International Journal For Advanced Research In Science & Technology
A peer reviewed international journal www.ijarst.in
ISSN: 2457-0362

Plant Disease Identification And Pesticides Recommdation Using Cnn

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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.

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

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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. Over widely available mobile networks, they can communicate with more sophisticated Cloud based backend services which can perform the compute heavy tasks, maintain a centralized database, and perform data analytics. Another leap of technology in recent years is AI based image analysis which has surpassed human eye capabilities and can accurately identify and classify images. The underlying AI algorithms use Neural Networks (NN) which have layers of neurons with a connectivity pattern inspired by the visual cortex. These networks get "trained" on a large set of pre-classified "labeled" images to achieve high accuracy of image classification on new unseen images. Since 2012 with "AlexNet" winning the ImageNet competition, deep Convolutional Neural Networks (CNNs) have consistently been the winning architecture for computer vision and image analysis [3]. The breakthrough in the capabilities of CNNs have come with a combination of improved compute capabilities, large data sets of images available and improved NN algorithms. Besides accuracy, AI has evolved and become more affordable and accessible with open source platforms such as TensorFlow [4]. Prior art related to our project includes initiatives to gather healthy and diseased crop images [5], image analysis using feature extraction [6], RGB images [7], spectral patterns [8] and fluorescence imaging spectroscopy [9]. Neural Networks have been used in the past for plant disease identification but the approach was to identify texture features. Our proposal takes advantage of the

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evolution of Mobile, Cloud and AI to develop an end-to-end crop diagnosis solution that simulates the expertise ("intelligence") of plant pathologists and brings it to farmers. It also enables a collaborative approach towards continually increasing the disease database and seeking expert advice when needed for improved NN classification accuracy and tracking for outbreaks.

2.LITERATURE SURVEY

2.1 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.

2.2 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.

2.3 Integrating soms and a bayesian classifier for segmenting diseased plants in uncontrolled environments

AUTHORS: D. L. Hernández-Rabadán, F. Ramos-Quintana and J. Guerrero Juk

ABSTRACT: This work presents a methodology that integrates a nonsupervised learning approach (self-organizing map (SOM)) and a supervised one (a Bayesian classifier) for segmenting diseased plants that grow in uncontrolled environments such as greenhouses, wherein the lack of control of illumination and presence of background bring about serious drawbacks. During the training phase two SOMs are used: one that creates color groups of images, which are classified into two groups using K -means and labeled as vegetation and nonvegetation by using rules, and a second SOM that corrects classification errors made by the first SOM. Two color histograms are generated from the two color classes and used to estimate the conditional probabilities of the Bayesian classifier. During the testing phase an input image is segmented by the Bayesian classifier and then it is converted into a binary image, wherein contours are extracted and analyzed to recover diseased areas that were incorrectly classified as nonvegetation. The experimental results using the proposed methodology showed better performance than two of the most used color index methods.

2.4 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). The reported classification accuracies of the algorithms are an average of three runs. When the second derivatives dataset were analyzed, the QDA-based classification algorithm yielded the highest overall average classification accuracies of about 95%, with HLB-class classification accuracies of about 98%. In the combined dataset, SIMCA-based algorithms resulted in high overall classification accuracies of about 92% with low false negatives (less than 3%).

2.5 Rethinking the inception architecture for computer vision

AUTHORS: Christian Szegedy, Vincent Vanhoucke, Sergey Ioffe, Jonathon Shlens, Zbigniew Wojna

ABSTRACT: Convolutional networks are at the core of most state-of-the-art computer vision solutions for a wide variety of tasks. Since 2014 very deep convolutional networks started to become mainstream, yielding substantial gains in various benchmarks. Although increased model size and computational cost tend to translate to immediate quality gains for most tasks (as long as enough labeled data is provided for training), computational efficiency and low parameter count are still enabling factors for various use cases such as mobile vision and big-data scenarios. Here we explore ways to scale up networks in ways that aim at utilizing the added computation as efficiently as possible by suitably factorized convolutions and aggressive regularization. We benchmark our methods on the ILSVRC 2012 classification challenge validation set demonstrate substantial gains over the state of the art: 21.2% top-1 and 5.6% top-5 error for single frame evaluation using a network with a computational cost of 5 billion multiply-adds per inference and with using less than 25 million parameters. With an ensemble of 4 models and multi-crop evaluation, we report 3.5% top-5 error on the validation set (3.6% error on the test set) and 17.3% top-1 error on the validation set.

3.SYSTEM ANALYSIS

3.1 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.

3.1.1 DISADVANTAGES OF EXISTING SYSTEM:

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

3.2 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

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ISSN: 2457-0362

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.

3.2.1 ADVANTAGES OF PROPOSED SYSTEM:

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

SCREENSHOTS

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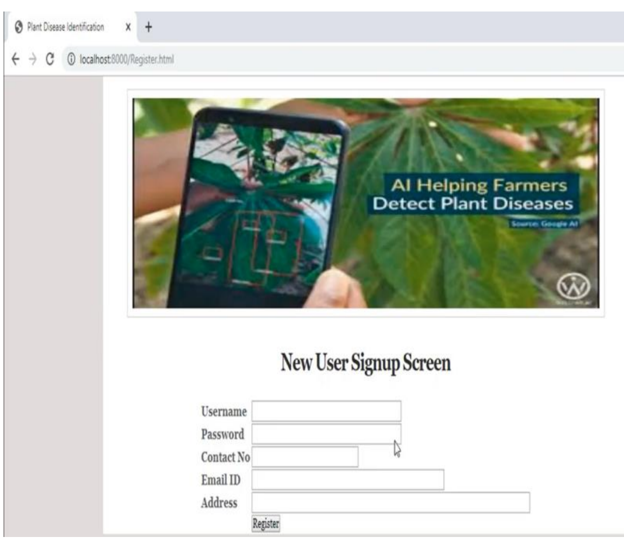
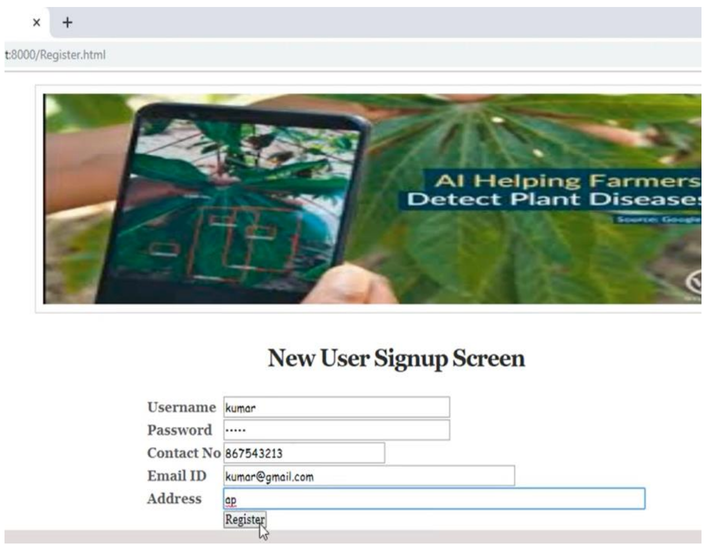
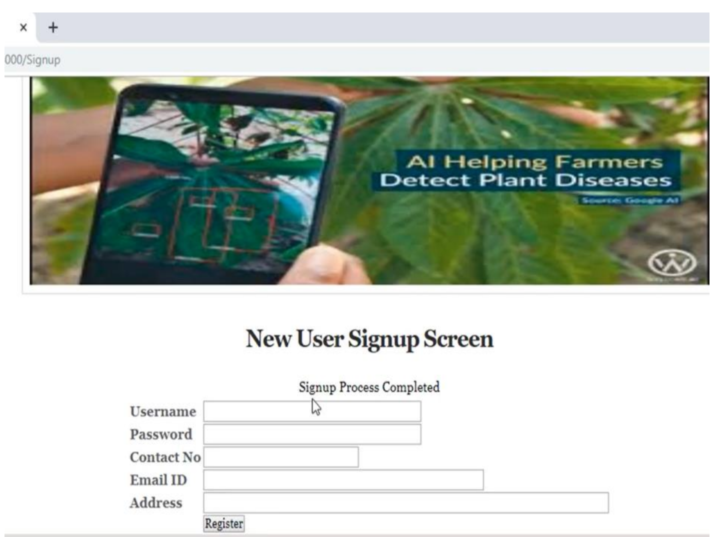




Signup



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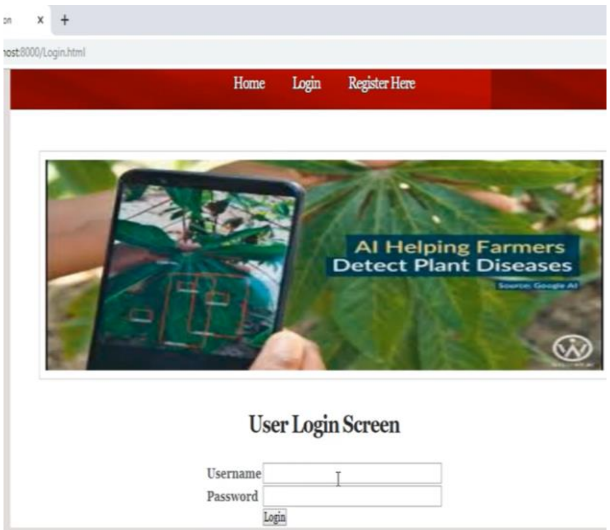
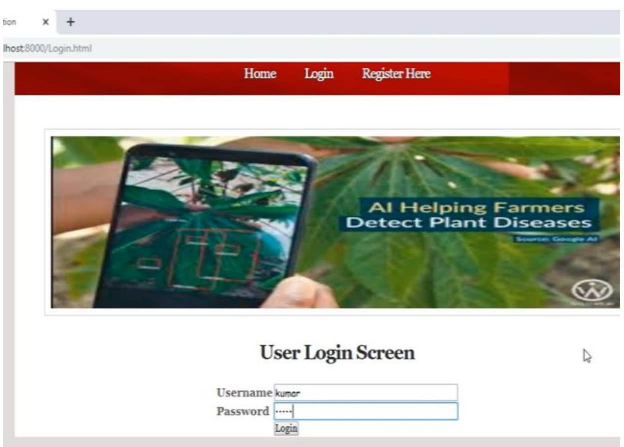
Login.html





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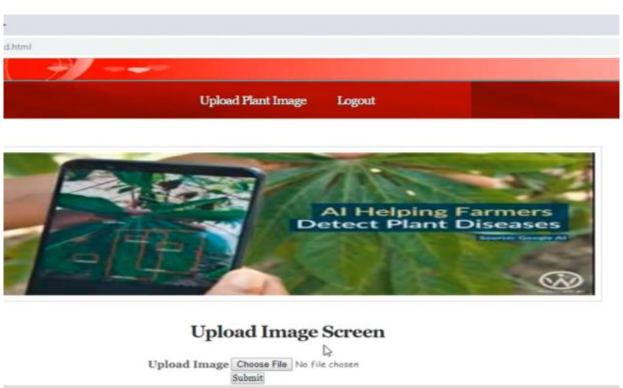

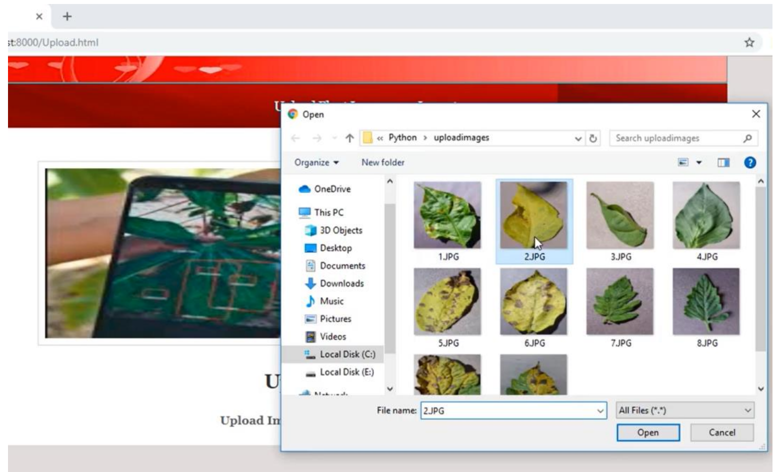

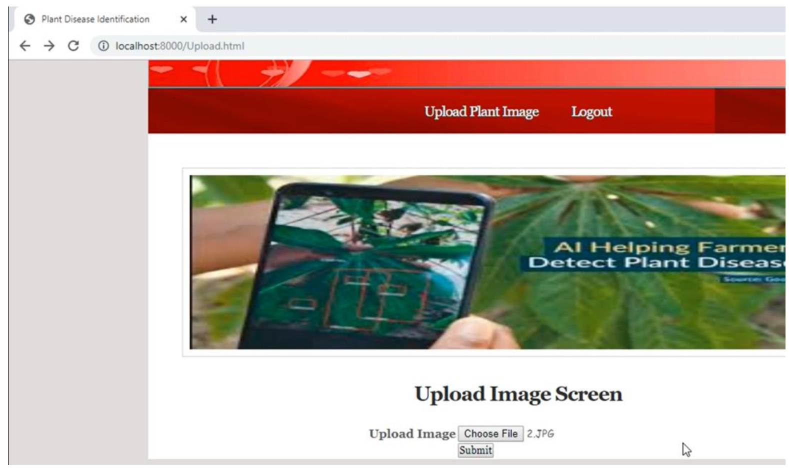

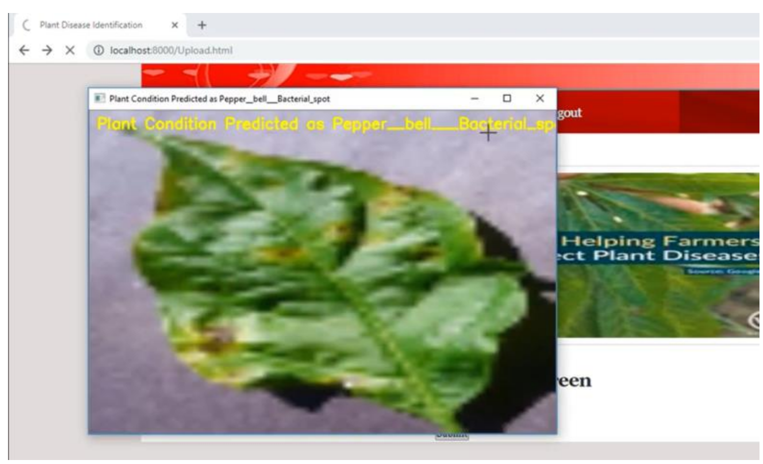

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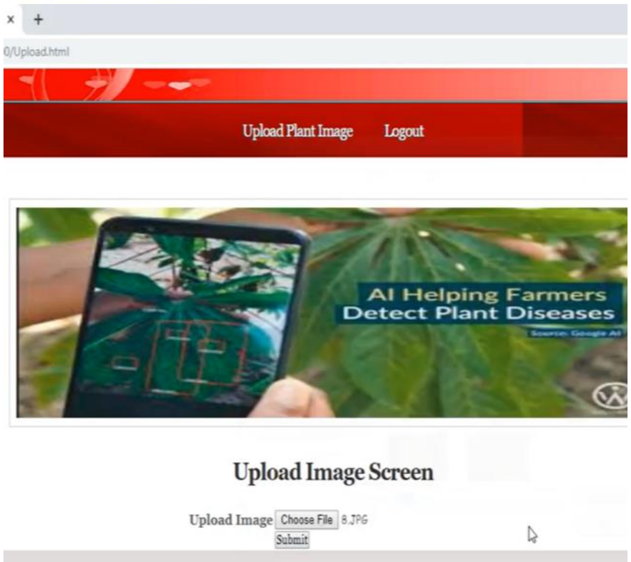
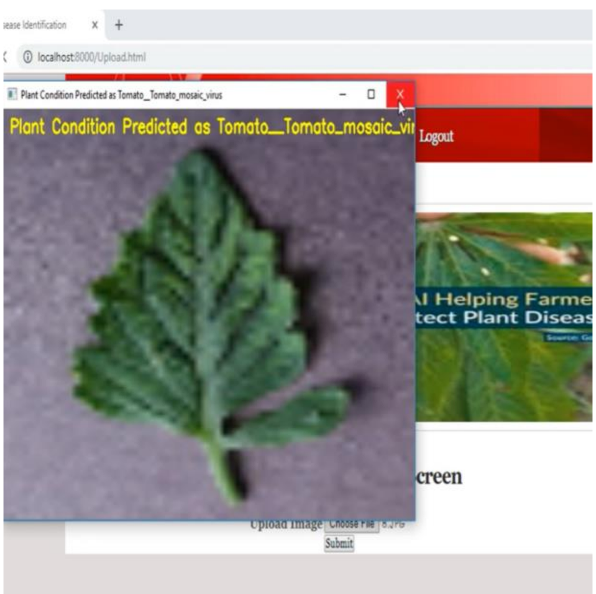
ISSN: 2457-0362





8.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.

FUTURE WORK AND EXTENSIONS

Future work involves expanding the model to include more parameters which can improve the correlation to the disease. We can augment the image database with supporting inputs from the farmer on soil, past fertilizer and pesticide treatment along with publicly available environmental factors such as temperature, humidity and rainfall to improve our model accuracy and enable disease forecasting. We also wish to increase the number of crop diseases covered and reduce the need for expert intervention except for new types of diseases. For automatic acceptance of user uploaded images into the Training Database for better classification accuracy and least possible human intervention, a simple technique of computing the threshold based on a mean of all classification scores can be used. Further application of this work could be to support automated time-based monitoring of the disease density maps that can be used to track the progress of a disease and trigger alarms. Predictive analytics can be used to send alerts to the users on the possibility of disease outbreaks near their location.

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