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AN ARTIFICIAL INTELLIGENCE AND CLOUD BASED COLLABORATIVE PLATFORM FOR PLANT DISEASE IDENTIFICATION, TRACKING AND FORECASTING FOR FARMERS

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***Abstract*—** Plant diseases are a major threat to farmers, consumers, environment and the global economy. In India alone, 35% of field crops are lost to pathogens and pests causing losses to farmers. Indiscriminate use of pesticides is also a serious health concern as many are toxic and biomagnified. These adverse effects can be avoided by early disease detection, crop surveillance and targeted treatments. Most diseases are diagnosed by agricultural experts by examining external symptoms. However, farmers have limited access to experts. Our project is the first integrated and collaborative platform for automated disease diagnosis, tracking and forecasting. Farmers can instantly and accurately identify diseases and get solutions with a mobile app by photographing affected plant parts. Real-time diagnosis is enabled using the latest Artificial Intelligence (AI) algorithms for Cloud-based image processing. The AI model continuously learns from user uploaded images and expert suggestions to enhance its accuracy. Farmers can also interact with local experts through the platform. For preventive measures, disease density maps with spread forecasting are rendered from a Cloud based repository of geo-tagged images and micro-climactic factors. A web interface allows experts to perform disease analytics with geographical visualizations. In our experiments, the AI model (CNN) was trained with large disease datasets, created with plant images self-collected from many farms over 7 months. Test images were diagnosed using the automated CNN model and the results were validated by plant pathologists. Over 95% disease identification accuracy was achieved. Our solution is a novel, scalable and accessible tool for disease management of diverse agricultural crop plants and can be deployed as a Cloud based service for farmers and experts for ecologically sustainable crop production.

1. Introduction:

Agriculture is fundamental to human survival. For populated developing countries like India, it is even more imperative to increase the productivity of crops, fruits and vegetables. Not only productivity, the quality of produce needs to stay high for better public health. However, both productivity and quality of food gets hampered by factors such as spread of diseases that could have been prevented with early diagnosis. Many of these diseases are infectious leading to total loss of crop yield. Given the vast geographical spread of agricultural lands, low education levels of farmers coupled with limited awareness and lack of access to plant pathologists, human assisted disease diagnosis is not effective and cannot keep up with the exorbitant requirements. To overcome the shortfall of human assisted disease diagnosis, it is imperative to build automation around crop disease diagnosis with technology and introduce low cost and accurate machine assisted diagnosis easily accessible to farmers. Some strides have been made in applying technologies such as robotics and computer vision systems to solve myriad problems in the agricultural domain. The potential of image processing has been explored to assist with precision agriculture practices, weed and herbicide technologies, monitoring plant growth and plant nutrition management [1][2]. However, progress on automating plant disease diagnosis is still rudimentary in spite of the fact that many plant diseases can be identified by plant pathologists by visual inspection of physical symptoms such as detectable change in color, wilting, appearance of spots and lesions etc. along with soil and climatic conditions. Overall, the commercial level of investment in bridging agriculture and technology remains lower as compared to investments done in more lucrative fields such as human health and education. Promising research efforts have not been able to productize due to challenges such as access and linkage for farmers to plant pathologists, high cost of deployment and scalability of solution. Recent developments in the fields of Mobile technology, Cloud computing and Artificial Intelligence (AI) create a perfect opportunity for creating a scalable low-cost solution for crop diseases that can be widely deployed. In developing countries such as India, mobile phones with internet connectivity have become ubiquitous. Camera and GPS enabled low cost mobile phones are widely available that can be leveraged by individuals to upload images with geolocation.

2. Literature Survey:

A survey of image processing techniques for agriculture AUTHORS: Lalit P. Saxena and Leisa J. Armstrong

ABSTRACT: Computer technologies have been shown to improve agricultural productivity in a number of ways. One technique which is emerging as a useful tool is image processing. This paper presents a short survey on using image processing techniques to assist researchers and farmers to improve agricultural practices. Image processing has been used to assist with precision agriculture practices, weed and herbicide technologies, monitoring plant growth and plant nutrition management. This paper highlights the future potential for image processing for different agricultural industry contexts.

Imagenet classification with deep convolutional neural networks AUTHORS: A. Krizhevsky, I. Sutskever and G. E. Hinton,

ABSTRACT: We trained a large, deep convolutional neural network to classify the 1.2 million high-resolution images in the ImageNet LSVRC-2010 contest into the 1000 different classes. On the test data, we achieved top-1 and top-5 error rates of 37.5% and 17.0% which is considerably better than the previous state-of-the-art. The neural network, which has 60 million parameters and 650,000 neurons, consists of five convolutional layers, some of which are followed by max-pooling layers, and three fully-connected layers with a final 1000-way softmax. To make training faster, we used non-saturating neurons and a very efficient GPU implementation of the convolution operation. To reduce overriding in the fully-connected layers we employed a recently-developed regularization method called "dropout" that proved to be very effective. We also entered a variant of this model in the ILSVRC-2012 competition and achieved a winning top-5 test error rate of 15.3%, compared to 26.2% achieved by the second-best entry.

Visible-near infrared spectroscopy for detection of Huanglongbing in citrus orchards
AUTHORS: S. Sankaran, A. Mishra, J. M. Maja and R. Ehsani

ABSTRACT: This paper evaluates the feasibility of applying visible-near infrared spectroscopy for in-field detection of Huanglongbing (HLB) in citrus orchards. Spectral reflectance data from the wavelength range of 350–2500nm with 989 spectral features were collected from 100 healthy and 93 HLB-infected citrus trees using a visible-near infrared spectroradiometer. During data preprocessing, the spectral data were normalized and averaged every 25nm to reduce the spectral features from 989 to 86. Three datasets were generated from the preprocessed raw data: first derivatives, second derivatives, and a combined dataset (generated by integrating preprocessed raw data, first derivatives and second derivatives). The preprocessed datasets were analyzed using principal component analysis (PCA) to further reduce the number of features used as inputs in the classification algorithm. The dataset consisting of principal components were randomized and separated into training and testing datasets such that 75% of the dataset was used for training; while 25% of the dataset was used for testing the classification algorithms. The number of samples in the training and testing datasets was 145 and 48, respectively. The classification algorithms tested were: linear discriminant analysis, quadratic discriminant analysis (QDA), k-nearest neighbor, and soft independent modeling of classification analogies (SIMCA).

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3. Existing System:

In India alone, 35% of field crops are lost to pathogens and pests causing losses to farmers. Indiscriminate use of pesticides is also a serious health concern as many are toxic and biomagnified. These adverse effects can be avoided by early disease detection, crop surveillance and targeted treatments. Most diseases are diagnosed by agricultural experts by examining external symptoms. However, farmers have limited access to experts.

Disadvantages:

Indiscriminate use of pesticides is also a serious health concern as many are toxic and biomagnified.

4. Proposed System

In this project author using convolution neural network as artificial intelligence to train all plant diseases images and then upon uploading new images CNN will predict plant disease available in uploaded images. For storing CNN train model and images author is using cloud services. so, using AI author predicting plant disease and cloud is used to store data.

In this Project author using smart phone to upload image but designing android application will take extra cost and time so we build it as python web application. Using this web application CNN model will get trained and user can upload images and then application will apply CNN model on uploaded images to predict diseases. If this web application deployed on real web server then it will extract users location from request object and can display those location in map

Advantages

Accurately identify diseases and get solutions with a mobile app by photographing affected plant parts.

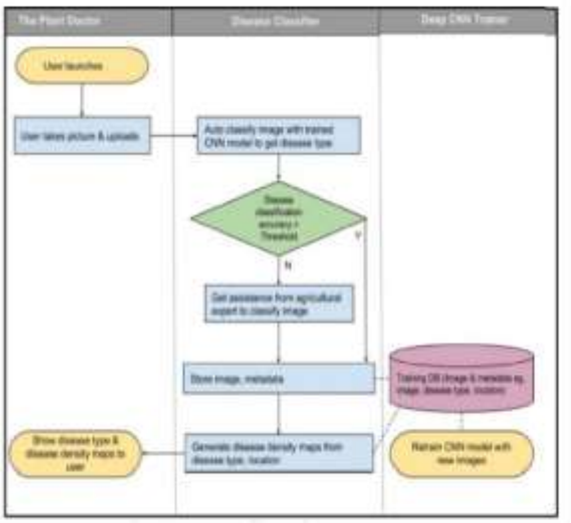


Fig.1: Proposed model flow

5. MODULES DESCRIPTION

REGISTER :

In this module user/former has to register himself.

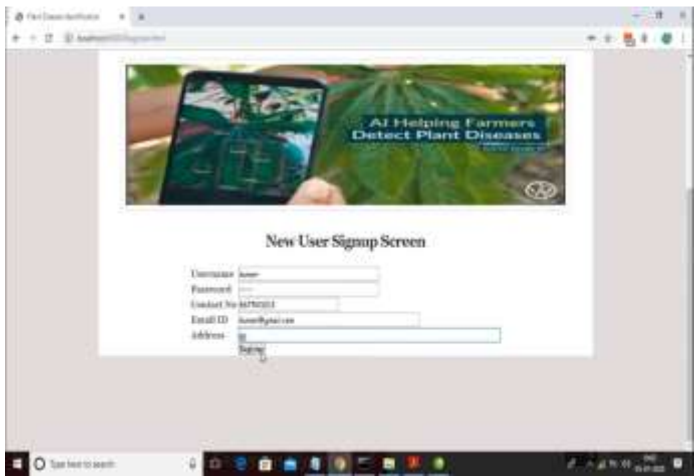
LOGIN:

In this module user/former has to login with valid user name and password.

UPLOAD PLANT IMAGE:

In this module user/former should upload plant image and can identify the plant disease.

LOGOUT:



After completion of user activities can logout from the application by using this module.

6. Result & Analysis:

7. CONCLUSION:

This paper presents an automated, low cost and easy to use end-to-end solution to one of the biggest challenges in the agricultural domain for farmers – precise, instant and early diagnosis of crop diseases and knowledge of disease outbreaks - which would be helpful in quick decision making for measures to be adopted for disease control. This proposal innovates on known prior art with the application of deep Convolutional Neural Networks (CNNs) for disease classification, introduction of social collaborative platform for progressively improved accuracy, usage of geocoded images for disease density maps and expert interface for analytics. High performing deep CNN model “Inception” enables real time classification of diseases in the Cloud platform via a user facing mobile app. Collaborative model enables continuous improvement in disease classification accuracy by automatically growing the Cloud based training dataset with user added images for retraining the CNN model. User added images in the Cloud repository also enable rendering of disease density maps based on collective disease classification data and availability of geolocation information within the images. Overall, the results of our experiments demonstrate that the proposal has significant potential for practical deployment due to multiple dimensions – the Cloud based infrastructure is highly scalable and the underlying algorithm works accurately even with large number of disease categories, performs better with high fidelity real-life training data, improves accuracy with increase in the training dataset, is capable of detecting early symptoms of diseases and is able to successfully differentiate between diseases of the same family.

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