IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Combatting Plant Pathogens: Detection And Remedial Strategies

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ABSTRACT

Plant diseases pose formidable challenges to global food production, impacting crop yields, quality, and overall agricultural sustainability. Plant cultivation faces persistent threats from various pathogens. Early diagnosis and appropriate remedy of plant diseases is crucial for preventing widespread crop damage, ensuring food security and enhance the quality of the production. This project focuses on the development of a comprehensive framework for combatting plant pathogens through the integration of Convolutional Neural Networks (CNNs) for detection and remedial strategies. By employing sophisticated image processing techniques, the proposed system aims to analyze visual symptoms captured through imaging technology, facilitating early disease identification. The implementation of CNNs promises to revolutionize the traditional methods of disease diagnosis, enabling farmers to take proactive measures to prevent and control outbreaks. The main objective is to offer efficient and timely solutions for safeguarding plants against various diseases by providing specific remedies and preventive measures.

1. INTRODUCTION

Agriculture plays a crucial role in society, providing food and resources for a growing global population. Farmers face numerous challenges as they do not know about that disease of plants at the right time. The identification of plant diseases traditionally relied on visual inspection by agricultural experts, which often led to delayed diagnoses and ineffective control measures. Due to population growth and environmental changes, the need for accurate, rapid and innovative approaches for disease detection is increased. This project provides rapid and accurate identification of plant diseases. In addition to disease detection, this project explores remedial strategies by integrating CNN-based identification with precision agriculture methods.

Combatting Plant Pathogens: Detection and Remedial Strategies embarks on a pioneering journey to redefine the battleground against agricultural threats, focusing on a harmonious interplay of detection and innovative remedial strategies. The goal is to create a holistic approach that not only identifies plant pathogens but also optimizes the application of remedial measures. By combining AI-driven detection with precision agriculture techniques, such as targeted pesticide application and alternative organic treatments, it enhance the efficacy of disease management strategies.

The anticipated outcomes of this project include the development of a robust and automated system capable of recognizing a wide range of plant diseases. This system is expected to provide farmers with timely and

accurate information, enabling them to make informed decisions to protect their crops. Furthermore, by integrating CNN-based detection with precision agriculture practices, the research aims to contribute to sustainable farming by minimizing theenvironmental impact of disease management strategies.

This project represents a significant step towards a more resilient and technology- driven agricultural sector, emphasizing the synergy between artificial intelligence and precision agriculture. The integration of CNNs for plant pathogen detection and remedial strategies holds the potential to transform the way farmers approach disease management, fostering a more sustainable and productive agricultural ecosystem.

The advent of advanced technologies, particularly in the field of artificial intelligence (AI), has opened new avenues for improving disease management in agriculture. Convolutional Neural Networks, a class of deep learning models, have demonstrated remarkable success in image recognition tasks. Their ability to automatically learn hierarchical features from raw data makes them particularly well-suited for the complex and nuanced visual patterns associated with plant diseases.

The significance of this project is as follows: Timely and accurate detection of plant diseases is critical for implementing effective control measures. The consequences of delayed or inaccurate disease identification are profound, impacting not only crop yields but also contributing to increased reliance on chemical treatments, raising environmental concerns. The ability to identify pathogens at an early stage enables farmers to intervene promptly, preventing the spread of diseases and minimizing crop losses. Conventional methods of disease identification often struggle with the diverse and evolving nature of plant pathogens. The integration of CNNs, known for their prowess in image recognition tasks, offers a promising solution to enhance the accuracy and efficiency of disease detection, marking a significant departure from traditional approaches.

This project aims to address the critical issues surrounding plant disease detection in modern agriculture. It will leverage cutting-edge technologies and methodologies to develop a comprehensive system that combines both plant disease detection and implementing remedial strategies.

2. LITERATURE SURVEY

Title: Smart Agriculture Monitoring using Energy Harvesting Internet of Things (EHIoT)

Author: H. Sharma, A. Haque, Z. Jaffery

Year: 2019

Description: The Internet of Things (IoT) are now a days being used for the smart agriculture monitoring and control applications. Small wireless sensor networks (WSN) are used as IoT nodes in agriculture monitoring which is very much similar to those used in Industries, Process control, Building Automation and Security Systems. This paper proposes IoT sensor nodes which are powered by solar energy are used for monitoring and control of agriculture fields. The monitoring and control in agriculture fileds include operations like crops managements, crops harvesting, water supply control, animal control, pesticide distribution, humidity and temperature measurement applications.

Title: Plant Disease Detection Using Machine LearningAuthor: Shima Ramesh, Ramachandra Hebbar

Year: 2018

Description: Crop diseases are a noteworthy risk to sustenance security, however their quick distinguishing proof stays troublesome in numerous parts of the world because of the non-attendance of the important foundation. Emergence of accurate techniques in the field of leaf-based image classification has shown impressive results. This paper makes use of Random Forest in identifying between healthy and diseased leaf from the data sets created. The proposed paper includes various phases of implementation namely dataset creation, feature extraction, training the classifier and classification. The created datasets of diseased and

healthy leaves are collectively trained under Random Forest to classify the diseased and healthy images. For extracting features of an image it utilize Histogram of an Oriented Gradient (HOG). Overall, using machine learning to train the large data sets available publicly gives a clear way to detect the disease present in plants in a colossal scale.

Title: Agriculture Monitoring System Using Smart And InnovativeFarming: A Real-Time Study

Author: Andzio Elion Privat Dany

Year: 2019

Description: In Proposed system,it is used to develop an optimal crop irrigation/agriculture system based on a network of wireless sensors. The work intended to strategize and maintain a control organism utilizing crop sensor that senses with data managing with a web application and a smartphone. Consisting three modules mobile applications, web applications and hardware. Initial module was developed and executed in the device of the connected control box to collect crop data. Using Soil moisture sensors employed to observe the soil relative to a control unit. Second one module holding a web use developed and executed to operate all related details to crop data and farming area information. Applying data mining to assess data to calculate humidity, soil temperature, and humidity for ideal prospect conduct of crop nourishment. In last part, it is largely observed to maintain crop irrigation with a mobile app on a mobile device. Given process helps manual or automatic user management. The electronically managed practice processes data from the soil moisture sensor for irrigation. On the other hand, an end user can choose for manual management of crop irrigation in operational management mode. Given system can conduct warnings with an API LINE for a LINE app. This mechanism was executed and verified in farms and fields. Results indicated that the execution was advantageous in cultivation. A soil moisture capacity has been adequately maintained for plant evolution, cost reduction, and increased cultivated production. Furthermore, this effort signifies the impelling force of agriculture by digital invention.

Title: A Study on Various Techniques for Plant Leaf Disease Detection Using Leaf Image

Author: Sakshi Raina, Abhishek Gupta

Year: 2021

Description: Agriculture plays an important role in the economy of any country and there are a lot of varieties of crops for farmers. The problem or issues occurs when the crops are infected by some disease and the farmers do not know about that disease of plants at the right time. And when the disease is detected, the farmers do not know which disease it is. Therefore, the examination of automatic leaf disease detection in agriculture is a fundamental subject of research as it could display advantages in the observation of vast fields of yields and thus identify manifestations of disease as they occur on plant leaves. The study of plant disease means the study of different patterns visible with the eyes above the plants' leaves. By looking at the different color and texture features of the same plant, now it can be analyzed that which portion of the plant is healthy and which part of the plant has a disease. The process of knowing the disease of the plant occurs in the laboratory. This process takes a lot of time and it is very expensive. For that, the researcher used different types of techniques so that disease will be detected on time and expenses should be reduced. So, this research work attempts to describe the approach suggested by the study articles. Different scholars view the images in terms of Artificial Intelligence, Machine learning and demonstrate their achievements and problems that still exist. To draw some assumptions, our study of the various approaches suggested is also given. Image Acquisition, Image Preprocessing, Image segmentation, Feature Extraction and Statistical Analysis, Classification based on classifier are the key steps for the identification of diseases. This paper provides, along with the available datasets, a survey of the available approaches to solving the problem discussed.

Title: Identification of Plant-Leaf Diseases Using CNN and Transfer- Learning Approach

Author: Sk Mahmudul Hassan,Arnab Maji

Year: 2021

Description: The timely identification and early prevention of crop diseases are essential for improving production. In this paper, deep convolutional-neural- network (CNN) models are implemented to identify and diagnose diseases in plants from their leaves, since CNNs have achieved impressive results in the field of machine vision. Standard CNN models require a large number of parameters and higher computation cost. In this paper, it replaced standard convolution with depth=separable convolution, which reduces the parameter number and computation cost. The implemented models were trained with an open dataset consisting of 14 different plant species, and 38 different categorical disease classes and healthy plant leaves. To evaluate the performance of the models, different parameters such as batch size, dropout, and different numbers of epochs were incorporated. The implemented models achieved a disease-classification accuracy rates of 98.42%, 99.11%, 97.02%, and 99.56% using InceptionV3, InceptionResNetV2, MobileNetV2, and EfficientNetB0, respectively, which were greater than that of traditional handcrafted-feature-based approaches. In comparison with other deep-learning models, the implemented model achieved better performance in terms of accuracy and it required less training time. Moreover, the MobileNetV2 architecture is compatible with mobile devices using the optimized parameter. The accuracy results in the identification of diseases showed that the deep CNN model is promising and can greatly impact the efficient identification of the diseases, and may have potential in the detection of diseases in real-time agricultural systems.

3. PROPOSED SYSTEM

In the proposed system, Combatting Plant Pathogens: Detection and Remedial strategies using CNNs presents a promising solution to revolutionize agriculture by providing an automated, efficient, and accurate method for early disease diagnosis. Beyond detection, effective solutions are integral to combatting plant pathogens. The project aims to empower farmers and agricultural experts with a powerful tool that can significantly impact crop management, ensuring better yields and sustainable agricultural practices. Using a dataset of plant images, a deep learning model, such as a Convolutional Neural Network (CNN), is trained to accurately identify diseases. The system then utilizes a knowledge base to recommend targeted remedial strategies, including appropriate pesticides and cultural practices. Additionally, a fertilizer recommendation system is incorporated, suggesting optimal fertilization strategies based on the plants.

4. MODULES

4.1.1 Data Collection and Pre-processingData Acquisition

- Data acquisition collects diverse set of plant images that include both healthyand diseased plants.
- Plant Village dataset is used, which has 54,305 image samples of different plantdisease species in 38 classes.

Data Augmentation

- Data augmentation techniques are used to artificially increase the diversity of the dataset. Common augmentations include rotation, flipping, noise removals, zooming, and changes in brightness and contrast.

4.1.2 Pathogen Identification and Surveillance Module

This module involves the identification, monitoring, and surveillance of prevalent pathogens affecting plants. Employing advanced laboratory techniques such as DNA sequencing, PCR (Polymerase Chain Reaction), this module identifies the genetic signatures of pathogens responsible for infections.It has robust information about various plant pathogens, aiding in the accurate classification of identified genetic material. Genomic analysis provides insights into pathogen characteristics, virulence factors, and potential

resistance, facilitating the development of targeted remedial strategies. By understanding their identities, targeted strategies are developed to combat them

4.1.3 Integrated Disease Management (IDM) Module

IDM involves combining various strategies, including cultural practices, chemical control into a holistic approach for disease management. By integrating different approaches, IDM helps us effectively control and prevent plant diseases. This module seamlessly integrates data from the disease identification system, remedial strategies, and fertilizer recommendations, providing a unified platform for effective decision-making. Leveraging the identified diseases and their causative agents, the IDM Module aligns targeted remedial strategies, incorporating pesticides, cultural practices, and other interventions tailored to specific pathogens.

4.1.4 Integrated Pest Management (IPM) Module

IPM is a smart and sustainable approach to protect the plants from harmful pests and diseases by using IPM toolkit which comprises a range of methods. IPM aims to manage pests, including pathogens, effectively while minimizing environmental impact and economic losses.

4.1.5 Biological Control and Remedial Strategies

This module focuses on implementing eco-friendly methods to manage diseases without relying heavily on chemical interventions. It provides efficient and timely solutions for safeguarding plants against various diseases. It also provides personalized recommendations for crop management practices, including planting schedules, irrigation, and fertilizer applications, to minimize disease risk. By harnessing the identified diseases and their causal agents, the system recommends tailored biological control measures and specific cultural practices to mitigate the impact of pathogens. Simultaneously, fertilizer recommendations are adjusted to support plant health and resilience.

5. CONCLUSION

The development of the “Combatting Plant Pathogens: Detection and Remedial Strategies" project is essential for safeguarding crop health and ensuring food security. The emphasis on early detection and targeted remedies by using advanced methods enables farmers to respond proactively to potential threats, minimizing the impact of plant diseases and also it protect the plants from harm.

6. RESULT

Fig 1: Home Page

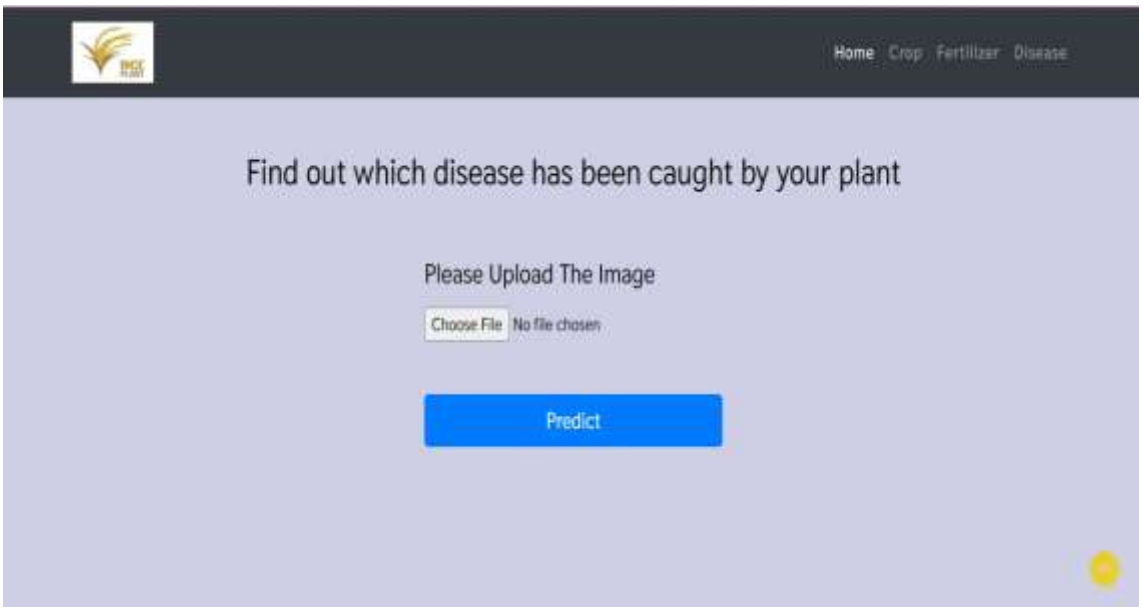

Fig 2: Pathogen Identification

Fig.3: Pathogen Identification with Input

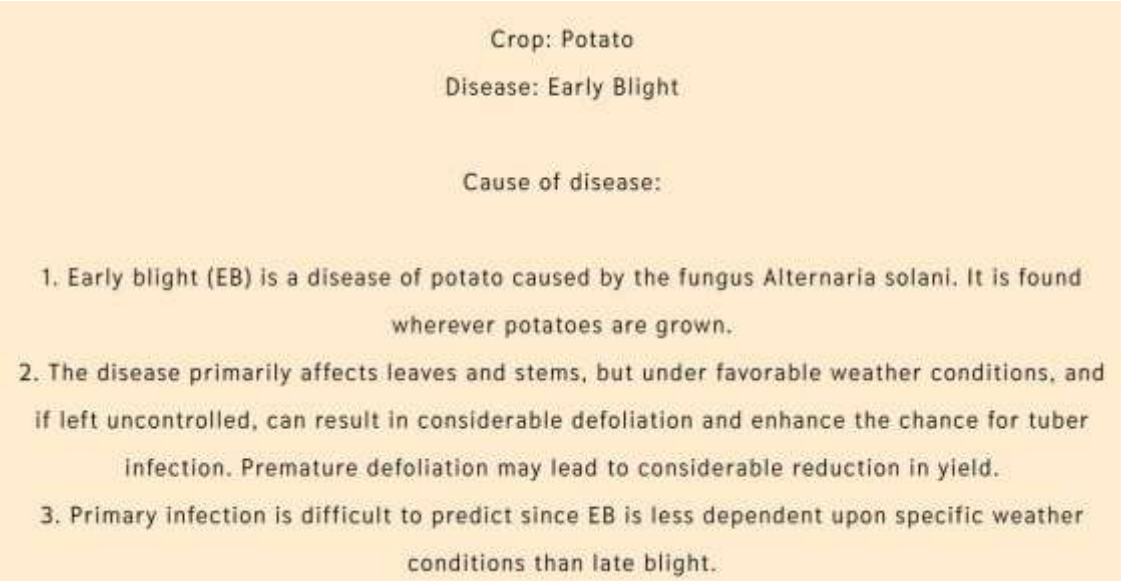

Fig.4: Pathogen Identification Output

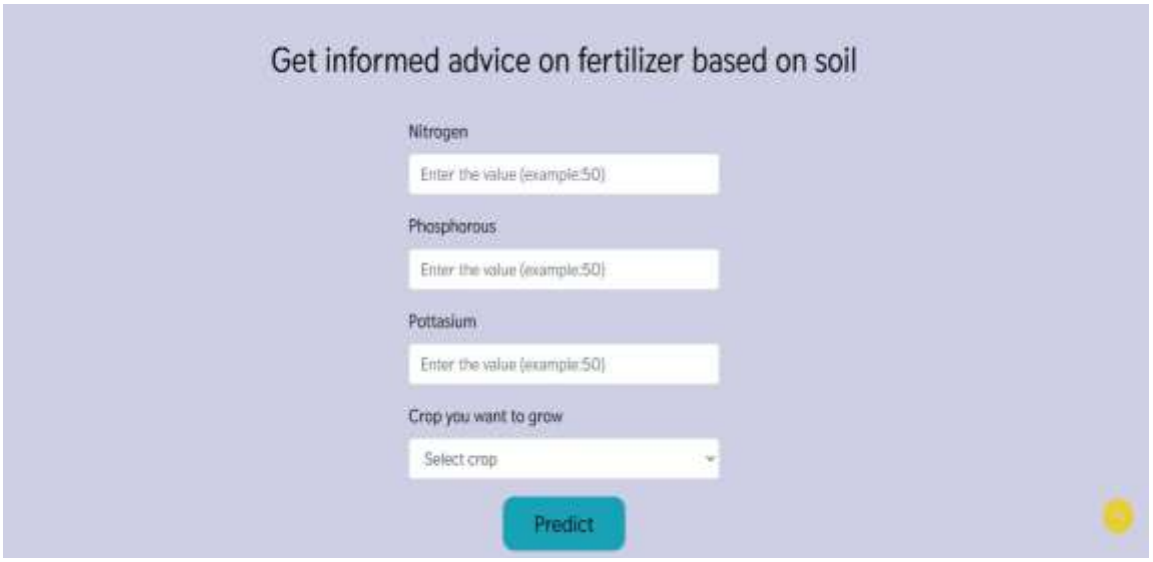

Fig.5: Fertilizer Recommendation

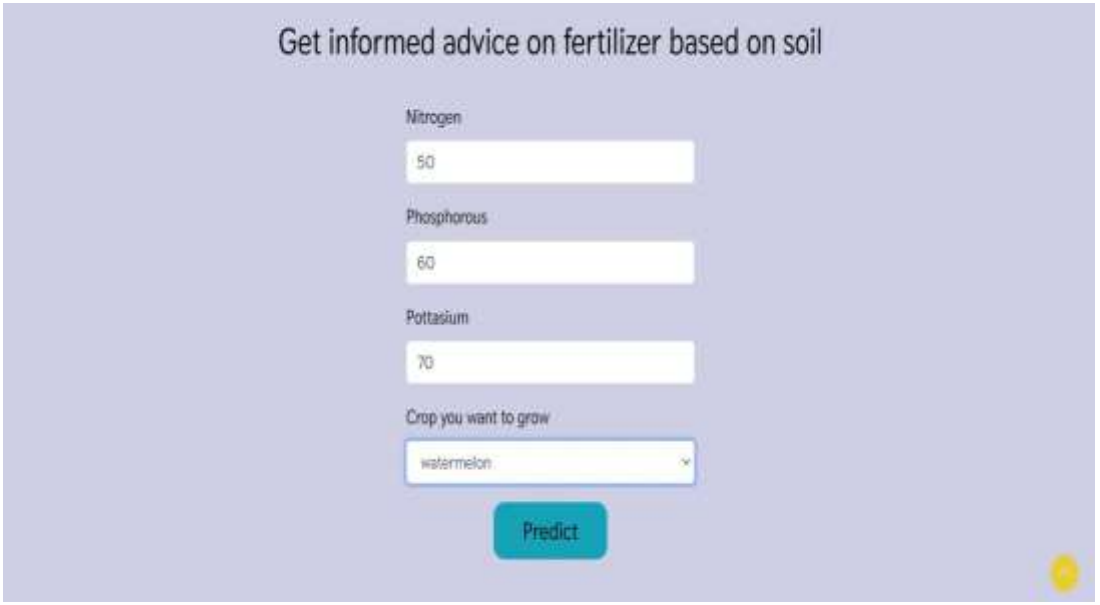

Fig.6: Fertilizer Recommendation with Input

The P value of your soil is high.

Please consider the following suggestions:

1. *Avoid adding manure* – manure contains many key nutrients for your soil but typically including high levels of phosphorous. Limiting the addition of manure will help reduce phosphorus being added.
2. *Use only phosphorus-free fertilizer* – if you can limit the amount of phosphorous added to your soil, you can let the plants use the existing phosphorus while still providing other key nutrients such as Nitrogen and Potassium. Find a fertilizer with numbers such as 10-0-10, where the zero represents no phosphorous.
3. *Water your soil* – soaking your soil liberally will aid in driving phosphorous out of the soil. This is recommended as a last ditch effort.
4. Plant nitrogen fixing vegetables to increase nitrogen without increasing phosphorous (like beans and peas).

Fig.7: Fertilizer Recommendation Output

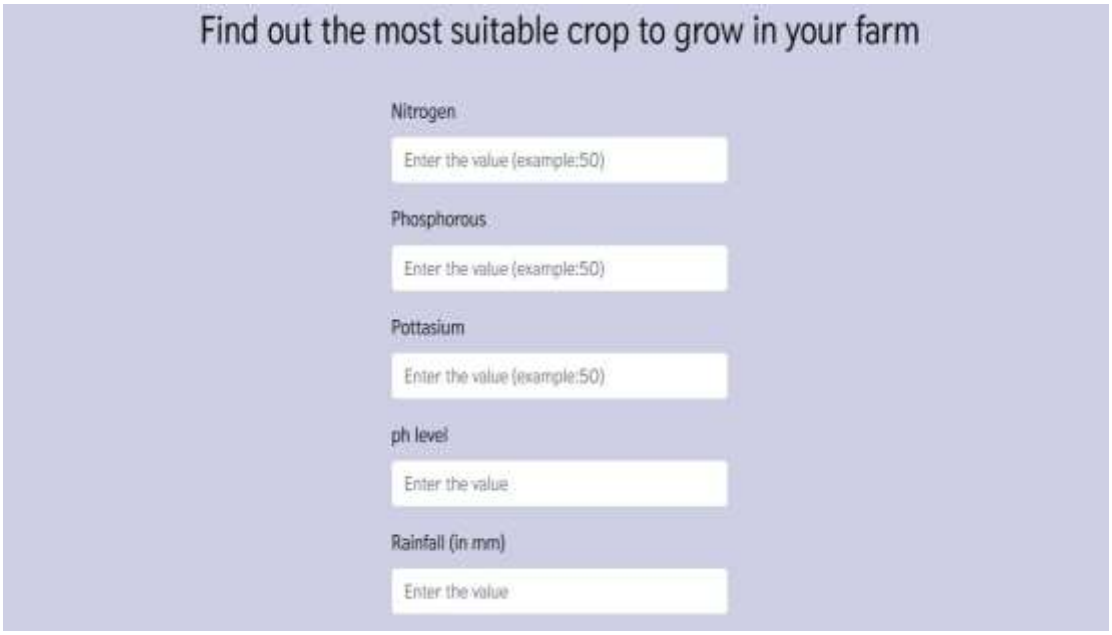

Fig.8: Crop Recommendation

Fig.9: Crop Recommendation with Input

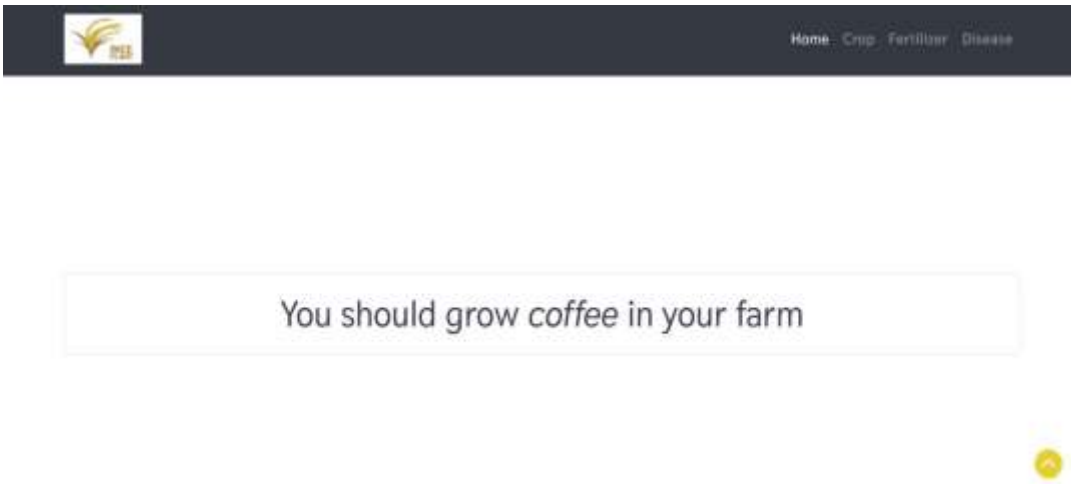

Fig.10: Crop Recommendation with Output

7. FUTURE SCOPE

Enhancements can be made to the user interface of "Combatting Plant Pathogens: Detection and Remedial Strategies" to make them more user-friendly by developing a mobile application that allows farmers to easily access informationabout plant diseases, receive real-time alerts.

8. REFERENCE

1. N. Gandhi, L. J. Armstrong, O. Petkar, and A. K. Tripathy, ''Rice crop yield prediction in India using support vector machines'', in Proc. 13th Int. Joint Conf. Comput. Sci. Softw. Eng. (JCSSE), Jul. 2016, pp. 1–5.

2. M. Khan and S. Noor, ''Irrigation runoff volume prediction using machine learning algorithms'', Eur. Int. J. Sci. Technol., vol. 8, pp. 1–22, Jan. 2019.

3. M. Khan and S. Noor, ''Performance analysis of regression-machine learning algorithms for predication of runoff time'', Agrotechnology, vol. 8, no. 1, pp. 1–12, 2019.

4. H. S. Gill, G. Murugesan, B. S. Khehra, G. S. Sajja, G. Gupta, and A. Bhatt, ''Fruit recognition from images using deep learning applications'', Multimedia Tools Appl., vol. 81, no. 23, pp. 33269–33290, Sep. 2022.

5. S. Khaki and L. Wang, '' Crop yield prediction using deep neural networks", Frontiers Plant Sci., vol. 10, p. 621, May 2019.

6. E. Khosla, R. Dharavath, and R. Priya, ''Crop yield prediction using aggregated rainfall-based modular artificial neural networks and support vector regression'', Environ., Develop. Sustainability, vol. 22, no. 6, pp. 5687–5708, Aug. 2020.

7. P. S. Maya Gopal and R. Bhargavi, ''Optimum feature subset for optimizing crop yield prediction using filter and wrapper approaches'', Appl. Eng. Agricult.,vol. 35, no. 1, pp. 9–14, 2019.

8. P. S. M. Gopal and R. Bhargavi, ''Performance evaluation of best feature subsets for crop yield prediction using machine learning algorithms', Appl. Artif.Intell., vol. 33, no. 7, pp. 621–642, Jun. 2019.