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Agrotech Fusion - Tele-Consultation application for farmers

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ABSTRACT: In the evolving landscape of agriculture, technological advancements have become a cornerstone for addressing the myriad of challenges faced by the farming community. This project delineates the development of an innovative web application tailored for farmers, aiming to revolutionize agricultural practices through a suite of integrated digital solutions. The application is designed to facilitate tele-consultations and leverage image processing for the identification of crop diseases. To address these challenges and promote the welfare of farmers across the country, we propose the development of an innovative solution that integrates tele-consultation services with image processing technology, complemented by the creation of a comprehensive national database. The primary objective of this project is to establish a robust tele-consultation platform, connecting farmers with agricultural experts. Farmers will be able to seek expert advice, thus bridging the gap between rural areas and specialized knowledge centers. Farmers will be able to capture images of their crops, leaves or specific plant parts using smartphones or other devices. These images will be processed to extract vital information about the plant's health, growth status. In conclusion, the integration of tele-consultation with image processing technology will revolutionize the agriculture and horticulture sectors, making farming more efficient, sustainable and productive. By providing farmers with expert support and leveraging data-driven insights, this project aims to uplift the livelihoods of farmers and strengthen the agricultural backbone of the nation.

I. INTRODUCTION.

Early detection of plant disease aids in the prevention of large-scale crop losses. Farmers must apply the appropriate insecticides for their crops. Too many pesticides are harmful to crops and farmland. Getting expert advice will help you avoid misusing chemicals on plants. Plants have been the focus of many researchers to aid farmers and others involved in agriculture. When a disease is visible to the naked eye, it is straightforward to detect. The illness may be discovered and treated early if the farmer has sufficient information and monitors the crops on a regular basis. However, this phase only exists when the disease is extreme or crop output is low. Then there are the different innovations. Farmers will benefit from the introduction of automated disease detection tools. This approach yields outcomes that are suitable for both little and large-scale agricultural cultivation. Importantly, the results are precise, and the disorders are detected in a very short amount of time. These technologies rely heavily on deep learning and neural networks to function. Deep Convolutional Neural Network is utilized in this study to identify infected and healthy leaves, as well as to detect illness in afflicted plants. The CNN model is designed to suit both healthy and sick leaves; photos are used to train the model, and the output is determined by the input leaf.

II. LITERATURE SURVEY

2.1. K. Muthukannan and colleagues discovered spot infections in leaves: They discovered spot infections in leaves and categorized them according to the diseased leaf categories using various machine learning algorithms. LVQ - Learning Vector Quantization, FFNN - Feed Forward Neural Network, and RBFN - Radial Basis Function Networks were utilized to diagnose diseased plant leaves by analyzing the collection of form and texture data from the afflicted leaf picture. The simulation showed that the proposed system is effective.

2.2. The study of plant leaf disease detection by Malvika Ranjan and colleagues: It starts with image capturing. Color data, such as HSV features, are retrieved from the segmentation results, and an artificial neural network (ANN) is then trained by selecting feature values that can effectively discriminate between healthy and sick samples. Using a combination of image data processing methods and ANN, the current study suggests a method for identifying cotton leaf illnesses early and reliably.

2.3. Srdjan Sladojevic and colleagues present Deep Convolutional Neural network Supported Identification of Crop Diseases by Plant Image Classification : A new method for the construction of a crop diseases recognition model based on plant image classification and deep convolutional networks. The methodology employed and the novel technique of training allow for a quick and painless system set up in practice. With the ability to identify crops from their surroundings, the built model can recognize thirteen types of plant illnesses from healthy leaves. All of the necessary processes for applying this diseases recognition model are detailed throughout the study, beginning with the collection of photographs in order to establish a database that is evaluated by agricultural experts. Caffe, a deep learning framework developed by Berkley Vision and Learning Centre, was used to perform the deep CNN training. The experimental results on the developed model achieved precision between 91% and 98%, for separate class tests, on average 96.3%.

III. SYSTEM ANALYSIS

3.1. Existing System:

The existing system for agricultural support is primarily composed of disparate, localized services with limited digital integration, relying on in-person expert consultations and conventional methods for disease diagnosis and crop management. This fragmented approach often results in delayed responses and information dissemination, with minimal use of data analytics or real-time decision-making tools. Farmers face challenges in accessing centralized information, leading to inefficiencies and a gap in harnessing advanced technological solutions for agriculture.

3.2. Proposed System:

The proposed system is a cloud-based, multi-lingual web application designed for farmers, leveraging AWS and RDS to offer real-time image processing for crop disease identification and a comprehensive agricultural knowledge repository. It facilitates immediate tele-consultation with experts, integrates geolocation for precision farming, and includes a feedback mechanism to ensure service quality. This system aims to bridge the technological gap in current agricultural practices, offering a scalable, accessible platform for enhanced decision-making and resource optimization in the farming sector. We are building a neural network model for image classification. This model will be deployed on the AWS for detection of plant leaf disease through Camera. The recognition and classification procedures are depicted.

- (1) The first step is to collect data. We are using the PlantVillage Dataset, which is widely available. This dataset was released by crowdAI.
- (2) Pre-processing and Augmentation of the collected dataset is done using pre-processing and Image-data generator API by Keras.
- (3) Building CNN(Convolutional Neural Network) Model for classification of various plant diseases.
- (4) Developed model will be deployed on the AWS.

IV. METHODOLOGY

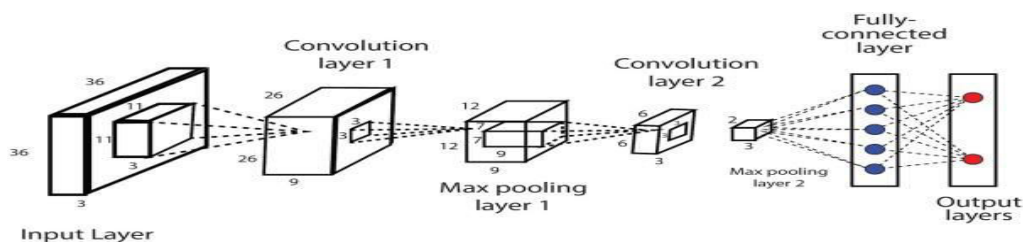
4.1. Front-end Technology :

HTML would be employed to ensure that the content is semantically structured, making it accessible and easily understandable for users and search engines. It forms would be used to enable farmers to submit queries and upload images of their crops for analysis. HTML would facilitate the display of images captured by farmers and potentially processed images showing crop health and growth status. CSS is applied to create a responsive layout, making the

application accessible and functional across various devices and screen sizes. JavaScript is used for client-side image processing, allowing for the analysis of uploaded images to extract information about crop health and diseases. JavaScript facilitate asynchronous communication with the server for tasks like submitting consultation requests and fetching expert advice. JavaScript utilizes to integrate with external APIs for accessing additional data or services, such as weather forecasts and agricultural databases.

4.2. CNN Algorithm:

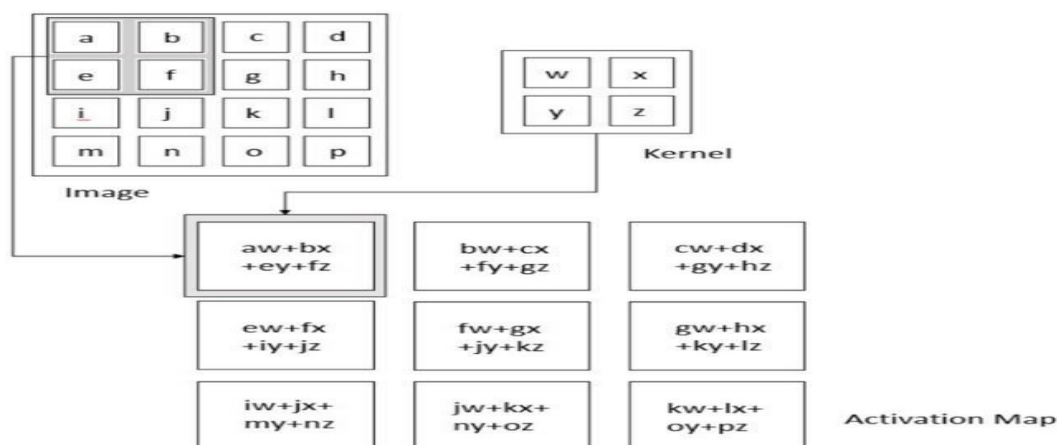
A Convolutional Neural Network has three layers: a convolutional layer, a pooling layer, and a fully connected layer.



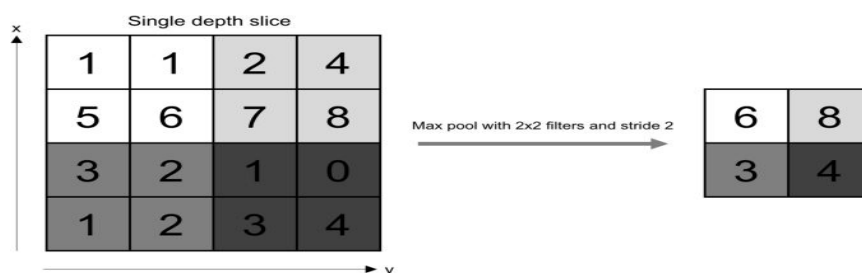
A Convolutional Neural Network has three layers: a convolutional layer, a pooling layer, and a fully connected layer.

4.2.1. Convolution Layer:

Convolutional layer produces an activation map by scanning the pictures several pixels at a time using a filter. Figure shows the internal working of the convolution layer.



4.2.2. Pooling Layer: Pooling layer: reduces the amount of data created by the convolutional layer so that it is stored more efficiently. Figure shows the internal working of the pooling layer.

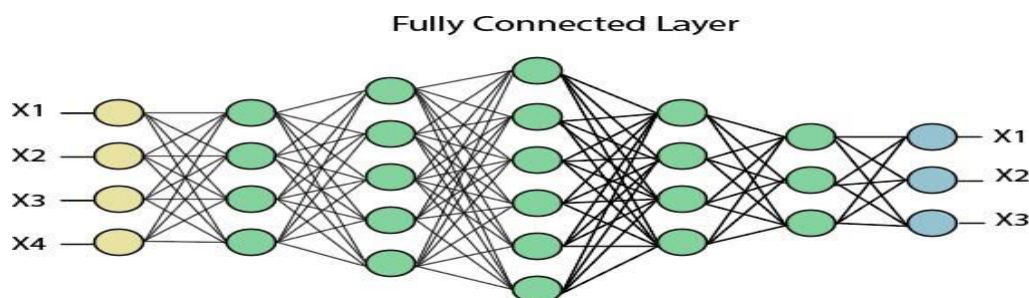


4.2.3. Fully Connected Layer:

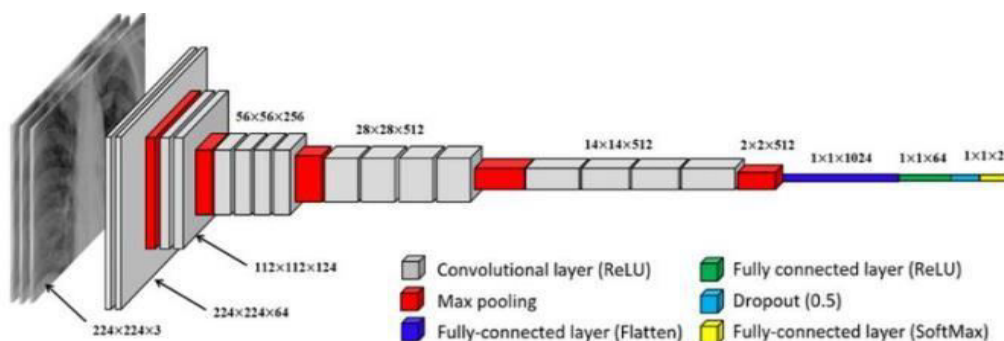
Fully connected input layer – The preceding layers' output is "flattened" and turned into a single vector which is used as an input for the next stage.

The first fully connected layer – adds weights to the inputs from the feature analysis to anticipate the proper label.

Fully connected output layer – offers the probability for each label in the end. Figure shows the internal working of fully connected layer.



VGG16 is a convolutional neural network (CNN) architecture proposed by the Visual Geometry Group (VGG). It is named "VGG16" because it consists of 16 weight layers, including 13 convolutional layers and 3 fully connected layers. VGG16 is known for its simplicity and effectiveness in image classification tasks. VGG16 has been pre-trained on large-scale image datasets like ImageNet, making it a popular choice for transfer learning.

**4.3. Google APIs for Location:**

A powerful mapping platform service developed by Google is called Google Maps API. This mapping service can be incorporated by the developers into any program or website. Additionally, developer data may be connected with this service. This service provides information on detailed street maps and imagery. Data on distance and anticipated trip times are also available. To embed Google Maps in a particular website or application, an API key is needed. To use this service and create an API key, we need a Google account. The following form is provided by the Google Maps library: com. google. Android. gms. Map View and Map Fragment classes both display the map component.

4.4. Chat-bot Algorithm:

Google Dialogflow provides the underlying technology and tools necessary to develop the conversational interface, including natural language understanding, intent recognition, context management, and integration with various platforms. By leveraging Dialogflow, we were able to create the chatbot's algorithm that interprets user inputs, determines their intent, and generates appropriate responses or actions.

V. SYSTEM DESIGN

Agricultural experts, farmers and government officers should register in the website. Farmers will be able to capture images of their crops, leaves or specific plant parts using smartphones or other devices. These images will be processed to extract vital information about the plant's health, growth status. Farmers are able to schedule appointments with

agricultural experts based on their availability. Both parties will receive notifications and reminders for upcoming consultations. The integration of tele-consultation with image processing technology will revolutionize the agriculture and horticulture sectors, making farming more efficient, sustainable and productive. By providing farmers with expert support and leveraging data-driven insights, this project aims to uplift the livelihoods of farmers and strengthen the agricultural backbone of the nation.

5.1. One to One Interaction:

With the aid of our recently suggested method, farmers and agricultural experts can converse. Both farmers and experts will find it simpler to communicate as a result experts will try to help the farmers in detecting the disease and recommend the necessary fertilizers to cure the disease.

5.2. Agri Chat-bot:

This is a built-in chatbot functionality where it helps the farmers to resolve their problems with their crop. The chatbot in the agricultural web application serves as an interactive assistant, designed to streamline communication between farmers and the system. The chatbot offers an intuitive interface for farmers to ask questions, seek advice, and access relevant information.

5.3. Crop data and disease repository:

The system contains comprehensive repository of crop data and disease information to aid in accurate disease identification. This repository could include data on crop varieties, common diseases, pest management practices, and best agricultural practices.

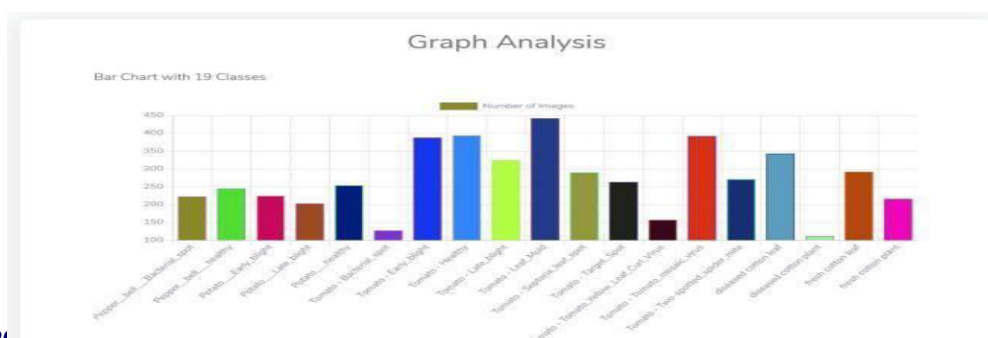
VI. RESULTS

The results of the project demonstrate the tangible impact of leveraging technology to revolutionize agricultural practices, empower farmers with knowledge and support, and foster a more resilient and sustainable farming ecosystem. Through continuous evaluation, iteration, and improvement, the application can enhance its effectiveness and positive outcomes for the farming community.

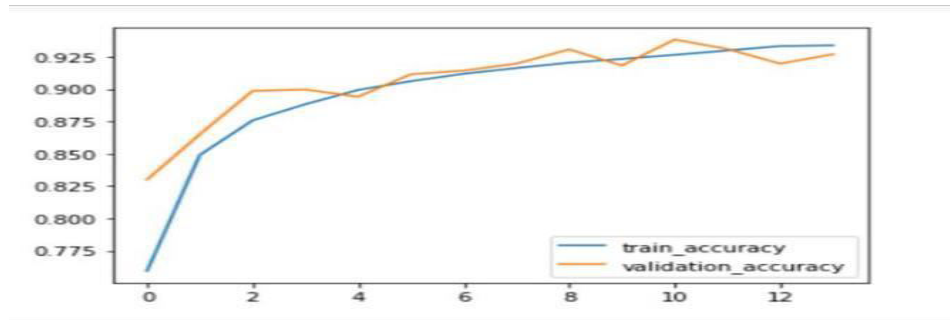
The below table represent about the status of the training, validation images and classes.

Train Test Model			Run Algorithm
Train And Test Table			
ID	Dataset uploaded successfully	Status	
1	Training Images	4580	
2	Validation Images	2346	
3	Classes	19	

The below graph is the analysis of number of images different types of infected leaves and it is classified into 19 classes.



A 95.6% accuracy rate was achieved using early stopping while Training the model on 50 epochs. Figure depicts the visualization of training and validation accuracy.



VII. CONCLUSION

The conclusion of the proposed web application for farmers is that it represents a transformative step in agricultural practices, merging advanced technologies like deep learning, AI, and cloud computing. This integrated platform is poised to significantly enhance crop disease diagnosis, decision-making processes, and resource management in farming. By offering real-time data analysis, multilingual support, and efficient expert consultation, it aims to empower the global farming community, making agriculture more efficient, sustainable, and accessible. The project showcases how technology can be leveraged to address critical challenges in the agricultural sector, ultimately contributing to improved productivity and sustainability in farming practices. The applications of Deep Convolutional Neural Networks have been formulated with the goal of classifying both crop species and identity of disease on images. We successfully created disease classification techniques used for plant leaf disease detection. A deep learning model that can be used for automatic detection and classification of plant leaf diseases is created. 19 classes of plants were taken for identification through this work. Through this, we were able to do image-processing tasks. We were also able to create the vgg-16 model which is an advanced convolution model and train the model with the data for prediction.

VIII. FUTURE ENHANCEMENT

For future enhancements, the project could explore incorporating satellite imagery and drone technology for detailed crop monitoring, implement advanced predictive analytics for yield forecasting, and integrate IoT for real-time soil and weather condition monitoring. Expanding the AI chatbot capabilities to include voice recognition and regional dialects could further enhance user accessibility. Additionally, developing a community-driven feature where farmers can share local knowledge and practices, and exploring blockchain for secure data sharing and supply chain transparency, would significantly elevate the platform's impact.

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