally, the system uses sensors to measure soil parameters such as moisture, temperature, and pH levels. By collecting and analyzing this data, the system provides valuable information about the environmental conditions to farmers, assisting them in making informed decisions. Overall, the system aids in leaf disease detection and provides soil testing capabilities for agricultural purposes.

III.HARDWARE COMPONENTS

ARDUINO UNO

Arduino is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller. Arduino Software (IDE) was the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards

Temperature and Humidity Sensor (DHT11)

The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use, but requires careful timing to grab data.

MOISTURE SENSOR

This moisture sensor module is used to detect the moisture. It measures the volumetric content of water

Software Requirement

Arduino IDE

The Arduino IDE is a software development platform that provides a user-friendly interface and a complete set of tools for programming Arduino boards. The IDE is designed to be simple and easy to use, making it a popular choice for beginners and experienced developers alike. Developers can write code in the text editor provided by the IDE. The code is written in a variant of the C++ programming language that is designed for Arduino development. Developers can also create their own libraries and add them to the IDE. This allows for faster development and easier reuse of code.

IV.SOFTWARE REQUIREMENTS

PYTHON IDLE

Python IDLE is an Integrated Development Environment (IDE) for Python programming language. IDLE stands for Integrated Development and Learning Environment. These are a class of applications that help you write code more efficiently. One of the key features of IDLE is its interactive mode, which allows executing Python code one line at a time and seeing the results immediately. This is particularly useful when debugging code or experimenting with new ideas can use the code editor to write and edit Python code, and the Python shell to execute code and can interact. IDLE supports syntax highlighting, code completion, and code folding to make coding easier and more efficient

V. BLOCK DIAGRAM

The soil testing using DHT 11, soil moisture sensor, and PH sensor is a system that enables farmers to monitor the health and fertility of their soil. The design of the system involves the integration of the DHT 11 temperature and humidity sensor, soil moisture sensor, and PH sensor. These sensors collect data on the soil's

temperature, humidity, moisture content, and PH levels, respectively. The leaf diseases detection uses laptop to generate results. We will also highlight some of the key features of the project, such as its design aesthetics. This section will provide readers with a high-level understanding of the project's main objectives and goals. We will explain the design process, including the tools and methodologies used, and discuss the factors that influenced design decisions. The system is also equipped with a laptop that provides information on the soil parameters, and leaf diseases detection allowing farmers to know about the soil's health and also leaf health. The implementation of this system involves the installation of the sensors in the soil at a suitable depth, followed by the connection of the sensors to the UNO board. Overall, the system enabling farmers to make informed decisions about crop management.

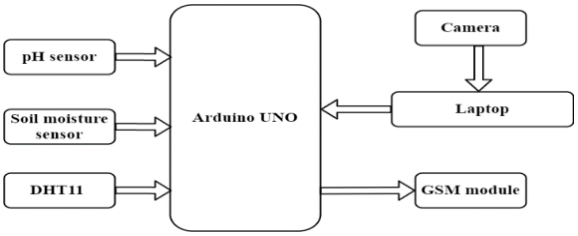

Fig 1: Block diagram of proposed system

VI. FLOW CHART

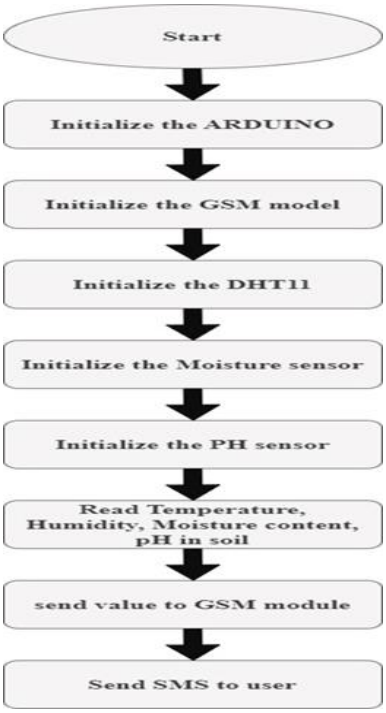

Fig2:-Flow chart of soil test

To start, connect the Arduino UNO board to a computer and open the Arduino IDE. Initialize the GSM module by configuring communication parameters and settings. Next, initialize the DHT11 temperature and humidity sensor, as well as the moisture and pH sensors, by setting up the communication protocol and configuring relevant settings. Read values from each sensor by sending commands and retrieving data. Format the collected sensor data for the GSM module and send it through the appropriate communication protocol. Finally, transmit the formatted data to the user via SMS over the GSM network. Pressing the reset button on the Arduino UNO initiates the initialization process again Flow chart of traininig and testing.

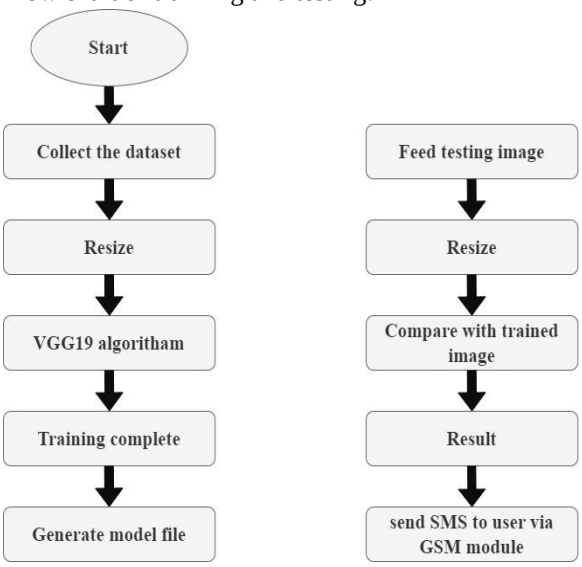

Fig3:-Flow chart of training and testing

The leaf disease detection system involves several steps. First, a dataset of leaf images is collected, including both training and testing images. The images are then resized to a uniform size as part of the pre-processing process. The VGG algorithm, a deep learning architecture, is chosen for training the model on the training images. During training, the algorithm learns to recognize patterns and features associated with different leaf disease categories. After training, a model file containing learned weights and biases is generated. To classify a new testing image, it is resized and fed into the model. The algorithm predicts the category of the leaf disease, and the result can be compared with the true label for evaluating accuracy. Finally, using GSM, an SMS is sent to the user with information about the detected leaf disease.

VII. RESULT

The Leaf Disease Detection and Soil Nutrients deficiency Recognition System is a computer vision-based technology designed to assist farmers in identifying leaf diseases and soil conditions in their crops.

The deep learning algorithms were able to accurately identify and classify different types of leaf diseases as whether leaf is healthy or unhealthy. In field tests, the Leaf Disease Detection it will able to provide farmers with real-time feedback on the health of their plant leaf. This system was trained using a large dataset of images of healthy and unhealthy leaves.

5.1 Image Set:

The sample image dataset of the unhealthy leaf disease images and healthy leaf image collected from internet source. The data set collected from Kaggle.

Total number of Tomato leaf training samples = 500 images

Total number of testing samples = 100 images

Total number of Brinjal leaf training samples = 300 images

Total number of testing samples = 30 images

5.2 Leaf Diseases Detection:

The proposed algorithm is developed using python. The plant leaf disease detection model is built using Convolutional Neural Network and trained with 300 different Brinjal images of leaves with or without diseases. The leaf is run through the leaf disease detection model. If the disease is detected by the models and GSM model to send the message to the farmers as Healthy or Unhealthy.

The Fig 5.1 is sample input image given to the system. This image would be used as input data for the algorithm, which would then analyze it using deep learning techniques to identify leaf diseases whether healthy or unhealthy.

Fig 5.1: Sample input of a leaf

Figure 5.2 shows a screenshot of the command window displaying an image of a healthy Brinjal leaf. This image is an example of the type of output that the Leaf Disease Detection would generate.

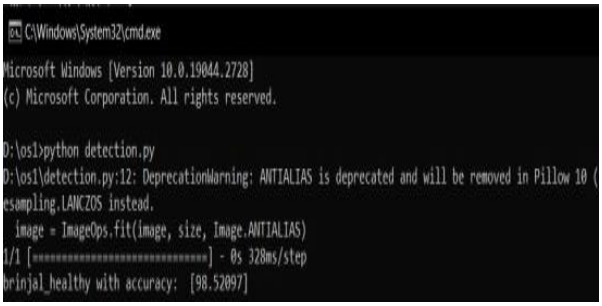

Fig 5.2:Brinjal leaf healthy.

After analyzing an input image of a plant leaf, the system would use VGG19 techniques to identify whether the leaf is healthy or unhealthy. The proposed system detects the leaf as healthy and sends SMS via GSM. The Fig 5.3 Shows Snapshot of Mobile Output where we can see updated information to the users via SMS.

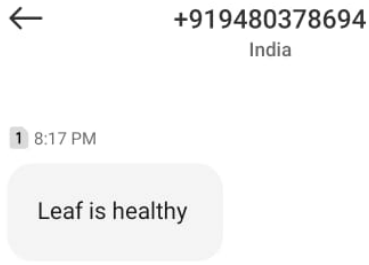

Fig 5.3 Snapshot of Mobile Output

The Fig 5.4 is sample input image given to the system. This image would be used as input data

Fig5.4: Sample input of leaf

Figure 5.5shows a screenshot of the command window displaying an image of anunhealthy Brinjal leaf.

Fig5.5: Brinjal leaf Unhealthy.

After analyzing an input image of a plant leaf, the system would use VGG19 techniques to identify whether the leaf is healthy or unhealthy. The proposed system detects the leaf as unhealthy and sends SMS via GSM. The Fig 5.6 Shows Snapshot of Mobile Output where we can see updated information to the users via SMS.

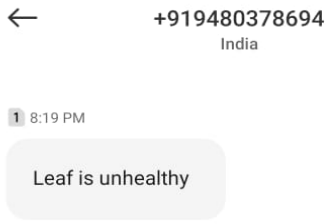

Fig 5.6: Snapshot of Mobile Output.

The proposed algorithm is developed using python. The plant leaf disease detection model is built using Convolutional Neural Network and trained with 300 different Tomato images of leaves with or without diseases.

The Fig 5.7 is sample input image given to the system. This image would be used as input data

Fig5.7:Sample input of leaf

Figure 5.8 shows a screenshot of the command window displaying an image of an unhealthy Tomato leaf.

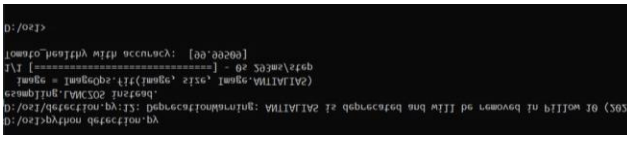

Fig5.8: Tomato leaf healthy.

Fig 5.9: Snapshot of Mobile Output.

The Fig 5.9 Shows Snapshot of Mobile Output where we can see updated information to the users via SMS.

The Fig 5.10 is sample input image given to the system. This image would be used as input data

Fig5.10:Sample input of leaf

Figure 5.11 shows a screenshot of the command window displaying an image of a healthy Tomato leaf.

Fig5.11: Tomato leaf Unhealthy.

The Fig 5.12 Shows Snapshot of Mobile Output where we can see updated information to the users via SMS.

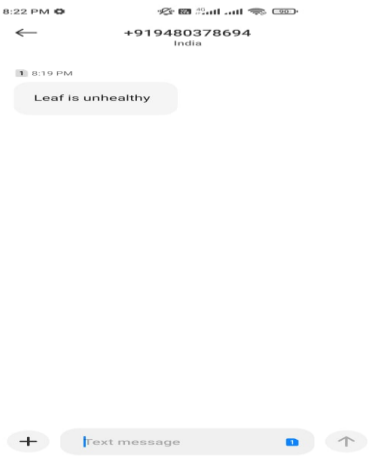

Fig 5.12: Snapshot of Mobile Output.

5.3 Soil Testing:

The Soil Testing Recognition System is a designed to assist farmers in identifying and analyzing soil conditions in their crops.This System is a technology that uses sensors to measure various parameters of soil, including moisture and pH levels. The system is designed to provide real-time feedback to farmers on the condition of their soil, allowing them to adjust their watering practices as needed.

	Temperature and humidity sensor	Soil	pH level
Dry Soil	32.90	Dry	3.82
Slightly Dry Soil	34.32	Dry	4.20
Slightly Wet Soil	30.7	Wet	4.78
Wet Soil	31.77	Wet	5.60

In this proposed system when the sensors are exposed to the soil the value of the sensors changes according to the moisture and temperature of the soil and the values are displayed in the serial monitor of the Arduino IDE software.

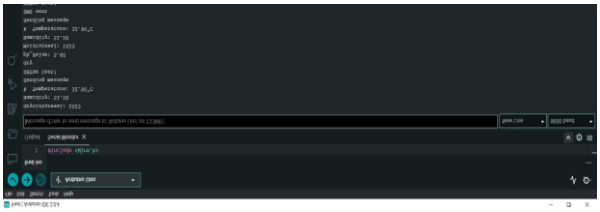

Fig 5.13: Value of sensor displayed in Serial Monitor

In this case, the sensor appears to be measuring the moisture level of the soil. The value displayed in the Serial Monitor indicates the current moisture level of the soil, which can be used to determine whether the soil is too dry or too wet. The DHT11 sensor measures temperature and humidity levels in the soil. The pH sensors measures values of pH content in soil.

The Fig 5.13 shows snapshot of value of sensor displayed in Serial Monitor where we can see all the sensors value.

Using soil testing sensors to send SMS notifications via GSM technology can provide farmers with real-time updates on soil conditions and enable them to quickly respond to any issues that may arise.Figure 5.14shows how soil testing sensors can send SMS notifications to a user mobile phone. Here SMS notification is shown on a mobile phone screen, indicating all sensors value as shown in Fig 5.14. i.e Snapshot of Mobile Output.

Fig 5.14: Snapshot of Mobile Output

5.3.1Table of Soil Testing Results

5.4 Environment and Society benefit

- Early intervention: Early detection allows for prompt intervention, which can help prevent the disease from spreading and causing more extensive damage. Similarly, early detection of soil testing can enable corrective action to be taken before the problem worsens.
- Increased yields: By detecting and addressing plant diseases and soil testing at early, farmers and gardeners can improve the health of their crops, resulting in increased yields.
- Reduced costs: Early detection of plant diseases and soil nutrient deficiencies can help reduce the costs associated with disease management and remediation. By addressing the problem early, farmers and gardeners may be able to avoid the need for expensive treatments or re-planting.
- Better resource management: Early detection can help farmers and gardeners better manage their resources, including water, fertilizers, and pesticides. By addressing plant diseases and soil testing early, these resources can be used more

efficiently, reducing waste and minimizing environmental impact.

- Improved plant quality: By addressing plant diseases and soil nutrient deficiencies early, farmers and gardeners can improve the overall quality of their plants. This can result in plants that are more robust, healthy, and visually appealing.
- Enhanced food security: Early detection and management of plant diseases and soil testing can help improve food security by ensuring a consistent supply of healthy crops.

VII.CONCLUSION

The development of a Leaf Diseases Detection & Soil Testing Detection System is a promising advancement in agriculture technology. Since sensors are fixed to the system it makes farming much easier, much faster and much efficient. This system is quite affordable and feasible. The Proposed system achieved with high accuracy and the infection predicted is highly effective. Leaf diseases may be reduced by the use of this system which is a time-saving and low-cost detection technique. This system can classify leaf disease within short time whether healthy or unhealthy along at a low cost. This system can be used as a primary detection for farmers and agriculturists. Being aware of leaf diseases can reduce the disease rate and increase production as well. This system uses DHT11, soil moisture, and pH sensors which is a powerful tool for farmers looking to optimize their crop yields and improve the health of their soil. By providing real-time data on soil conditions and sending SMS notifications. At last, all details will be sending to the farmers or owners as SMS. This system is a valuable tool for improving agricultural practices and ensuring sustainable crop production.

VIII. ACKNOWLEDGEMENT

We would like to thank VTU for providing this opportunity to work on this project. We also acknowledge our guide assistant professor department of ETE department JNNCE Shimoga for giving the knowledge about this project and also co-operating in implementing this research oriented-research.

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