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Crop Disease Identification Using Deep Learning Techniques

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Abstract

Cropdiseasesareahugedangertofoodsecurity,butduetoalackofinfrastructureinmanyregionsoftheworld,earlyidentificationisdifficult.Plantdiseaseisapersistentproblemforsmall farmers, posing a risk to their livelihood and food security. Image categorization inagriculture has been achieved by the recent revolution in smartphone penetration andcomputer vision models. Convolutional Neural Networks (CNNs) are state-of-the-art inimage recognition and can deliver a quick and accurate diagnosis. A Convolutional NeuralNetwork(CNN)is a Deep Learning method thatcan take an imageas input,assignimportance (learnable weights and biases) to distinct aspects/objects in the image, anddistinguish one from the other. The ultimate objective was to get real time dataset for inputimagesthatwerecollectedoforange,cottonandsweetlimethesearetheplantandtressthatare mostlygrowninVidarbhaalsothetypesofdiseasesthatmostlyaffectstheirgrowthwithname and their occurrence ,to get efficient output with a decision of category for eachindividual pixel and for segmentation of pixels, we have used semantic segmentation whichlabel each pixel of an image with a corresponding class of what is being represented. So, inthispaperweareclassifyingthepixelsanddetectingthediseasedpartfirst,andonthatbasispredi ctingthediseaseintheleaf.

Keywords:

DeepLearning,FCN,Detection,Segmentation

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INTRODUCTION

Agriculture is known as the backbone ofeconomyinIndia.Over70%oftheoverall populationisinvolvedintobusinesses related to agriculture directlyorindirectly.Themaingoalofagriculture isnotonlytofeedthepopulationbutalso it is an important is a source of energy. Itis a solution to many problems related toglobal warming. The harvest misfortunebecause of the ailments in the plants. Itbecomes very difficult to distinguish thetypeofdiseaseand workaccordingtothediseaseforthefarmers .

Bennett University (LeadingIndia.ai) is anationwideAIskillingandresearchinitiative,whichusuallyworksonAIandMLrelatedprojects.UnderBennettUniversity (Leadingindia.ai), we startedourprojectonthistopicof"CropDiseaseIdentificationUsingDeepLearningTechniques ". This project will ease upthe process of prediction of diseases inleavesinthegivendatasetandhelpfarmers to identify the disease and workonitaccordingly.

Themainobjectiveofthispaperistohelpthefarmers todistinguishbetween thediseases and treat the disease so that thedisease does not hamper the growth ofcrop.Sincecropdiseaseis majorproblemin agriculture industry, it becomes veryimportant to identify the diseases in thecropsandworkonit.Due tolackofnecessaryinfrastructuretothesmallfarmers,sometimesitbecomesverydifficult for them to identify the disease,which leads to the loss of entire crop. Sowe have used deep learning methods todetectthediseaseinplantsusingthedataset provided and help to identify thetypeofdisease.Plantdiseaseisa Persistentproblemforsmallfarmers,posing athreattorevenueandfoodsecurity.Imagecategorizationinagriculturehasbecomepossiblethankstothecurrentrevolutioninsmartphonepenetrationandcomputervisionmodels.

A Convolutional Neural Network (CNN)is a Deep Learning method that can takeanimageasinput,assignimportance(learnable weights and biases) to distinctaspects/objectsintheimage,anddistinguish one from the other. We madeuse of CNN to analyze images, and readthembasedonweightarchitectureofshared-weight of the convolution kernelsor filters that slide along input featurestranslation-equivariant responses knownasfeaturemaps.Itisusedforpreprocessing by making use of variouscnn algorithms. This network optimizesthefiltersthroughautomatedlearning.CNNisusedforextractingthefeatures ofthe imageswegivenasaninputfromourdatasettothemodelforprocessing.

Afullyconvolutionalnetwork(FCN)usesconvolutionalneuralnetworktotransform image pixels to pixel classes.WehaveusedFCNforsemanticsegmentation of images. FCN is used fortrainingandmakingthenetworkfaster,to provide betterresults

Alexnet is one of the CNN architectures;ithaseightlayerswithlearnableparameters. The model consists of fivelayerswithacombinationofmaxpoolingandother3fullyconnectedlayerswhich

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usesrelayactivation.Wemadeuseofthisarchitectureforbestaccuracy,trainingandtestingofinputimage's.Alexnetgives a wide advantage when it comes tosizeofthedatasetasitcanhandlemaximummnumberofimagestobeprocessed at the same time and makesrunning of the model more efficient toachievebetterresults.

Fig1.1:-Workflowofmodel

Inthismodelmadefordiseasedetectionafarmeroranyusercaneasilyuploadthecropimagesespecially of cotton, sweet limes andorangesin thedatabaseprovidedincrop disease detection website, whichis available online easily to every enduser.He/shecanalsogetalltheinformationneededrelatedtocropprovidedinourwebsite.ItincludesQualitycontrolinformation,howtoprevent a crop from the disease whichbeingspreadinginleaves.Thewebsitecontains login tab so an existing usercanvisitawebsitewhereverhe/shewantstoandregistertabfortheusersoa new user can put his/her informationandaddindatabase.Thenhecanperformfollowingoperationslikeupload the image, process the imageand also can check the accuracy forthoseinputimagewithallthepredictions containing information inform of images and text. The modelworkfastandgivesgoodaccuracy even the leaf is completely damagedthe model takes the same time. Theusergetsalltheresultonsiteitself.Foragriculture sector the model is usefulasitcontainslatestdeeplearning architectureusingfeatureextractionandtheefficiencyofthesystemisprogrammedonanacondanavigator,itallows you to launch applications andeasilymanageallthepackagesbycompressingthem all in one alsoifthey are oversized. The model allowsto launch applications in future alsoandeasilymanageallcondapackages,channelswithoutusinganycommands. TheprojectisbestforFutureResearchworkandcanbeupdatedeasilywith minimum hardwarerequirements.

Bennett University (LeadingIndia.ai) is anationwideAIskillingandresearchinitiative which usually works on AI andMLrelatedprojects.UnderBennettUniversity(Leadingindia.ai)westartedourprojectonthistopicof“CropDiseaseIdentificationUsingDeepLearningTechniques ". This project will ease upthe process of prediction of diseases inleavesinthegivendatasetandhelpfarmers to identify the disease and workonitaccordingly.

RELATED WORK

Wang,Bo,Farouk,Ahmed[1],“IdentificationofCropDiseasesandInsect Pests Based on Deep Learning”,this paper proposes an acknowledgmentmodelofharvestillnessesandbugbothersin view of profound gaining according tothe viewpoint of natural climate security.isThepaperimprovestheAlexNetnetwork's complete connection layer andutilises the enhanced network to evaluatea pre- processed crop image set in orderto recognise crop diseases and pests.
Theproposedmodelfunctionsadmirablywhenthequantityofinformation

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photographsvacillates,withnormalackno wledgment exactness and time forpear%ailmentsandbugsof96.26percent and321ms,individually,whicharesuperior to other similar models. All thewhile, when the recommended model isappliedtoextrainformationalcollections, theacknowledgmentprecisionismorepro minent than 91%, and the misfortunerate is under 0.320, giving a specializedhelp to edit bother control independentdirection.

JSujithra,MFerniUkrit[2],"AReviewOnC ropDiseaseIdentificationAndClassificati on Through Leaf Images", Itcontainsanoverviewonthe utilizationofpicturehandlingproceduresto distinguishplantinfections.Theplantdisea seswereidentifiedusingavarietyofcomput ervisionapproaches,howeverthere is still an influence on detecting alldiseaseswithasingletechnique.Theresul tsofthesurveyarecomparedtoothermethod ologies,leadingtoalgorithmssuchasSuppo rtVectorMachineandNeuralNetwork,whi chplayanimportantroleandachievesuperio rperformanceindiseaseidentificationandcl assification.Thismethod offers the best remedy for cropillnesses.Thisresearchhasonlybeendo neonafewplants.Therearestillmanymore crop kinds to diagnose. Such typesshould be saved for future research, andthe best answer should be found utilizingseveralmethods.

D. Lobo Torres *et al.*, [3], they proposedand evaluated the use of state-of-the-artfullyconvolutionalnetworksforsemanti csegmentationofathreatenedtree species using high spatial resolutionRGBimagesacquiredbyUAVpl atforms. Five architectures were tested:Segnet,U-Net,FC-DenseNet,andtwo DeepLabv3+variants,specificallyExcepti onandMobileNetV2.Theanalysis was conducted on a dataset thatrepresentedanurbancontext.Theexper iments demonstrated that networkscould learn the distinguishing features ofthetargettreespeciesinasupervisedway. This fact indicated that the tested FCNdesignscoulddelineateothertreespeci es,providedthatenoughrepresentativelabe lledsamplesareavailablefortraining.

Prof. A. R. BhagatPatil, Lokesh Sharma,[4],"ALiteratureReviewonDetect ionofPlantDiseases",itproposesaCNNbas edtechniqueforplantinfectioncharacteriza tionutilizingtheleavesofailingplants.Buil dingsuchabrainnetworkwithhigheffective nessisacomplicated assignment. Move learningcanbeutilizedtoaccomplishmoren oteworthy productivity. Origin v3 is oneofthemodelsaccessiblethatinnatelyha ve the capacity to arrange pictures andfurthercanbepreparedtodistinguishvar ious classes. Subsequently, utilizationof Inception v3 can assume key part inacquiring quick and viable plant illnessidentifiers. Likewise, by dataset groupingutilizingform strategy,the preparationsetcanbedecidedtoguaranteele gitimatepreparation of model for all highlights.Thisgivespreferablecomponen textractionoverarbitrarilyorderingthedata set. Ideal outcomes were gotten byutilizing the strategiesindicated in thepaper.Inthismanner,withexecutionand utilizationof thesestrategiesforplantillness order misfortunes in agribusinesscanbediminished.

S. S. Kumar and B. K. Raghavendra, [5],"DiseaseDetectionandDiagnosisonPl ant using Image Processing", it helpedustoknowthatImageprocessingisbe st

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wayfordetectinganddiagnosisthediseases. Diseasesdecreasetheproductivity of plant which restrict thegrowth of plant and quality and quantityofplantalsoreduces.Inimageprocessinginitially the infected region is found thendifferent features are extracted such ascolor,textureandshape.Finally,classificationtechniqueisusedfordetectingthediseases.Therearedifferentfeatureextractiontechniquesforextractingthecolor,textureandedgefeaturessuchascolorspace,colorhistogram,greylevelco-occurrencematrix (CCM), Gabor filter, Canny andSobeledgedetector.Therearealsodifferentclassificationtechniquessuchas SupportVectorMachine(SVM),ArtificialNeural Network(ANN),Backpropagation(BP)Network,ProbabilisticNeuralNetwork(PNN),RadialBasisFunction(RBF)NeuralNetwork.

NikhilPatil,RajabAli,VaibhavWankhedkar, Prof. DeepaliNayak, [6],theysuggestedaCNN-basedDeepLearningsystemforcropdiseasedetection. Farmers can benefit from theproposed method since it provides real-time information on crop disease. It alsominimizes outbreaks and upsurges thatcausemassivelossestocropsandpastures,puttingvulnerablefarmers'livelihoods at risk. As when compared totraditionalcropdiseasedetectionsystems, the described approach had anaccuracyrateof89percent,implyingthat 9 out of 10 crop photos were correctlyidentified.Theexperimentalresultsshowthatourproposedtechnologyissuccessful,anditmaybeutilizedbwidelybyfarmerstodetectcropdisease.

MathimithaS,PushpaRaniM,[7],"DetectionofPlantDiseasesBasedon ClassificationTechniques",Aclassification technique is used to detectplant leaf diseases. The contrast betweentheoriginalanddiseasedleafmaybeseenhere. The classification of three diseases,Blast, Bacterial Leaf Blast (BLB), andRice tungro, is the focus of this research.Basedonthesethreedisorders,the number of samples is utilised to identify.The majorgoalofthisprojectistodetectdiseases sooner and produce better plantdevelopment.

Kambale, Goutum, Bilgi, Prof.Dr.Nitin,[8], "A Survey Paper on Crop DiseaseIdentificationandClassificationUsingPattern RecognitionandDigital ImageProcessingTechniques",According tothesurvey,thisreportattemptstoinvestigate machine learning approachesutilizedbyresearchersfordiseaseidentificationandplantclassification.These machine learning technologies aidagriculturalprofessionalsindetectingsicknessinplantsinatimelymanner,andthenrecommendingtreatmentstofarmers.Accordingtoagriculturalexperts'recommendations,thefarmerwould cure the damaged plant as soon aspossible,increasingcropproduction.

S.W.Zhang,Y.J.ShangandL.Wang [9] "Plant Disease Recognition Based onPlant Leaf Image a plant illness basedleafacknowledgmentstrategywaspresentedinthispaper.Theproposedcalculation was varsities on five sorts ofmaizesicknesses.Thetrialresultsdemonstrate the proposed technique canperceive and group the plant sicknesseswith high acknowledgment rate. A plantsicknessacknowledgmentstrategyisproposedinlightofplantleafpictures.Tostart with, the spot is sectioned, and theinfection highlightvector is

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extricated.Then,atthatpoint,the

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removedhighlightsareaccommodatedthe K-closestneighborclassifiertoperceivetheplant infections.Trialresultsshowtheadequacyofthe proposedapproach.

OladapoIbitoye, [10] published by theauthorOladipoBiotype,purposedthatMasked face recognition is an essentialpartofhealthsafety,securityandsurveillancesystemswhichoffersincredible advantages in our daily lives,especiallyintheeraofthepandemicushered inbytheoutbreakofcoronavirusdiseaseintheyear2019(COVID-19.Theexistingsystemsofmaskedfacerecognitionweredevelopedtoautomaticallydetectandunderstandfacesoccludedwithmasksusingcomputervisionanddeeplearningtechniques. This study gives an analysisofsometechniqueswhichareusedfortheimplementationofmaskedfacerecognitionsystem,withemphasisonConvolutionalNeuralNetwork (CNN).The strengths and enhancement areas ofthe highlighted techniques towards real-timeimplementationwerediscussed.

JuanK.Leonard[11],"ImageClassificationandObjectDetectionAlgorithmBasedonConvolutionalNeural Network" by Juan K. Leonard, inthis paper he proposed after a systematicstudyofafterasystematicstudyofconvolutional neural networks and an in-depthstudyoftheapplicationofconvolutional neural networks in imageprocessing,themainstreamstructuralmodels,advantagesanddisadvantages,time / space used in image classificationbased on convolutional neural networksaregiven.Complexity,problemsthatmaybeencounteredduringmodeltraining, and corresponding solutions. Atthesametime,thegenerativeadversarial

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network and capsule network based onthedeeplearning-basedimageclassification extensionmodel arealsointroduced;simulationexperiments verifytheimageclassificationinterms ofaccuracy,theimageclassification methodbasedonconvolutionalneuralnetworks is superior to traditional imageclassificationmethods.

METHODOLOGY

The agricultural species leaf picturesare taken as input of the camera. Theleafwhichwewanttofindtheinformation about we simply take outthecameralensandcapturetheimage.So, we can upload the image and getthedetailedinformationofthe leafspecifying the diseased andhealthypart of the leaf using DL Techniques.Thisleafoutletisconvertedintopixelsandsegmentationisdoneusingimagepre-processing.Imagepre-processing:Imagepre-processingofaleafis doneby processingtheleafthroughdifferentpre-processingelements such as a. Resizing/Settingpixelresolutions,b.Filtering/PlainBackground. Resizingthepixelresolutionofanimage after taking a photo on cameraisimportantbychangingtheHorizontalandVerticalratioofan Image. To get the desired output it isnecessary to convert the image inputand get the desire output (here, thediseasedpartoftheleaf).

Filteringisdonetofiltertheunwantedbackgroundandgetthedesiredbackground only. Such as a full plainwhitebackground.Filteringcanbedonebyusingtechniquessuchasthresholdingetc.Uploadinganinput

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filtered image on the website to gettheresultsneededby theuseri.e.,featuresoftheleafsuchas thediseasedpartwhichistakenintoc onsideration and the redness on theleaf etc. such features are taken intocountindetectionasaresult.

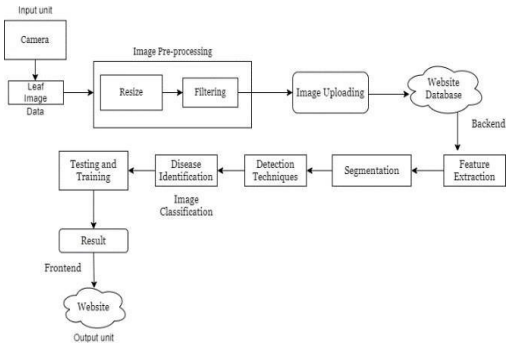

Fig-1:BlockDiagramofCropDiseaseIdentification Using Deep LearningTechniques.

After uploading the image on the web-ApplicationtheInternal processingforthe image takes place such as a. FeatureExtraction,b.Segmentation,c.Detection,
d. Disease Identification, e. Testing andTraining. Extraction of the image wherethebackgroundandimagepartsaretakenintoconsideration.Alltherequiredfeatures of the leaf such as the diseasedpart, which is taken into consideration and the redness on the leaf etc. such features,are taken into count for an appropriateresult.
Segmentationmeansdividingtherequired object of interestintovarioussegments and converting the object intopixels. To detect all the essential featuresusingDeepLearningTechniques,Detectiontechniquesareusedheretoderiveallfeaturesandlearningofalgorithmstorecognizealltheoccurrencesofanobjectcategoryhere

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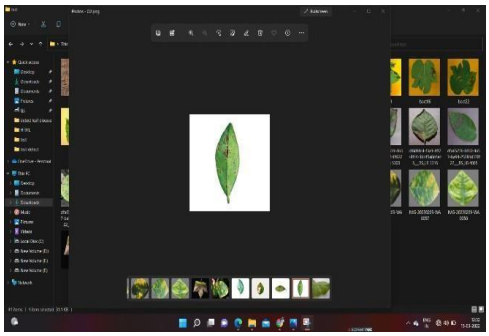
the bacterial or fungal part of the leaf isconsideredas anobject.

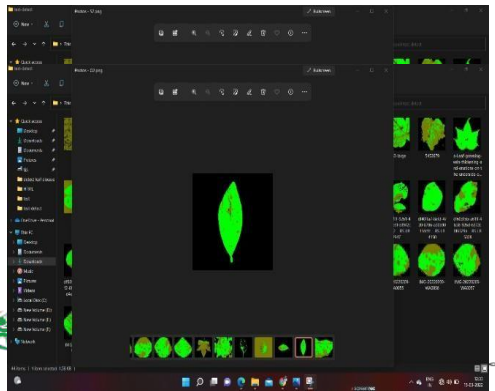
Identifying that which type of disease theleaf has been infected by and classifyingtheleafbasedonitsdiseaseandgivinganoutput to theuser. For ex:Consideracotton leaf with disease and is identifiedanddisplayedonthefronten dofthescreenas anoutput.

Train/Testis amethod tomeasure theaccuracy of your model. By splitting thedata set into two sets: a training set and atestingset.Trainingthealgorithmstoachieve the efficient output and to



showthe accuracy of the algorithm being used.Testingoftheinputimagedataasuploaded on a website by the user and topredict, label the image of leaf for betteraccuracyandgreatuserexperience.

The extractedfeature of the diseaseisthen compared with the ideal database,and it is provided to



the user directly ontheweb-applicationwithextrainformationlikethediseasenameandcharacteristics,etc.

RESULT

We have worked on the plant images and made a dataset from Kaggle, which containsapprox. 104 random leaf images to develop a model for detection of disease fromleaf images. Like any real-world data set, weencountered noise in both the images and labels. Images contains diseased part likebacterialor fungal infection in them. We have made our own dataset containing 500 images of plant leaves, which were collected from real farms with only threecategories of leaves species namely cotton, orange, & sweetlime. The images shots were taken at different time intervals within the span of 2 months.

Each leaf species contains up to 150 single plants leaf images, each one of whichhasbeen changedwith pixel resolution of 256*256 ofsize.The following figures show input images and output images using FCN network

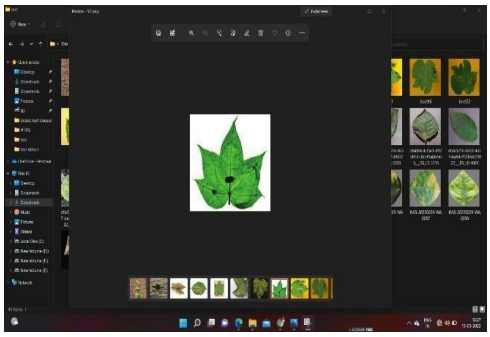


Fig2:InputImages

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Fig3:OutputScreenshots

CONCLUSION

Plantdiseasedetectionrequireshighprecisionandknowledgetodeterminethedisease.It is a complicated process to predict andidentifydisease toprotect plants.
Knowledgerequiresadeepunderstanding of various diseases causedbyinsects,pests,virus,infection ,etc.

We have developedasystemusingvariousmodelsbasedonfullyconvolutional neural networkarchitectures,todetectthe crop diseases using images. Our datasetcontains images of healthy leaves as wellas unhealthy or infected leaves for betterprecision and training.Theresultsgeneratedbycomparingvarious deep architectures using featureextraction gave us the understanding oftheaccuracyandefficiencyofoursystem.
Oursystemuses FCN architecture, which canaccuratelydetectdifferent varieties of diseases of variousplants usingleafimages.
Even at an early stage of infection, ourmodelcandetectthediseasehencecanbeused to reduce the damage that may havebeencausedbythedisease.

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