Yolo-Based Plant Disease Identification And Fertilizer/Pesticides Recommender System Application

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***Abstract*— The use of efficient machine learning algorithms in this complicated setting to identify plant and crop diseases is a call to action for technological advancement in the agricultural industry. The ability to digitally detect plant diseases has opened the door to more informed analysis, planning, and decision-making support made feasible by today's technology. By reducing the effect of illnesses on agricultural production and bolstering the sustainability of the agricultural sector in the long run, this method outperforms the conventional knowledge and exemplifies attention to detail. Here, we took a look at the YOLO method, a machine learning tool for detecting diseases in plant leaves, and discussed some of the problems with it and how to fix them. Automated disease detection technologies might assist farmers improve crop management, which could result in higher yields. This algorithm, which was trained using image data, is the best at detecting early symptoms of illness.In order to accomplish this, we will take a look at the YOLO model for detecting diseases in plant leaves and review the problems and solutions that come with it. So, the deep learning algorithm aids in disease identification and also provides solutions for intelligent agriculture and disease cures.**

Index Terms — Machine Learning, Application, Recommendation System, Cloud, Agriculture, YOLO.

I.INTRODUCTION

In view of its critical significance in a country's economic development, agriculture ranks among the most important economic sectors worldwide. From its humble beginnings as a means of subsistence to its current state as a sophisticated enterprise, agriculture has come a long way.Pests and diseases that affect plants are a major problem in farming because they reduce agricultural yields and quality. Fungi, bacteria, viruses, and other pathogens can cause plant illnesses, and if not addressed, they can spread quickly. One of the most prevalent plant diseases, leaf diseases may wreak havoc on harvests. The agricultural industry relies on prompt identification and diagnosis of leaf diseases.

In order to keep crops and fruits healthy and free of pests and illnesses that ruin them, it is necessary to identify these problems and then suggest fertilizers and pesticides that will help. Because they reduce plant health and yield, plant diseases are an essential topic to study. Conventional approaches are labor-intensive, costly, and time-consuming, and they have trouble detecting accurately. For the sake of both businesses and the environment, agriculture can profit from this fast and accurate disease diagnostic and pesticide and fertilizer recommendation system.

Traditional methods of plant disease detection rely on human observers looking for symptoms of illness. This becomes unaffordable when dealing with huge farms because of the huge number of specialists required and the continual plant monitoring. But in other countries, farmers either don't have access to the necessary resources or aren't aware of where to find experts. This means that seeking the advice of experts can be a time-consuming and financially draining affair. In these cases, the suggested approach is useful for monitoring large agricultural areas. It is more effective and cheaper to automatically diagnose plant diseases using visual clues on leaves. This also helps machine vision, which uses images to do inspections, guide robotics, and control processes automatically.

In order to effectively and accurately avoid plant diseases in complicated environments, it is necessary to first identify these diseases. Modern technology has made it possible to digitally identify plant diseases, which in turn allows for smart assessments and advanced decision assistance. This approach demonstrates precision, outperforming the conventional wisdom by mitigating the impact of diseases on agricultural output while promoting the long-term viability of the agricultural sector. Consequently, the algorithm is useful because it not only finds the sickness but also provides a cure, as well as information about intelligent farming and agricultural output.

II. RELATED WORK

In order to prevent crop loss and increase productivity, this part starts by reviewing the research on how to employ the right

procedures to identify healthy and sick leaves. Here we look at various machine learning methods that are currently available for identifying plant diseases.

In this paper, the author has used different techniques to detect the disease and give treatment. By doing so, we are able to provide customers with crucial data and suggestions for better crop management and for mitigating the effects of diseases on their harvests. Afterwards, the researchers created an Android app that improves the user interface compared to the online app, making it more convenient and accessible to more people.In order to forecast the likelihood of crop diseases based on picture classification, the writers, Mr. Sushant.S. Chavan and Mr. Nitish, took inspiration from the article "Android Based App To Prevent Crop Diseases In Various Seasons" [2]. In order for the application to provide personalized recommendations, farmers would most likely need to enter details about their crop, location, and growing circumstances. Researchers have utilized weather data and satellite pictures in this experiment to foretell when diseases could spread and notify farmers in advance.To protect different crops from illnesses at different times of the year, farmers rely heavily on knowing when and which fertilizers and pesticides to use.

Disease diagnosis consists on the following four phases, as suggested in the following paper [11] S. Ananthi, S. Vishnu Varthini "Detection of unhealthy region of plant leaves and classification of plant leaf diseases using texture features": Prior to the segmentation procedure, the input RGB image undergoes a color transformation. Then, using a certain threshold value, the green pixels are identified and rendered uninvolved. Finally, in order to generate useful segments, the texture statistics are calculated. In order to diagnose diseases and provide preventive for specific diseases, image processing can recognize color properties of leaves.This approach, according to the study, uses an image processing algorithm to identify diseased and healthy plant leaves based on their color features.

Using a single convolution neural network, the Yolo Deep Learning algorithm uses regression to identify class and object placements. After convolution on all photos, the image is converted into 416x416 in order to obtain the anticipated size from a predetermined format. They seperate the image pixels into two clusters then multiplying the clusters times the number of others to detect it is infected or not. Then the first random two centers or pixels are chosen from the infected leaf. The image is then split up into many grid cells. The task of determining whether there are items in the frame of each bounding box falls to each grid cell. Image processing-based methods for feature extraction and classification were presented by Pydipati, R., Burks, T.F., and Lee in their publication [12] "Identification of citrus disease using color texture features and discriminate analysis"

This article named "Applying image processing technique to detect plant diseases" [14] presents the method for early and accurate plant disease identification by Kulkarni et al. This approach employs a number of image processing methods, including artificial neural networks (ANN). The suggested approach achieves great results, with a recognition rate of up to 91%, thanks to its foundation in an ANN classifier for classification and a Gabor filter for feature extraction. A classifier based on artificial neural networks (ANNs) uses a combination of textures, colors, and other features to identify different plant diseases.

III. METHODOLOGY

The study's core focus is on analyzing YOLOv7's plant disease detecting capabilities. That is why we went ahead and examined a number of pertinent studies. In order to help you understand how YOLOv7 works, we compared it to competing technologies on the market and outlined its key pros and cons. You should know that this paper is all about making a complete stack app that combines YOLOv7 and a decision learning algorithm to treat sick plants with pesticides and fertilizers. In order to facilitate the sharing of solutions and suggestions between users, the program is expanding its capabilities to allow users to report issues that cannot be resolved through standard means that makes this applications more adaptable and use to understand with modern UI.

A. Yolov7 :

YOLO v7 is the latest iteration of the YOLO (You Only Look Once) method for object detection. The YOLO algorithm is well-known for being both fast and accurate when it comes to real-time object recognition. There have been numerous improvements to the architecture and training approach in YOLO v7, which has led to an increase in performance. A major aspect of YOLO v7 is its incredible speed, which allows it to process images at a staggering pace of 155 frames per second. One advantage of YOLO v7 over CNN is its superior accuracy compared to other object detection algorithms. YOLO v7 provides a fine method for auxiliary and lead loss, an efficient layer aggregation extension, capability to scale models based on concatenation, and a coarse-to-fine strategy for auxiliary and lead loss.

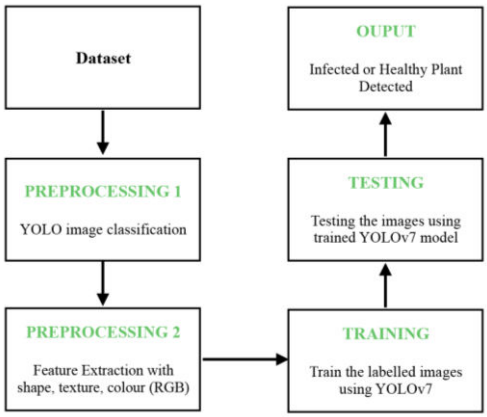

Fig 3.1 Working of YOLO in disease detection

The figure 3.1 illustrates the detection of infected or healthy plant leaf using YOLOv7 model.

B. Dataset :

This Plant Disease datasets typically encompass images and related data concerning the symptoms exhibited by various plant diseases. It is common practice to use these datasets to train machine learning models that can detect and categorize various diseases using image-based patterns and characteristics. Images of both healthy and sick crops, such as potatoes, tomatoes, and grapes, make up this dataset. There are 54,303 photos of healthy and diseased leaves in the PlantVillage collection, which is organized into 38 groups based on species and diseases and is available in the public domain.

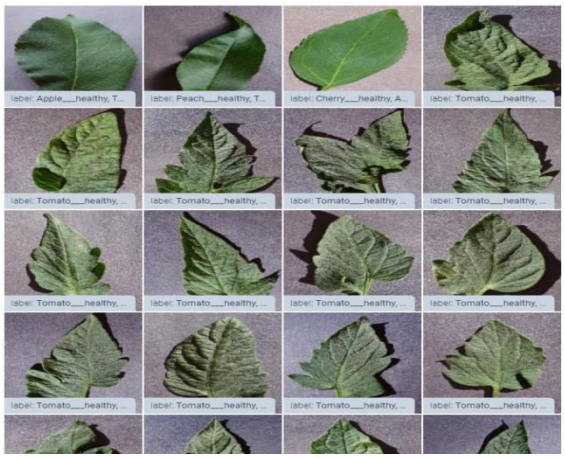

Fig 3.2 PlantVillage Dataset

The figure 3.2 illustrates the dataset of PlantVillage which consists of images with the collection of images depicting healthy and diseased crops, including tomatoes, potatoes, and grapes. It contains over 54,000 images representing 38 different group species.

C. Implementation :

The implementation process in this system that follows by using the YOLO v7 image classification technique that uses the image by recognition of patterns, color variation and spots on the plant leaf or the crop and additionally through developing the risk factors based on the levels such as high, low and moderate. By recognition of the features it tells the disease or pest that occurred to detect the disease and pests in the plant, crop and through the disease that has been identified with risk level that recommends the treatment using the decision tree algorithm with proper knowledge to the farmer when image is uploaded through this application in any format and the known disease is detected and treatment is given with proper pesticides and fertilizers within this application. If the unknown disease is detected the image with problem is posted to community then the agriculture experts or well-known farmers can give solution to it.

To deploy this model into mobile application, we need to convert the machine learning model to TensorFlow Lite. Then, we can use Android Studio to deploy it into our application. This will work for both Android and iOS. Along with the most common plant and agricultural diseases, we've included the most often cultivated crops worldwide. If you know what diseases affect plants and how to treat them, you may use fertilizers and pesticides to make your crops healthier. Standard information regarding agricultural or plant diseases is provided, along with further details like how to avoid them.

IV. EXISTING METHOD

The existing systems that widely used have been built utilizing CNN machine learning methods and Artificial Neural Networks. However, the accuracy of these models is limited, and the classification techniques used have only been designed to detect diseases in one specific type of plants.Part of the process involves capturing an RGB photograph of the crop or plant; next, the green pixel is separated from the original; finally, the disease is identified and categorized based on the color changes between the affected and unaffected areas. This is because the plant disease dataset used for picture classification has too many classes, leading to inaccurate results and wide confidence ranges. In order to circumvent this requirement, the YOLO v7 algorithm was developed. An important issue is that farmers still rely on their naked eyes to identify plant illnesses. This method has its limitations, as the farmer cannot tell which specific disease has affected the plant. Both the problems and the time-consuming methods of disease detection continue to be barriers for farmers.

V. PROPOSED METHOD

The development of the proposed system was intended to be in the best interest of the agriculture sector and farmers. In addition to detecting plant diseases, our system efficiently recommends pesticides and fertilizers based on risk factors for those diseases in an efficient way :

1. Machine Learning Model : In this system we used the YOLO image classification technique that uses the image for recognition of patterns, color variation and spots on the plant leaf or the crop. By recognition of the features it tells the disease that occurred.

2. Recommendation system : By using the decision tree algorithm based on the risk factor analysis method it recommends the treatment for specific disease.

3. Diseases and treatment : By adding the mostly used crops and plant in the dataset with the major diseases that appears on crops and plant leafs. Along with the disease and also providing the treatment to the following disease that is detected in the database.

4. Cloud : By using the MongoDB for query database and the google firebase storage for storage database for storing the files such as images of user generated documents and other in app plant images for information.

The approach that has been presented consists of three parts.

A. YOLO v7 Algorithm :

By using the YOLO v7 algorithm which increases the efficiency and the confidence intervals of this model. The images were inputted into the training and pre-processing then we use the image for recognition of patterns, color variation and spots on the plant leaf or the crop. It is based on the color transformation structure is taken for the input RGB image then is undergoes to the colour variation, patterns on the leaf and the spots to separate the diseased leaf from the infected part and the healthy leaf of the plant. Then by developing a risk factor upon the YOLO image classification the plant disease is identified as high, low, moderate to recommend the precise fertilizers and pesticides to infected plant.

B. Recommendation System :

Upon the identification of the plant disease, the system proceeds to suggest the most appropriate fertilizer or the pesticides, taking into consideration the specific disease type and various risk factors that developed upon. The recommendation module undergoes training on a comprehensive dataset that correlates different fertilizers with corresponding plant diseases. The system employs a decision tree algorithm to recommend the most suitable fertilizer, considering the detected plant disease and the risk factors such as low, moderate and high. The recommended fertilizer is then provided to the user, who can subsequently apply it to the plant or the crop.

C. Unknown Disease Identified :

In the event that an unidentified disease is discovered through the use of the YOLO image classification, the image along with a description of the problem can be uploaded to the application community section, and then the MongoDB and firebase storage services can be utilized. It is possible for agriculture specialists and well-known farmers to provide a solution to their difficulty. This feature in mobile application makes more productive.

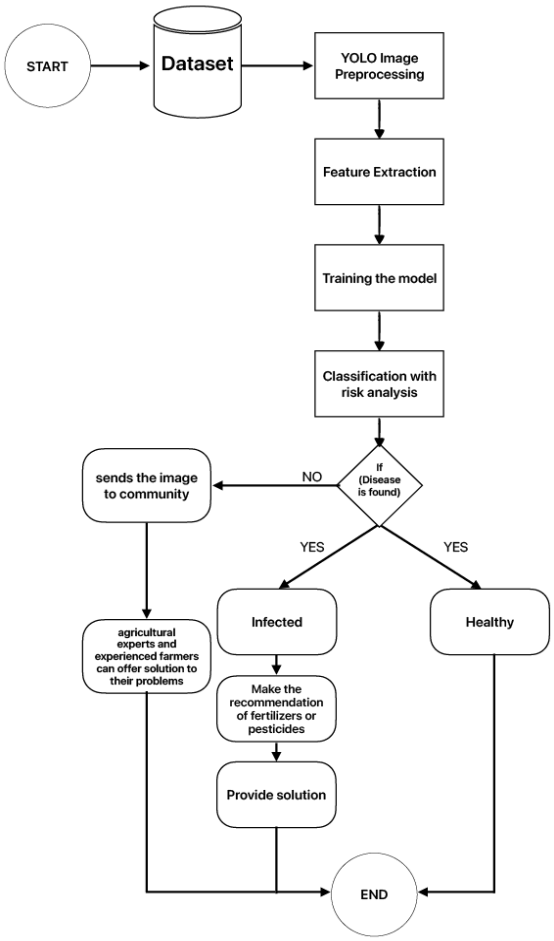

Fig 5.1 Working of Application flow diagram

The flow diagram of the application's workflow is shown in Figure 5.1.

VI. RESULTS AND DISCUSSION

The Plants Disease Detection and Fertilizer Recommender System using YOLOv7 model is a powerful tool that combines deep learning algorithms into mobile application to assist farmers in detecting diseases in their crops and recommending the appropriate fertilizers and pesticides treatment for optimal growth and yield with more modern and easy for understanding. By leveraging the capabilities of YOLOv7, the system can accurately process and classify images of healthy and infected leaves with the risk level of uploaded image.

Farmers stand to gain a great deal by implementing this approach. Farmers can take prompt action to stop the spread of plant diseases and reduce crop losses when they are detected early. The technology aids farmers in optimizing fertilizer use by giving precise recommendations; as a result, they use less chemical fertilizers and have less of an effect on the environment. Maximizing agricultural yields while simultaneously enhancing farming methods' efficiency and sustainability are the ultimate goals of the system.

VII. CONCLUSION

In conclusion, the Yolo-Based Plant Disease Identification and Fertilizer/Pesticides Recommender System that makes use of artificial intelligence and machine learning is a strategy that is promising and has the ability to fundamentally alter the agricultural sector. Deep learning algorithms, YOLO, are utilized by the system in order to effectively detect and diagnose problems in plants. By combining the YOLO and recommendation system with the decision tree algorithm, and by merging these elements into an full stack android application, we are able to provide a better advantage to farmers and users, while also providing them with an easy ability to understand the modern user interface.

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