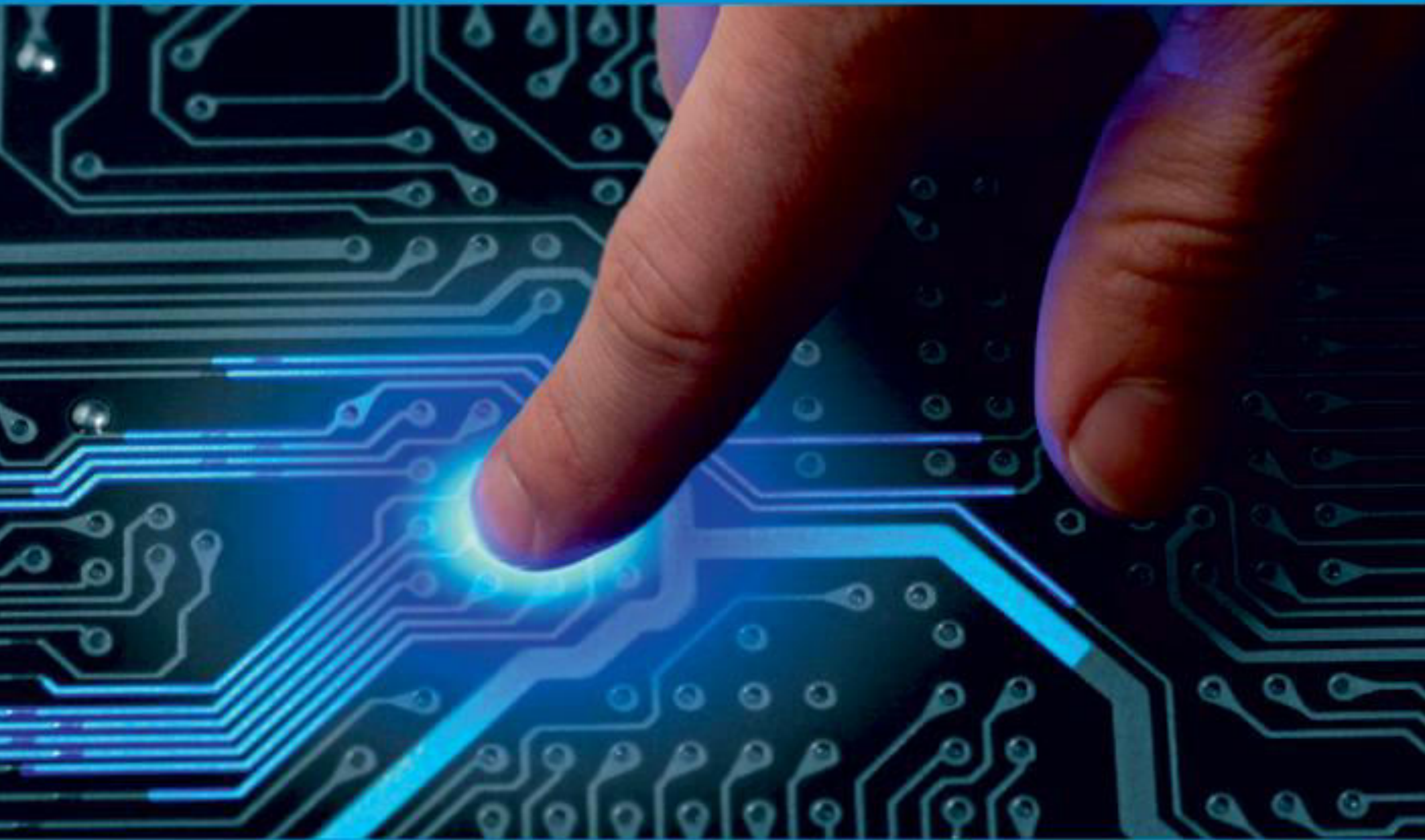
IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 12, Issue 6, June 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | A Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 6, June 2024 ||

| DOI: 10.15680/IJIRCCE.2023.1206037 |

Plant Disease Identification and Pesticides Recommendation Using CNN

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ABSTRACT: Plant diseases are a major threat to farmers, consumers, environment and to 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 externalsymptoms. 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. 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.

I. 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. In 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 accuratemachine assisted diagnosis easily accessible to farmers.

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 cropdiseases that can be widely deployed. 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-classifieds “labeled” images to achieve high accuracy of image classification on new unseen images. 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.

Our proposed solution brings plant disease diagnostics to farmers through a Cloud based scalable collaborative platform. The platform is accessible through a mobile app that enables users to upload images of multiple parts of their plant and get the plant disease automatically diagnosed in real-time. They can also view “disease-density” map for their neighborhood showing geographical spread of diseases. The uploaded image gets classified by our AI engine into the appropriate category of disease for which a previously identified best-known method solution is provided to the

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individual. Simultaneously, the geo-location of the image and a timestamp is used to tag the presence of the particular disease in that location.

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.

Proposed System

In this project we are 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 we will be predicting plant disease and cloud is used to store data.In this Project we are using smart phone to upload image but designing android application will take extra cost and time, So we are building 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.

Requirement Analysis

The work involves analyzing the design for few applications so as to make them more users friendly. So, it was really important to keep the navigations from one screen to the other and at the same time reducing the amount of typing the user needs to do. In order to make the application more accessible, the browser version had to be chosen so that it is compatible with most of the Browsers.

Requirement Specification

Graphical User interface with the User is a functional requirement, and for developing the application Python and Django Software is used, the operating Systems used are Windows 7, Windows XP and Windows 8. Technologies and Languages used to Develop is Phyton. Debugger and Emulator is chrome but any browser can be used. For developing the application, the Hardware Requirements are Processor: Pentium IV or higher, RAM: 256 MB and Space on Hard Disk: minimum 512MB

II. LITERATURE SURVEY

The author (1) has done a survey of image processing techniques for agriculture in which he presented 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)Measured quantitative virulence in the wheat pathogen *Zymoseptoria tritici* using high-throughput automated image analysis,

Zymoseptoria tritici, causal agent of *Septoria tritici* blotch on wheat, produces pycnidiain chlorotic and necrotic lesions on infected leaves. A high-throughput phenotyping method was developed based on automated digital image analysis that accurately measures the percentage of leaf area covered by lesions (PLACL) as well as pycnidia size and number. A seedling inoculation assay was conducted using 361 Z. tritici isolates originating from a controlled cross and two different winter wheat cultivars. Pycnidia size and density were found to be quantitative traits that showed a continuous distribution in the progeny. There was a weak correlation between pycnidia density and size ($r = -0.27$) and between pycnidia density and PLACL ($r = 0.37$). There were significant differences in PLACL and pycnidia density on resistant and susceptible cultivars. In all, >20% of the offspring exhibited significantly different pycnidia density on the two cultivars, consistent with host specialization. Automated image analysis provided greater accuracy and precision compared with traditional visual estimates of virulence. These results show that digital image analysis provides a powerful tool for measuring differences in quantitative virulence among strains of *Z. tritici.* (3) ImageNet classification with deep convolutional neural networks, used 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

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top-1 and top-5 error rates of 37.5% and 17.0%,respectively, 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 overfitting 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. (5) the author proposed an open access repository of images on plant health to enable the development of mobile disease diagnostics through machine learning and crowd sourcing. Which addresses about how Human society needs to increase food production by an estimated 70% by 2050 to feed an expected population size that is predicted to be over 9 billion people. Currently, infectious diseases reduce the potential yield by an average of 40% with many farmersin the developing world experiencing yield losses as high as 100%. The widespread distribution of smartphones among crop growers around the world with an expected 5 billion smartphones by 2020 offers the potential of turning the smartphone into a valuable tool for diverse communities growing food. One potential application is the development of mobile disease diagnostics through machine learning and crowdsourcing. The author released of over 50,000 expertly curated images on healthy and infected leaves of crops plants through the existing online platform Plant Village, they describe both the data and the platform. These data are the beginningof an on-going, crowdsourcing effort to enable computer vision approaches to help solve the problem of yield losses in crop plants due to infectious diseases.

III. SYSTEM DESIGN

In the present work we are using UML, which stands for Unified Modeling Language. UML is a standardized general-purpose modelling language in the field of object-oriented software engineering. The standard is managed and was created by, the Object Management Group. UML has become a common language for creating models of object-oriented computer software. In its current form, UML is comprised of two major components: a Meta-model and a notation. In the future, some form of method or process may also be added to; or associated with, UML.The Unified Modeling Language is a standard language for specifying, Visualization, Constructing and documenting the artifacts of the software system, as well as for business modelling and other non-software systems. The UML represents a collection of best engineering practices that have provensuccessful in the modelling of large and complex systems.
We used case diagram in the Unified Modeling Language (UML) which is a type of behavioral diagram defined by and created from a Use-case analysis. Its purpose is to present a graphical overview of the functionality provided by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases. The main purpose of a use case diagram is to show what system functions are performed for which actor. Roles of the actors inthe system can be depicted.

Class diagram in the Unified Modeling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among the classes. It explains which class contains information.
Sequence diagram in Unified Modeling Language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. Sequence diagrams are sometimes called event diagrams, event scenarios, and timing diagrams.
Collaboration diagram, also known as a communication diagram, is an illustration of the relationships and interactions among software objects in the Unified Modeling Language (UML). These diagrams can be used to portray the dynamic behavior of a particular usecase and define the role of each object.

System Testing

The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, sub-assemblies, assemblies and/or a finished product It is the process of exercising software with the intent of ensuring that the Software system meets its requirements and user expectations and does not fail in an unacceptable manner. There are various types of tests like Unit testing, Integration testing, Functional testing, System test, white Box test and Black box testing. Each test type addresses a specific testing requirement.

Test strategy and approach

Field testing will be performed manually and functional tests was written in detail. The Test objectives
Are all field entries must work properly, Pages must be activated from the identified link, The entry screen, messages and responses must not be delayed. The Features tested were to verify that the entries are of the correct format, No

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duplicate entries should be allowed, and all links should take the user to the correct page.**Integration Testing**
Software integration testing is the incremental integration testing of two or moreintegrated software components on a single platform to produce failures caused by interface defects.The task of the integration test is to check that components or software applications, e.g. components in a software system or – one step up – software applications at the company level– interact without error.**Test Results:** All the test cases mentioned above passed successfully. No defects encountered.

Acceptance Testing
User Acceptance Testing is a critical phase of any project and requires significant participationby the end user. It also ensures that the system meets the functional requirements. **Test Results:** All the test cases mentioned above passed successfully. No defects encountered.

Implementation
In this project we used 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 image to predict disease. If this web application deployed on real web server, then it will extract user's location from request object and can display those locations in map.If we run in local machine then we will get default IP '127.0.0.1' and for this IP will get only default latitude and longitude.

IV. RESULTS

The below mentioned are the results of our group project which uses Artificial Intelligence and Cloud Based Collaborative Platform for Plant Disease dentification, Tracking and Forecasting for Farmers

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

In this project we used smart phone to upload image but designing android application willtake extra cost and time so we build it as PYTHON web application. Using this web applicationCNN model will get trained and user can upload images and then application will apply CNNmodel on uploaded image to predict disease. If this web application deployed on real web server,then it will extract user's location from request object and can display those locations in map. If you run in local machine then we will get default IP '127.0.0.1' and for this IP will get onlydefault latitude and longitude.
To implement this project, we are using plant disease images dataset from 'Plant Village' web site. Python Django Server act like a cloud and web server, MYSQL database: used to store user's details and their uploaded image's location details.

To run this project, install python 3.7 and then install MYSQL database and create database inMYSQL by copying content from 'DB.txt' file and paste in MYSQL. Install below packages by opening command prompt and executing below commandsPip install Django, Pip install pymysql pip install geoip2, after installing above command put 'Plant Disease' folder in any directory of your system and then open command prompt and set location to Plant Disease and execute below command to start server python manage.py run server after executing above command will get below server screen

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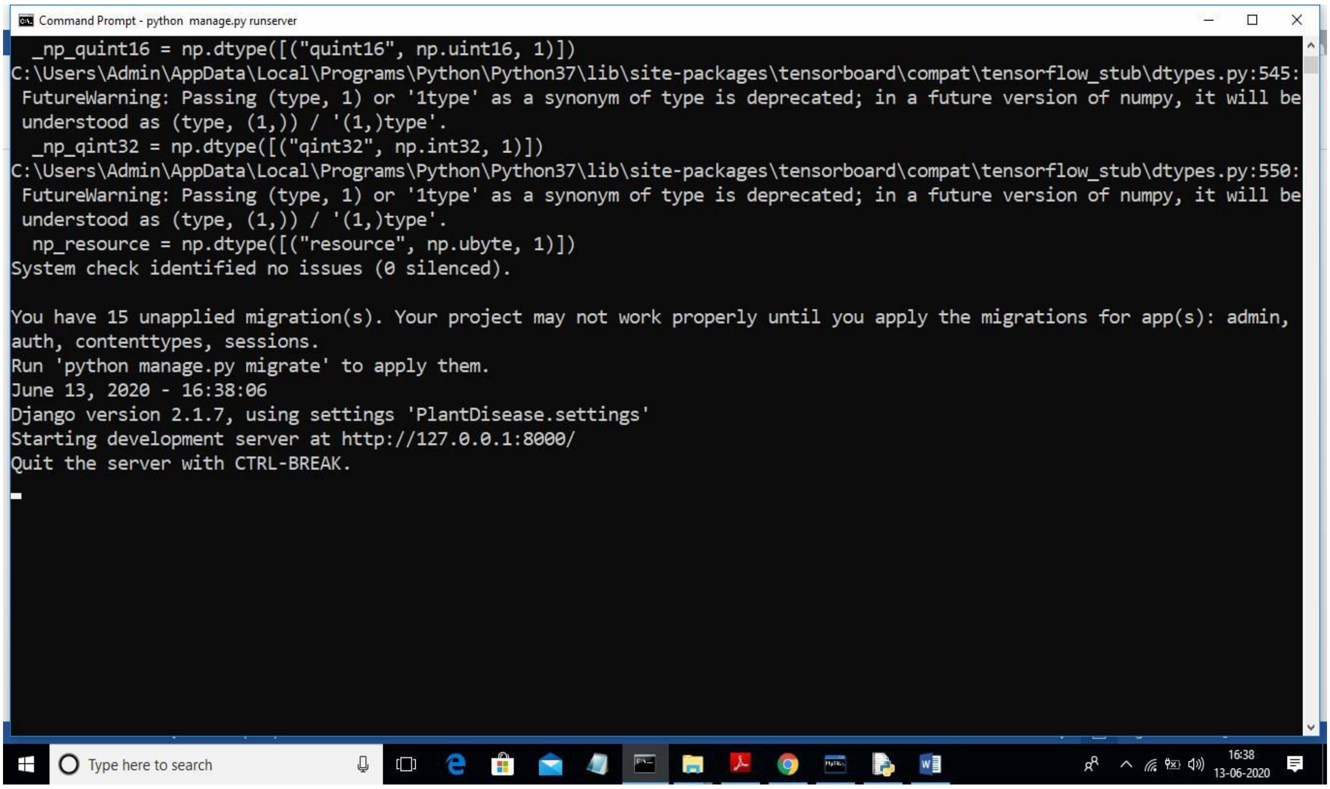
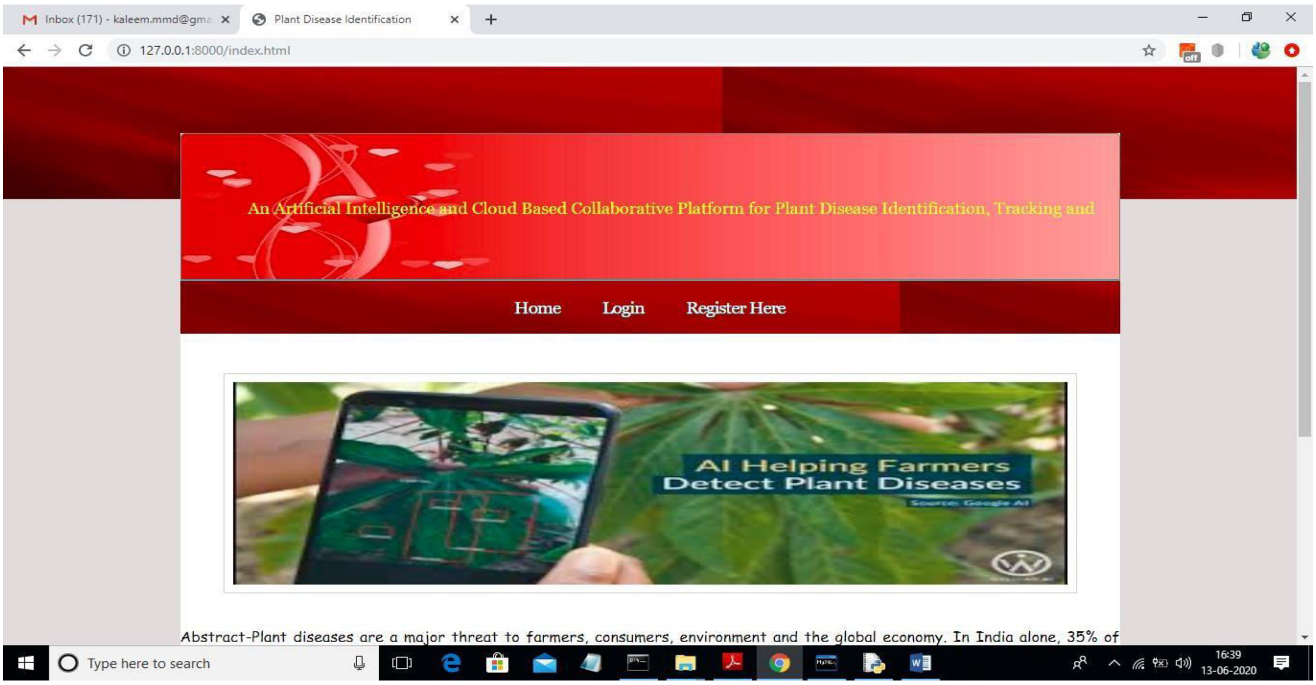


In above screen python server started and running on IP http://127.0.0.1:8000'. Now openbrowser and enter URL as 'http://127.0.0.1:8000/index.html' to get below screen

Fig-1 :- Phython Server Started Running



In above screen click on 'Register Here' link to allow user to register with the application

Fig-2 :- Registration

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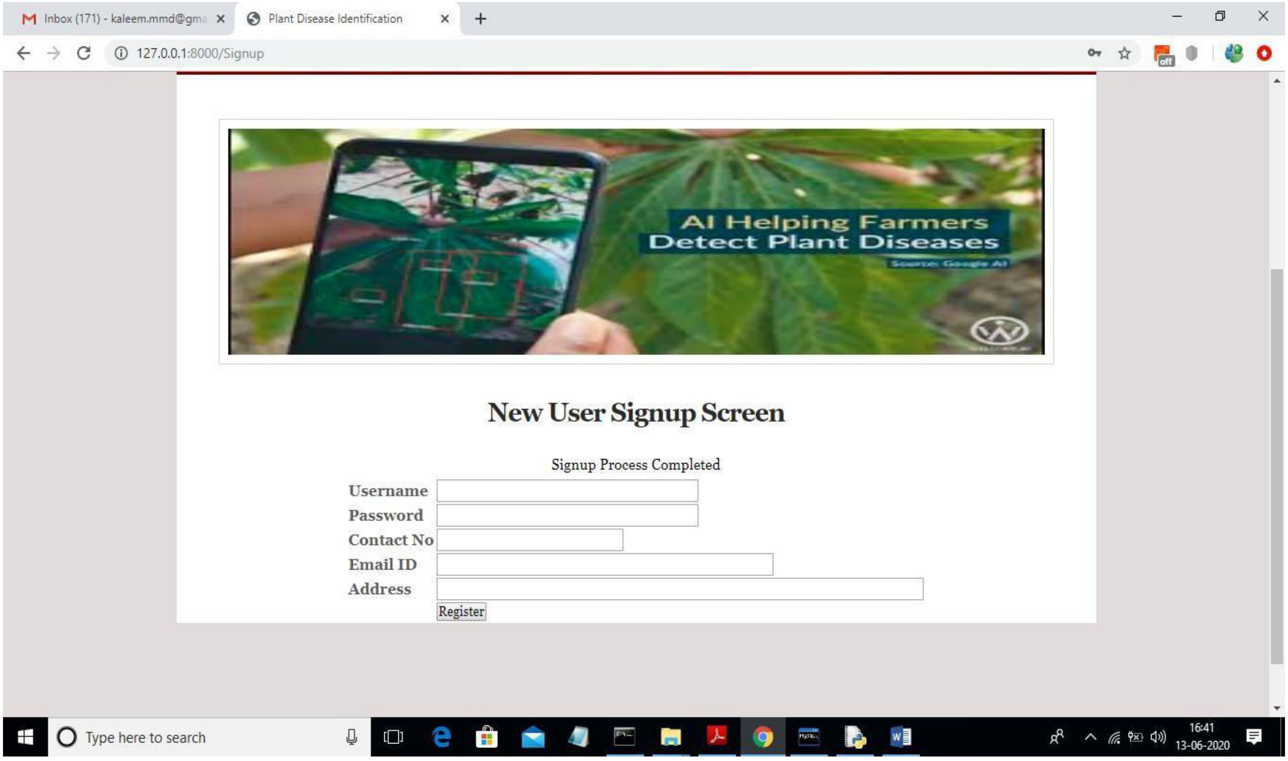
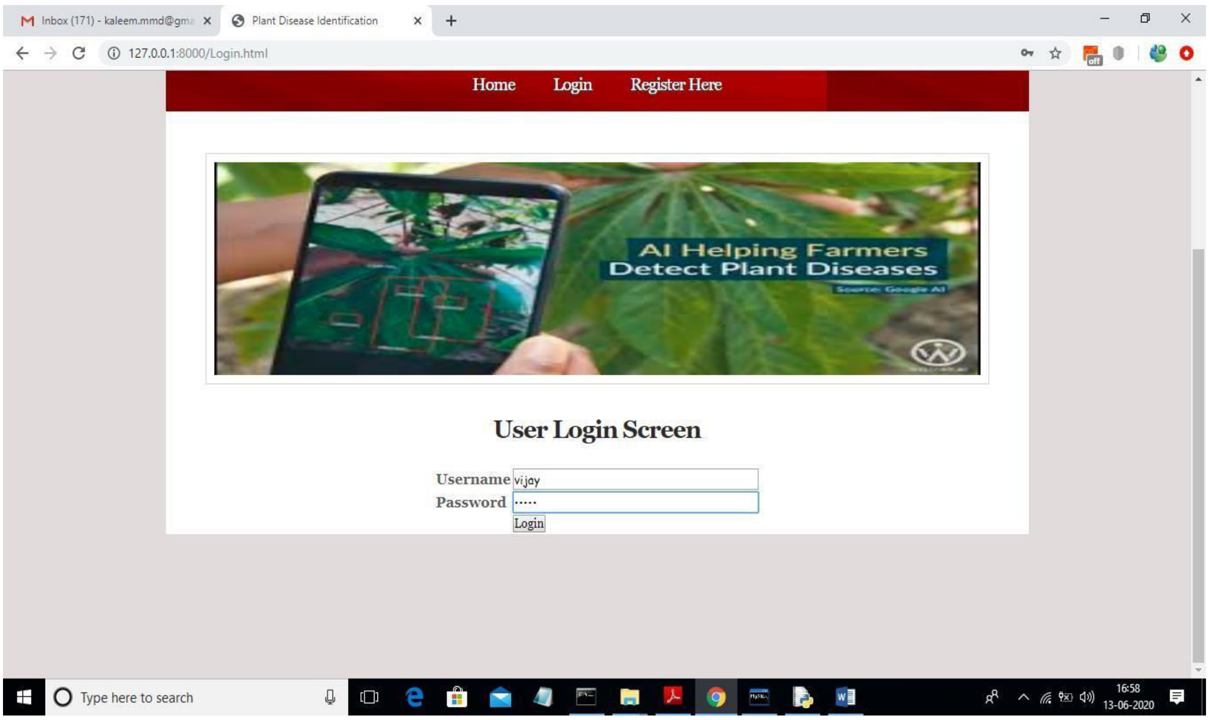


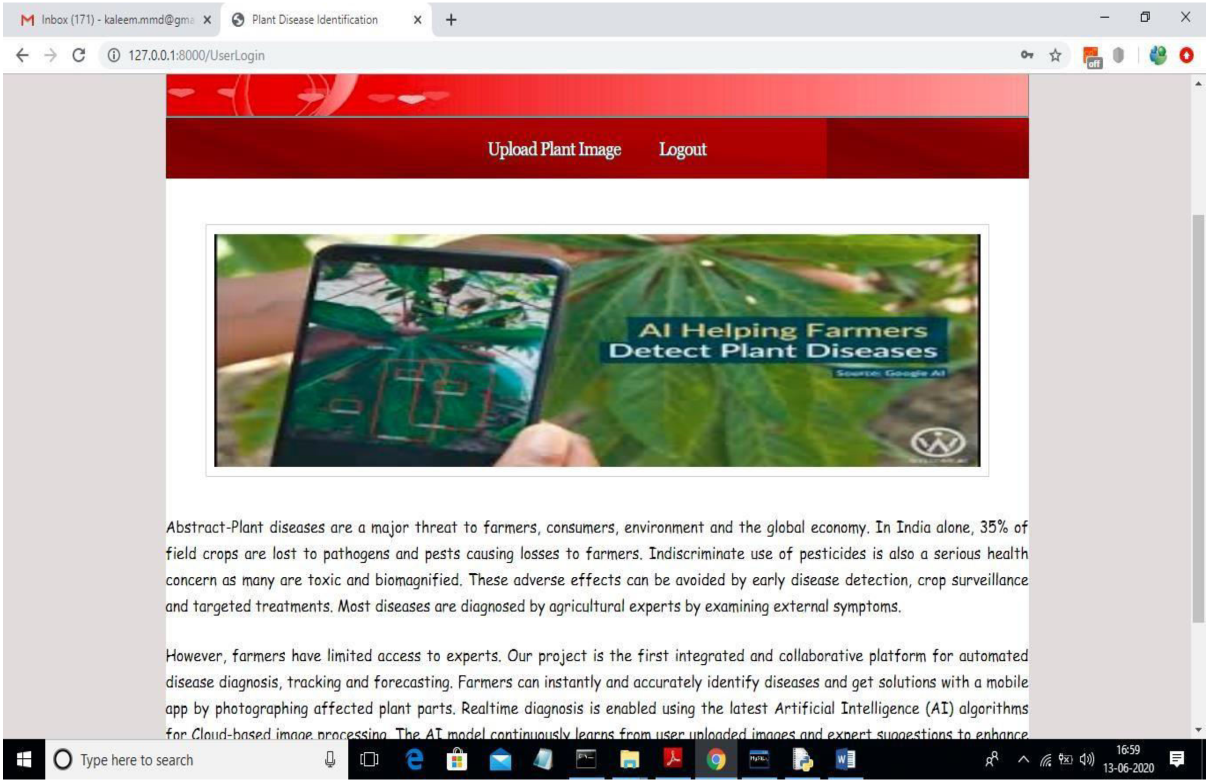
<u>In above screen user signup process completed. Now user can click on 'Login'link to login to application</u>

Fig- 3 :- Login to application



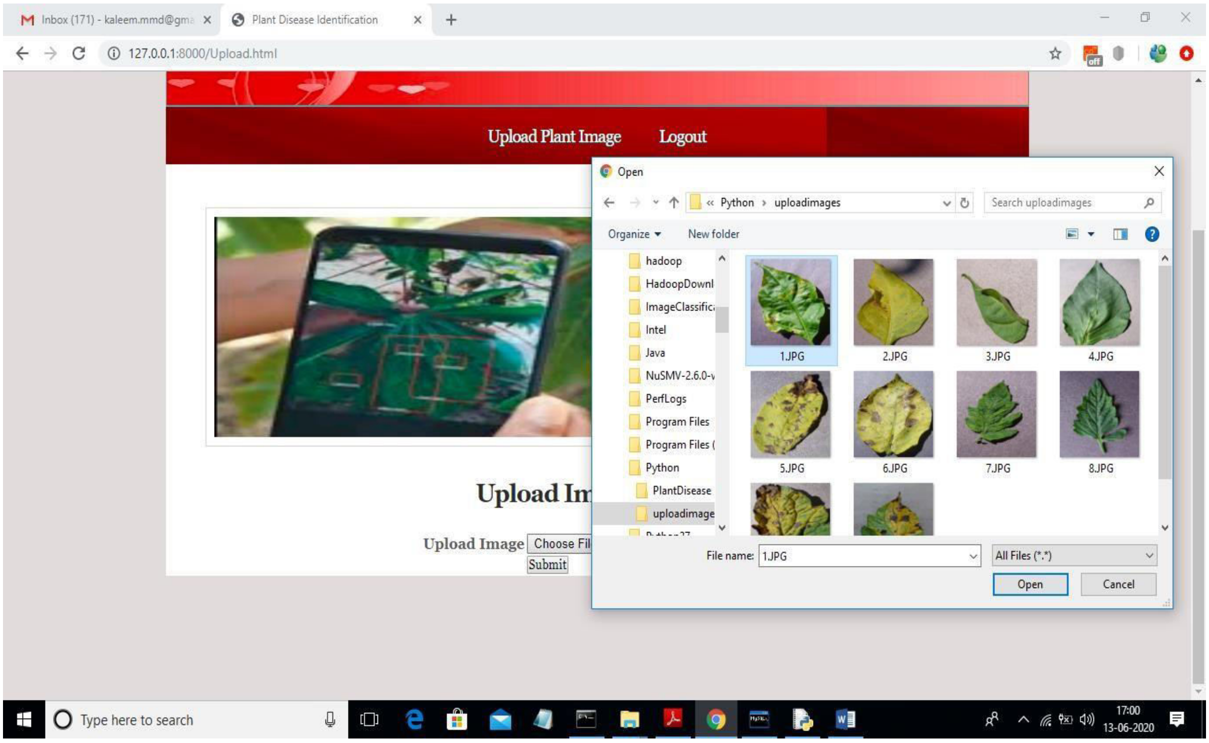
<u>After login will get below screen</u>

Fig-4 :- Login Screen



In above screen click on 'Upload Plant Image' link to get below screen

Fig-5 :- Upload Plant Image/ Crop image



In above screen uploading 1.JPG image and now click on 'Open and Submit button to Predict the disease upload image

Fig-6:- Open and submit to predict disease

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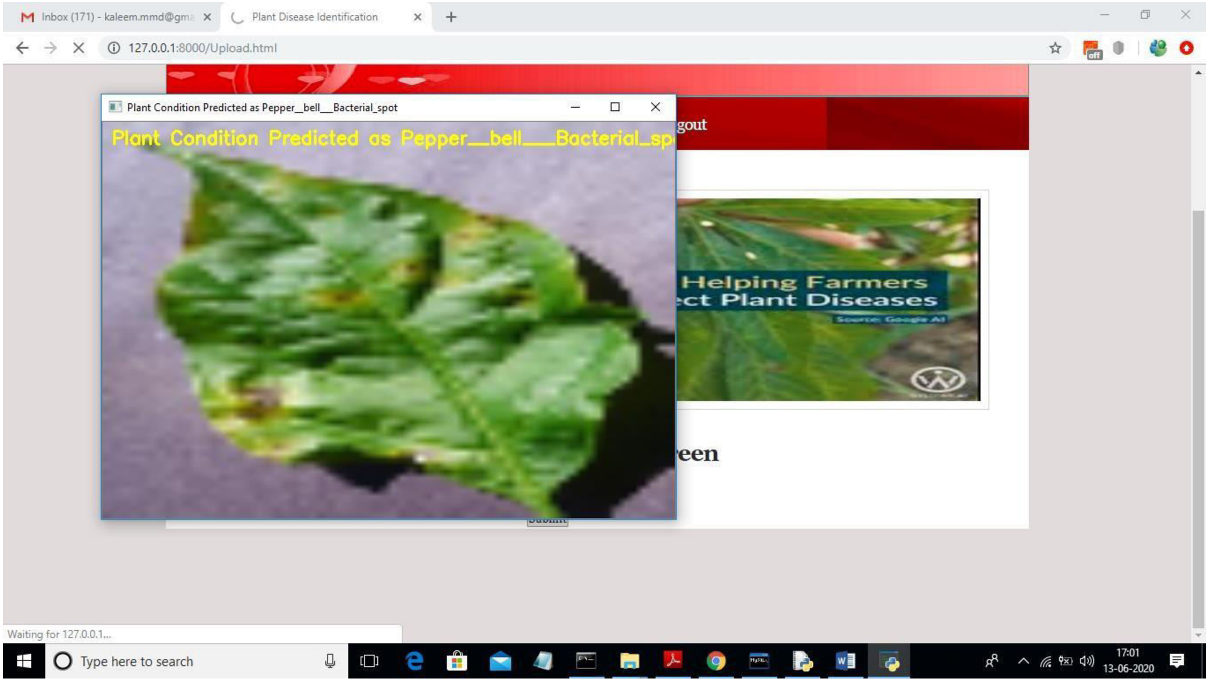
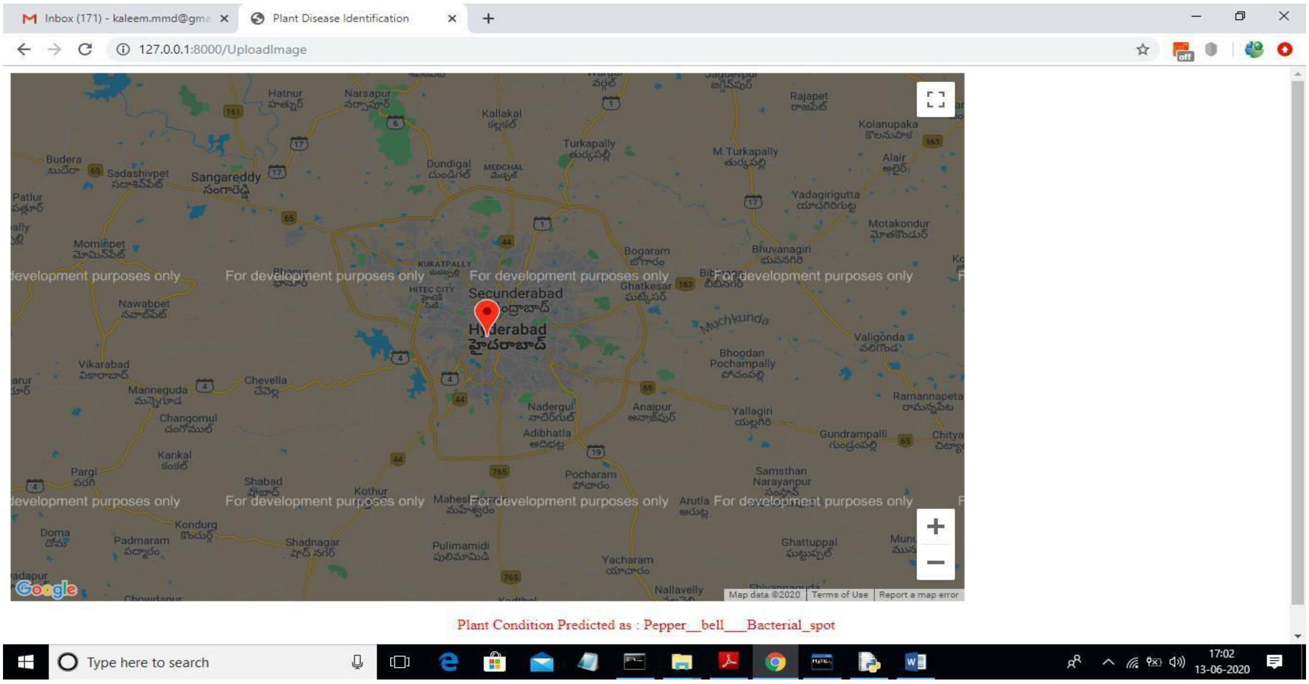


In above screen we will get image with predicted disease name printed on imageand now close that image to get locations in map

Fig-7:- Disease Predicted



In above screen in map we can get location of uploaded image mark with markerand below map we can see predicted disease name in red colour. Similarly you can upload any image from ‘uploadimages’ folder. In below screen we can see CNN layers created to build plant disease model

Fig-8:- Location Map

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V. 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 diagnosisof crop diseases and knowledge of disease outbreaks - which would be helpful in quick decisionmaking 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 diseaseclassification 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 andthe 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 thetraining dataset, is capable of detecting early symptoms of diseases and is able to successfullydifferentiate between diseases of the same family.

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