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SMART CROP HEALTH MONITORING SYSTEM WITH IOT INTEGRATION

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Abstract: **Agriculture is important to human existence. Approximately 60% of people are either directly or indirectly involved in some form of agriculture. Nonetheless, these days, farmer have moved to other industries and ceased farming as a result of reduced automation adoption and other variables including a rise in the demand for agricultural labour. In order to benefit from technology advancement, farmers are thus becoming more and more reliant on the development of cognitive substitutes. The combination of Arduino with the Internet of Things expands the possibilities in the realm of smart, accurate farming. To assist us in creating a technique for identifying leaf illness in plants, this approach combines the Internet of Things with Arduino, taking into account a number of components such a servo motor, a drive motor, and a flask module. A web application called the Flask module is used to determine whether or not the crop is affected. In addition to helping identify agricultural pathogens, it also identifies the source of illness and motivates the use of the right pesticides at the right dosages. And**
therefore, the sprinkler system sprays fertilizer and insecticides to the leaf at the proper doses.

Keywords– Arduino, IOT, Plant Leaf Disease Detection

I. INTRODUCTION

For farmers and agriculturalists, detecting leaf disease is crucial. Early leaf disease diagnosis can guarantee a higher yield and assist stop the spread of illness. However, manual leaf disease identification takes a lot of time and is frequently unreliable. As technology advances, solutions for automated leaf disease diagnosis can be developed, thanks to the Internet of Things

Mechanical and compound advancements have been developed to identify, investigate, and gather data on plant illnesses and circumstances in the cultivation area, from the development of agriculture to the increase of yields. Still, digitalization has been essentially the same in this industry. The development of IoT is expected to lead to the creation of an automated agricultural framework that will enable farmers to make knowledgeable decisions about their properties now and anticipate unfavourable situations in advance. As a result, it will benefit the farmers in addition to improving the plant's characteristics. In the farming sector, early identification of the illness and condition measure is crucial.

When a plant's fundamental activities are disrupted or altered, it is crucial to identify the illness and return it to its natural
state. Phytopathogenic illness Diagnosing a plant disease usually starts with identifying the afflicted plants. Identifying plant diseases is critical to both the economy and productivity of agriculture. In the realm of agriculture, the diagnosis of plant diseases is crucial. The quality or productivity of the resulting products is impacted if this plant or the surrounding region is not given the necessary care. This can have major consequences on plants. Furthermore, Plant disease detection has several advantages, including lowering the amount of labour required for monitoring large-scale agricultural farms and identifying disease signs early on.

Analysing and advising the farmer on plant conditions is significantly more challenging. As a result, not all farmers are aware of this procedure, and it requires a lot of time and money from professionals. An IoT application for monitoring plant diseases and creepy crawlies has been shown by one of the researchers [1]. Technology to perceive data and the role of IoT in horticulture disease and pest control, which includes agricultural disease and spooky bug checking frameworks, collecting data on infections and bugs using sensor hubs, information preparation, and mining. The integration of sensor monitoring techniques with IoT was another major emphasis of the current study.

The suggested mindset of the scientist [2] focuses on both farm and nursery climate discovery, with less computational unpredictability.in addition. The insect of interest was chosen to be the whitefly since it is a bio-attacker that poses a threat to a significant number of yields. Bug management in agricultural estates using MATLAB picture processing techniques was presented by another researcher [3].

Connecting a variety of sensors to the Arduino module allows for this. Parameters including soil moisture, temperature, and humidity are measured using a variety of sensors. Help boost farm output and shield agriculture from serious losses. The website's goal is to determine the situation as it stands. On the other hand, modern agricultural technology primarily aims to provide a greater yield and a successful economy [1].

In this paper, there are five sections. Section II provides an overview of the project objectives. III described the proposed methodology. The results and discussions are described in Section IV. In the final section of the paper, conclusions are presented.

II. OBJECTIVES

The identification of current cultivation and the creation of an Internet of Things-based plant disease detection system are the main objectives of this work. There are fewer healthy plants in the field due to a variety of agricultural diseases, changes in humidity and temperature, and poor soil. The recommended approach presents a method for doing so in order to notify farmers of the issue in its early phases.

III. DATA DESCRIPTION

To create our "plant leaf disease detection" system for this research, we used potato leaves. There are several classifications of both healthy and sick plant leaves in this collection. AppleScab1, AppleCedarRust2, AppleCedarRust3, AppleCedarRust4, PotatoEarlyblight1, PotatoEarlyblight2, PotatoEarlyblight3, PotatoEarlyblight4, PotatoEarlyblight5, PotatoHealthy1, Potato Healthy2 are among the disorders. We have utilized the "potato/apple disease leaves" dataset from Kaggle for the purpose of disease identification and treatment. For disease identification, we have employed a flask module that displays the source of the ailment and the appropriate application of pesticides and fertilizers in the appropriate amounts.

IV. PROPOSED PLANT LEAF DISEEASE DETECTION

Enabling Indian farmers to improve agricultural quality is the main goal of this initiative. This initiative finds the crop disease and suggests appropriate therapy. The farmer

can upload an image of the specific damaged crop using our program. Our program will diagnose the condition and recommend a course of action of how it happens. There are two phases involved in detecting illnesses in crops: Finding the precise illness harming the crop must come first, followed by figuring out the best cure or therapy for it. Farmers will be able to increase the quality of their crops with the aid of this treatment.

A. COMPONENTS USED

ARDUINO

With the Arduino platform, users may design and program their own electrical devices using microcontrollers. Because of its straightforward and user-friendly design, a broad spectrum of individuals may utilize it. even those with less technical knowledge. A single-board microcontroller that is programmed using a condensed version of the C++ programming language forms the basis of the Arduino system. The board has a variety of inputs and outputs that may be utilized to communicate with the outside world, including digital and analog pins. Servo motors and drive motors are two examples of the system components that may be controlled using Arduino boards. The board can also be utilized for other device connections and data logging.

Figure 1- Arduino Uno ATmega328

2. SERVO MOTOR

Utilizing IoT (Internet of Things) technology, servo motors may be employed in plant disease diagnostic systems. Though they are not directly engaged in plant disease detection, servo motors can serve as actuators in automated systems for a variety of applications. To get the best possible data gathering or to start acting upon the identification of plant diseases, the servo motor can be utilized to move the spraying pipes or other parts to various locations.

Figure 2- Servo Motor

3. DRIVING MOTOR

The use of driving motor in this project is described as follows: power moves from the connecting wires to the motor when the system commands that the pump be turned on. However, the transmitted power is insufficient to operate the pump. Thus, we employ a driving motor that is equipped with an amplifier there. in order to enhance the signal received from the Arduino, which is enough to activate the pump that sprays pesticides.

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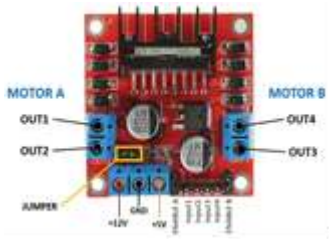

Figure 3 – Driving Motor

4.WATER PUMP MOTOR

In this Project the pesticide spraying system may easily incorporate this DC 3V–5V micro-submersible water pump. The water suction method, which the water pump uses, involves draining the water via the intake and releasing it through the outlet.

Figure 4 – Water Pump Motor

5. FLASK MODULE

The Python framework for web applications is called Flask. It's a well-liked option for creating web apps as it's lightweight and simple to use. Creating RESTful APIs is made simple with Flask, which offers frameworks and tools to manage online requests and answers.

The Identification of Leaf Disease with the Flask App, users may submit photographs of their leaves and the app will forecast if the leaves are healthy or unhealthy. The deep learning model is utilized by the Flask App to provide predictions based on the uploaded photos.

There are two primary parts to the Flask app:

1. The Web Interface

Users may upload photos of leaves to the online interface to get predictions about whether the leaves are healthy or unhealthy. JavaScript, HTML, and CSS are used in the interface's construction. Users may choose which image to submit by using the file upload button on the interface.

2. The Prediction Engine

Predicting whether the leaves are healthy or ill is the responsibility of the prediction engine, which processes the uploaded picture. Flask and Kera's are used in the development of the prediction engine. When a picture is uploaded, the Flask application gets it and sends it to the prediction engine. The Flask application receives a forecast from the prediction engine once it has processed the picture using the deep learning model. The forecast is then shown to the user via the Flask app. The test leaf images we used are:

Figure 5 -AppleCedarRust3

Figure 6 -PotatoEarlyBlight3

Figure 7 - TomatoHealthy

The Main Screen

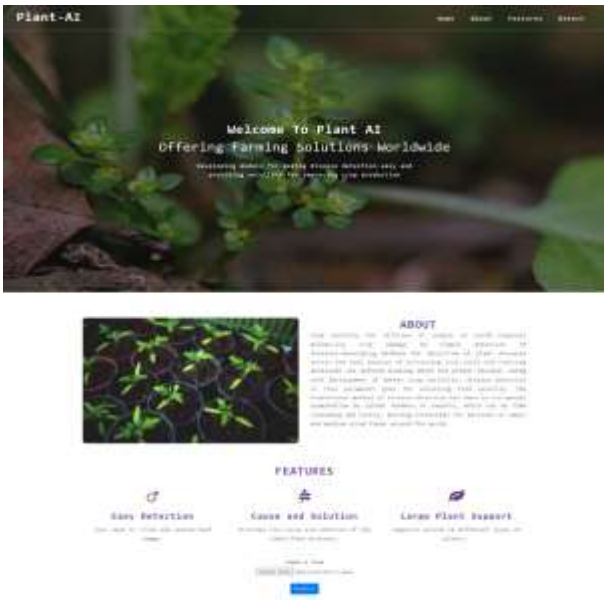

Figure 8 -Main screen when Flask Module Opened

The test picture is chosen on the flask module's main panel. After selecting the predict button, the test image's condition is displayed.

Figure 9 -Main screen with the test image given

The Result Screen

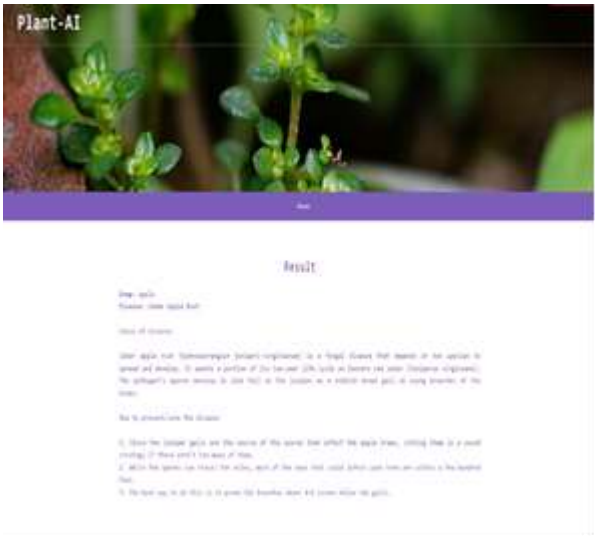

Figure 10 -The Result for the given Test Image

Following prediction, the result screen displays the crop's
name, the illness's name, its cause, and recommended preventive steps to combat the disease. and if the leaf is healthy, it displays the name of the crop along with the phrase "The crop is healthy," indicating that no illness has been caused.

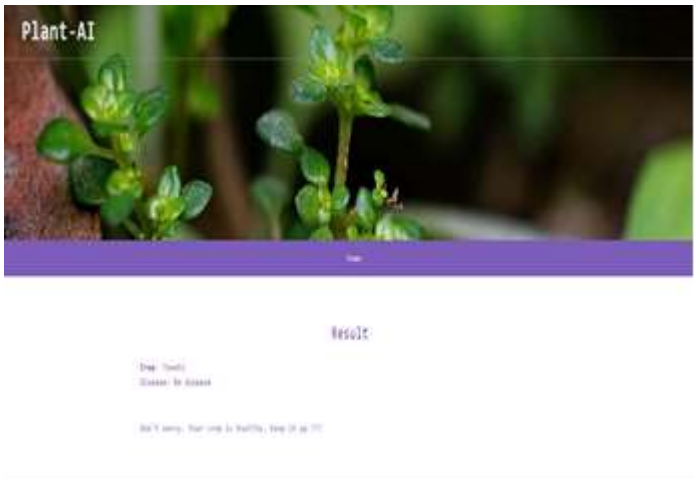

Figure 11 - Result when the Healthy Leaf tested

So, with the use of the Leaf Disease Detection Flask Module Farmers and other agriculturalists may be able to increase crop yields and identify leaf diseases more effectively. Along with the causes of illnesses, it also explains how to avoid them by using the proper amounts of pesticides and fertilizers. The program may be developed further to incorporate more functions and a wider range of leaf illnesses, giving users access to more thorough information about leaf health.

V. CONCLUSION

Agriculture is gaining energy from a variety of technologies, such as IOT.This project is a web-based commercial tool for crop health monitoring. The program will assist farmers in monitoring crop health and increase the effectiveness of crop harvesting. The only thing this framework can do is determine if the leaf which is testing is infected or not. The name of the pesticide that must be used in order to stop the illness from spreading is another significant advantage of this approach. In order to save labour expenses and eliminate the need for routine plant observation to determine whether or not a disease is affecting a plant, the precise name of the pesticide corresponding to the illness is provided.

VI. FUTURE SCOPE

Plant disease detection using Flask apps has a promising future with the potential to revolutionize agriculture. Here are some exciting possibilities:

Detection of several diseases and pests: This project is capable of identifying a greater variety of plant diseases and pests, including early warning indicators, than just one illness.
Analysis of nutritional deficiencies: The program might examine plant tissues to find nutrient deficits and provide remedies.

Real-time field monitoring: By integrating drones or IoT sensors, it may be possible to continuously monitor crops, which would facilitate early disease detection and better disease control.

VII. REFERENCES

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https://www.kaggle.com/datasets/kaustubhb999/tomatoleaf
[5] Dataset2
https://www.kaggle.com/datasets/ranveerrathour/potatoapple-disease