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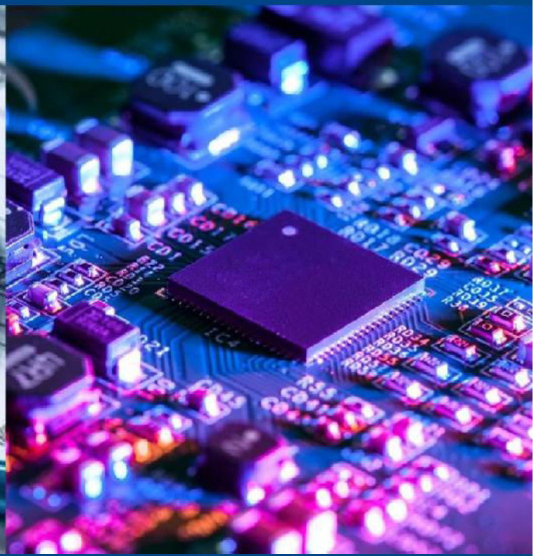

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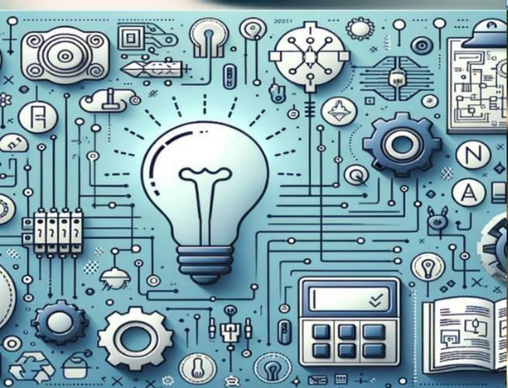

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BOTANI SCAN AI PLANT DISEASE DETECTION

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ABSTRACT: In today's agriculture, the initial detection and diagnosis of plant diseases are essential steps affecting crop loss and food security. Botani Scan AI is an AI-based deep learning web application designed to detect plant diseases using leaf images. The system uses Deep Learning with Convolutional Neural Networks (CNNs) to identify the diseases for multiple plant species and many different diseases. The user can upload one image of a plant from a leaf, then the system quickly analyzes the image and returns the name of the plant disease along with suggestions to treat any identified disease. Thus, farmers and agriculture specialists can use Botani Scan AI, an AI-powered tool, quickly, cheaply, and easily to manage plant diseases while moving to lessen the need for manual inspection and increase productivity in the cropsector.

KEYWORDS: Botani Scan AI, plant disease detection, deep learning, convolutional neural networks, smart agriculture, image classification, precision farming, AI in agriculture, leaf image analysis, and disease diagnosis systems.

I. INTRODUCTION

Agriculture is still an important foundation of the global economy and global food security, however it is becoming increasingly vulnerable to changing climate extremes, pest and plant diseases. Plants and plant health are critical to the healthy production of crops and loss of yield, timely identification and management of diseased plants is essential. Conventional approaches to detecting diseases have relied upon human experts, which can be subjective and time consuming, and often in rural or under-resourced environments, may be unavailable entirely. To begin to tackle these challenges within agriculture, Botani Scan AI automates the identification of crop diseases using deep learning and computer vision.

Botani Scan AI also provides a scalable, efficient, an affordable solution to modern agriculture, harnessing the user rapid feedback and insight from real-time field disease detection and intervention across a regional area. The lowering price of smartphones and real-time internet provide this AI-enabled tool future potential to reach farmers, at the grassroots level, within respective regions, which will greatly enhance previous intervention and crop management practices to areas across regions.

II. LITERATURE SYRVEY

Detecting noninfectious and infectious plant diseases has been studied for many years in both the agriculture and computer vision communities. Earlier approaches relied primarily on observations of experts, and laboratory testing, which are expensive, and time consuming, and not feasible for large scale use. These last few years have seen an increasing number of studies apply automated methods using machine learning and imaging techniques to detect disease based on appearance (visible symptoms) on leaves. Patil and Kumar (2011) considered detecting leaf disease based on image segmentation with K-means clustering, but had limited results because they relied mostly on simple methods of feature extraction. Pujari et al. (2016) built on this work by considering color and texture features and using Support Vector Machines (SVM) for classification, and were able to improve classification magnitude, however they still were limited to handcrafted features.

With the advent of deep learning, Convolutional Neural Networks (CNNs) emerged as automatic detectors of plant diseases using images from leaves. Mohanty et al. (2016) successfully applied Deep CNNs on the Plant Village dataset

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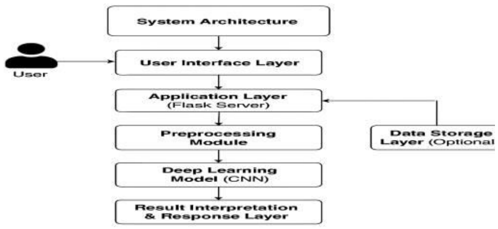
and achieved > 99 percent accuracy on identifying 26 diseases across 14 crop species. However, the model used ideal conditions for image capture; therefore, they had not considered robustness relative to conditions experienced through established field settings. More recently, Ferentinos (2018) was able to successfully apply Convolutional Neural Network (CNN) architectures including AlexNet, VGG, and ResNet to build models of high generalizability in real world conditions.

These themes emerge frequently in imaging plant disease detection research. However, due to requiring relatively potent computational power, and large, annotated datasets for training, they face obstacles in accessibility and application. EXISTING SYSTEM The older methods for identifying diseases in plants rely on manual inspections by agricultural specialists. The manual identification of diseases is exhaustive, subjective, and incomplete, and often if the identification is not done by trained agriculture personnel it can be incorrect. There have been several digital applications for disease recognition that only utilize simple image processing, or use older machine learning algorithms based on traditional models (e.g., SVM or decision trees), that rely on manual features extraction that does not scale and is difficult to make robust for real-world agricultural conditions. These and associated systems often have no accuracy, or inaccuracy based on changing lighting, or background noise, or occluded leaf images for example. Most of the existing work has little or no user interface, or a web deployment, or is not accessible for farmers with a low degree of technical literacy PROPOSED SYSTEM Botani Scan AI- Botani Scan AI will use deep learning with convolutional neural networks (CNN) to identify and classify the diseases in images of leaves, with a high degree of accuracy automatically. Botani Scan AI does not rely on manual feature engineering (older systems) in the training process. The model and system are trained with a diversity of the images concerned and anatomical variation, leaving this more representative of real-world conditions. These systems were developed with a cloud deployment through the URL of a Flask-built web application that allows the user to upload their images and receive disease identification and subsequent actions. Botani Scan AI provides solutions that help bridge the gap between high-performance AI, linking it to the day-to-day needs of target farmers, and provide a scalable solution for accuracy and controllable diagnostics.

III. SYSTEM ARCHITECTURE

Secure Bridge architecture includes four main layers of architecture: Presentation Layer, Business Layer, Service Layer, and Data Access Layer. This structure keeps the applications modular, maintainable, and scalable for secure workspace activities, both individual and collaborative.



There are three user types: employees (remote professionals), company users, and administrators. Each type of user interacts with the platform at a different experience and interface adapted to their needs.
[1]User Interface Layer The User Interface layer represents the first point of contact with the users of the system. The user interface is made up of web technologies HTML, CSS, and Javascript. The user interface was designed with considerations of response and speed. The user interface is mostly self-guided and simple in design and layout to make it easier for a user who has had little to no technical experience to interact with the platform.
[2] Application Layer The workflow begins with user interaction and sending the image from the user interface to the application layer through the flask framework. The application layer encapsulates the backend logic of the system which receives the user uploaded image, identifies and acts on any erroneous uploads or errors with incorrect format structures, and then sends the problematic image to the preprocessing level for inputs. The application layer controls the entire flow of the input image to the model and the output to the user interface or display.
[3] Preprocessing Layer This layer will take the raw input image and get it ready to run through the entire prediction pipeline. It will do resizing, normalization, and change the image values into a tensor in a element-wise fashion. The experience of working with images can vary depending on the image value size source and the actual visual size they are rendered to. So, establishing these metrics is important to maintain the consistency of data inputted into the deep

learning model, thereby impacting the prediction accuracy's reliability and accuracy.

[4] Deep Learning Model Layer The foundation of the system is a trained Convolutional Neural Network (CNN) with PyTorch. The model accepts the image as input, and then processes it through the architecture to note patterns, textures, and features that represent some form of plant disease. In the end, the model will classify an image into some set of defined classes, for example, leaf blight, or rust, or healthy. Since the CNN architecture is capable of deep learning from the image features, the system has accuracy that reflects its capabilities.

[5] Disease Information Mapping Layer After the model makes its prediction, this layer maps the predicted result to specific disease characteristics. Each predicted class relates to a specific disease and this layer provides relevant data including symptoms, causes, possible treatments, and so on. The data will typically be stored in JSON format or light weight database for quick access.

[6] Response Layer The prediction and accompanying inputs are returned through this layer to be rendered on the UI. The return layer ensures the user gets returns which are informative but succinct. They will get the name of the disease, the confidence behind the prediction, and the next best steps, which should be informative and actionable.

[7] Data Storage Layer (Optional) With more sophisticated implementations of the system, you will utilize a data storage layer which saves user inputs, prediction history, and logs for how the model performs at making predictions. This is useful for monitoring trends, updating the model with new data, and eventually providing the user with personalized recommendations.

IV. METHODOLOGY

Botani Scan is a brand new online decision support tool that uses AI and has a series of steps for plant disease detection through deep learning. The first step is to take a large number of images of plant leaves and to process the images by cleaning the images and rescaling the images so they can be interpreted by the computer model. The processed data is used to train a deep learning model (Convolutional Neural Network) to learn the patterns of common plant diseases. After the model has been trained, it is paired with a simple web application. When a user uploads a leaf image, the application processes the image and predicts if the plant is healthy or diseased, and provides the user with the prediction and information.

V. DESIGN AND IMPLEMENTATION

Botani Scan AI was designed and implemented with the primary goal to offer a reliable, scalable, and easy to use platform for plant disease detection through deep learning. The user interface; the backend server; and the trained deep learning model. The user interface is developed using web-based technologies such as HTML, CSS, and JavaScript providing users with a very easy to use way to upload their plant leaf images. The user interface connects to a backend server developed using Flask (Python) resulting in the backend server managing all incoming requests and controlling how the data flows between the frontend and the Model. The development of the deep learning model (the implementation is the focus). The deep learning model we will be using is based off a model developed in PyTorch, that was trained on a large dataset of plant leaf images from many different types of crops, both healthy and diseased! The model was developed based off a Convolutional Neural Network (CNN), because CNN's are known to provide good performance in the classification of images. During training and using the dataset, the images were pre-processed; the images were resized, normalized and augmented to ensure models would take on accuracy and generalization. Once the model was trained we saved the model as a .pt file, and transferred it to the Flask server where we are now able to make inference (predictions), in real-time to aid farmer's decision making.

VI. OUTCOME OF RESEARCH

As a result, this research has led to the successful implementation and execution of a deep-learning-based diagnostic system that can accurately and efficiently detect leaf-based plant diseases. The trained Convolutional Neural Network (CNN) model had notable prediction accuracy during validation and testing that could provide a reliable diagnosis of many plant diseases from leaf images. Using the web application interface of the model, the user no longer have manual recordings as they can use any new images they upload and obtain a diagnosis.

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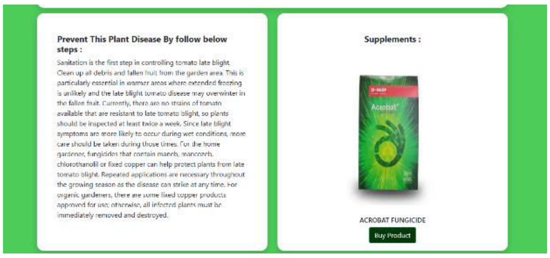
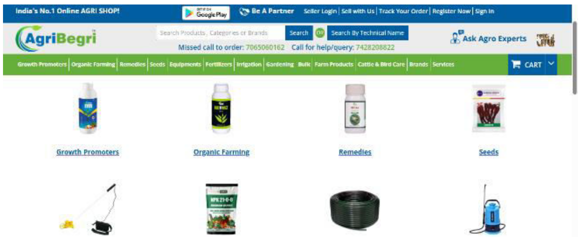
This new system has the potential to reduce dependency on the expertise of the agricultural experts and provide farmers with tangible tools for early detection of existing plant diseases, thus allowing farmers better management of their disease. Thus, we can affirm on a broad scale that AI can remove inefficiencies that could improve productivity through more professional, timely, and more readily available system-based avenues for plant disease management.





VII. RESULT AND DISCUSSION

Botani Scan AI employed an AI system with sophisticated methods of detecting plant diseases, with excellent accuracy and precision, and accuracy is defined as the ability to classify plant diseases. The Convolutional Neural Network (CNN) model was able to obtain a large and diverse data set of plant leaves (170 entries for each class) and was successful according to its evaluation metrics. In a controlled trial, the model was able to identify specific diseases; leaf spot, rust, blight, and powdery mildew. For each of the previous classification of plant diseases, the model achieved greater than 95% in all of the specific testing groups. Testing against the unseen image set was validated several times to ensure high precision and recall from the model for testing different classes of diseases. The second prime topic of discussion is about the scalability of the project. The design of Botani Scan AI is in a modular capacity, so the model can be updated with new data, and also allows the model to have new plant species and regional diseases added to it. The positive results of the current version clearly show there is opportunity for implementing deep learning to agriculture, and also demonstrates a strong foundation to invest further development into mobile formats, languages, and offline capability for rural farmers.

VIII. CONCLUSION

The actualization of Botani Scan AI illustrates a novel way of applying deep learning procedures to develop a real world solution in agricultural science. The Botani Scan system utilizes a trained Convolutional Neural Network (CNN) model integrated with a simple and user-friendly web-based interface to provide a timely and accurate scanning approach to detecting plant disease. Overall, this is an easy way to save time and energy for end-users and bolster confidence with this viable decision-support tool for the user community of agricultural professionals and farmers alike. We have seen great initial results on a broad variety of plant diseases using imagery of leaves, at a low cost, and that would be easily accessed by a wide audience. In addition to the cost and access benefits and with minimal reliance on cost of an expert for the base of the disease detection, there are additional benefits to plant health management, and as enhanced mobile app features will be added in the future we can add support for additional crops, mobile app deployment, and offline capability. Botani Scan AI generally is to enhance smart farming through the lens of artificial intelligence via viable agricultural solutions, and ultimately deliver smarter, sustainable, and technology-lead agricultural solutions. In addition, this study paves the path towards integrating AI-powered disease detection within large-scale agricultural management systems.

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