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Revolutionizing Agriculture Machine and Deep Learning Solutions for Enhanced Crop Quality and Weed Control

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ABSTRACT

Deep learning is the nucleus in machine learning discipline which uses knowledge representation of learning. Learning can be supervised or unsupervised. Much Deep learning architecture are available which includes deep belief networks, deep neural networks and recurrent neural networks of which it has been applied to most of the fields. The commonly used applications of deep learning are vision related, audio, video, language processing, social media, medical, game and many more programs where they have produced promising accurate results comparable to and in few cases superior to human experts. Smart agriculture is an area that can benefit from the latest advances in expert systems. One of the objective is to remove the weeds by reducing the use of herbicides used, the risk of pollution of crop and water. The image of crop field is given as input training examples. By using the extracted feature, the images with weeds are detected and classified. A deep learning model is developed using convolution neural network to detect weeds with a good accuracy so that the model could be used to detect the weeds in the cucumber crop field ina shorter time.

Introduction

DeepLearningisanimportantfunctioninartificialintelligencethatworksimilartothatofour brain in processing data and it creates pattern, which are helpful in decision making. Deep learning is a part of machine learning in Artificial Intelligence, which has the capability of learning any unsupervised data that even the data may be in unlabeled, orin unstructuredform. In this digital era, theapplications are aligned with deep learningfunctionalities, which has broughtasuddenincreaseofdatainallformslikeimages,videosetcand from everypartofthe world. The data, which is emerging out in this digital environment, is generally and purely knownasBigData.Therearemanysourcesofdatageneration likesocialmedia,internetsearch engines,e-commerceapplications,onlinecinemasandmanymore.This hugevolumeofdata with various other characteristics

like veracity, viscosity and velocity etc isnow freely and easily available.TheBigDatacanbesharedthroughvariousfilesharingapplications,whichisusedin financialservices-frombusinessestoconsumers.However,80%ofthedata,whichnormallyis intheunstructuredform,issohugeinnature. Theunstructureddata usuallycouldtakea longdurationforusto analyseitand minerelevant information which will be used for the analysis of the system. The corporate identify the incrediblepotentialthatcanresultfrom wasting this valuableinformationandareincreasingly adapttomodernintelligencesystems.Inordertoprocessthehugevolumeofdataandextractthe unique patterns the most common ArtificialIntelligence techniques usedfor processing the data ismachinelearningalgorithms.MachineLearningprovidesmanycategoriesofalgorithmslike prediction, regression, clustering etc that generate a high-precision analysis report and patterns withhistoricaldataornewlygenerateddata.Ifmedicalcompanywantstodetectthediseaseor occurrence of a specific disease pattern or potential for fraud in its system like forgery of insurance documents, originalityof drugs etc it could employmachine learning algorithms and toolsfor this purpose.The computational algorithm employedinto the data analytics system will processallthekindofdatainthatparticulardomainanditextractspatternsfromthehistorical dataanddetectsanyanomaliesinthesystem.Deeplearning domainisasubsetofmachine learning andfollows a hierarchicallevel of artificial neural networks to do the process of pattern identification.Theartificialneuralnetworksimitatesthefunctionalityofthehumanbrainandit contains millions neuron nodes connected to each other like a web. There is a fundamental difference in the way that how the traditional algorithms process the data and the Machine learningalgorithmsprocessthedata.Anonlinearapproach ofdataprocessingisemployedin Machine Learning and deep learning based application development. The deep learning techniquesusesanonlinearapproachwhichtakesmanyattributesforprocessinginparallel.In thecaseofanomaly/frauddetectioninanetworkbasedapplicationsittakesmanyparametersas input which includes time of occurrence of the event, geographical location information, identification of the device like IPaddress and Hardwareaddress, type ofeventsand manyother feature that is likely to point to the illegal activity. The initial layer i.e the input layer of the neuralnetwork processes takes the raw input data containsvariousattributes of variety of data. Theinputlayerpassesitontothenextlevelhiddenlayersandfinallyitwillbesenttoaoutput layer.Deeplearningnetworksnotonlytakesthetextdatainthetabularcolumnformatand producesanhighaccuracyoutput,italsotakestheimages,audios,videosandtimeseriesdata andpromisesahighaccuracyoutput.ThesocialmediaFacebookResearchdivisionheadand Father of network Architecture YannLeCun uses a new architecture which is good at object recognition inimage dataset called the Convolutional NeuralNetwork (CNN).The convolutional techniqueisshowingagreatsuccessinimageprocessinglikemultilayerperceptronfeedforward neural networks. Also this technique is capable of scaling with data and model size and the modelcouldbewelltrainedwithbackpropagationalgorithm.Thisfundamentalideaandthe requirementleadstothesignificanceofdeeplearningasthedevelopmentofCNNswithlarge numberoflayers,whichhaspromisedtoproduceahighaccuratedetectionandclassificationrate onimageandvideocontent.Deeplearningmethodshaveseveralwell-definedcomputational models,whichconsistofmultiplecomputationallayers tolearnrepresentationsofinputdata withmultipleabstractionlevels.Deeplearningisawellknownclassificationandprediction techniquewhichisusedforconstructingandtrainingneuralnetworkmodelsthatareconsidered

highlypromisingbestmodelsforimagepromising.Deeplearningtechniqueshavetheworddeep inthesensethatitsinputdatashouldbepassedandprocessedthroughaseriesofnonlinear transformationsbeforeitcomesoutoftheoutputlayer.For extractingthefeaturesfromthe images,deeplearningnetworksemployanautomatedtechnique.Thetraineddatafollowsthe welldefinedtrainingprocedureanditidentifiesthenewandrequiredpatternfromtheimage given as input to network. Image recognition is another interesting area of application. The imagesarerepresentedasa2Darrayofpixels.Eachpixelwith RGBchannelsorgrayscaleis feeddirectlyintoaconvolutionalneuralnetworkwhichistrainedend-to-end.ACNNconsistsof alternatinglayersofconvolutionscalledconvolutionallayers,andalsoitcontainspoolingand sub samplinglayers. The result of this is adeep abstract representation of imagesat theoutput layer thusCNNs or convents isthusit apowerfultoolforclassifyingthecontentsofimages.

Thereforethedeepnetworkleadstothesuccessof:

1. Google photos: Powered by a large scale CNN in the cloud running on powerful Google serverswithtensorprocessingunits(TPU)anddevelopedusingTensorFlow,anowpopular machinelearning(ML) library. Google photos scans and tags the backed up photos in the cloud automaticallyso that theyareeasily accessibleand searchable.
2. MicrosoftHow-Old: Though notveryaccurateat determining a personsage from photos,even humans find it difficult to do so.
3. Clarifai:Anotherinterestingcloud-basedimagerecognitionservice.
4. Natural languageunderstanding(NLU)isaboutextractingfromspokenwords.Inthiscase thissub-systemneedstoextractmeaningfromaconversationjust asarealhumanwould.Thisis such a very hard problem that it is termed AI-hard or AI-complete because solving it is like usheringinrealAIorwhatistermedstrong-AI.
5. Naturallanguagegeneration(NLG):Thenaturallanguageunderstandingisaboutfinding meaningbutNLGisaboutgeneratinglanguagesothatthesystemcanrespondinarespectable andunderstandableinacorrectmannertoanotherintelligentagentusuallyahumaninahuman- computer interface. The system needs to somehow crawl through it's knowledge representations effectivelyandefficiently and be able toformulate a waytorespond back.The actual robotvoice canthenbegeneratedbyothergenerativemodels,andDeep MinddemonstratedWaveNetfor such tasks.

LITERATURESURVEY

The study on CNN has expanded thoroughly and rapidly in recent times in the field of agriculture and many researchers have many termsto describe the combining models involving different algorithms. CiroPotena,Daniele Nardi, and Alberto Pretto designed a robotics system forautomatingcertainagricultureactivitiesthatemployanunmannedgroundvehicle(UGV) provided witha high resolution camera of multispectral capability.This would help to carry out crop/weed detectionandclassificationtasksintheagriculturefieldwithout humanintervention. Theirdesignexploresachannelthatconsistsoftwodifferentarchitecturesofconvolutional neural networks (CNNs) connected to the input RGB plus Near Infra-Red(NIR) images. A lightweightversionofCNNisusedtoachieveafast,scalable,robust,pixel-wise,binaryimage segmentation,inordertoextractthepixelsthatshowsprojectionsof2D/3Dpointswhichbelong to green vegetation category. A deeper CNN architecture could be employed to classify the extractedpixelsbetween thetwoprominent crop andweedclasses. Afurtheraddedimportant contributionofthisworkisanewkindofdatasetsummarizationalgorithm.Thepurposeofthis algorithmis toselectthemostinformativesubsetsfromalargedatasetthat

betterdescribethe originaloneautomatically.Thiswouldenableustospeedupt hemanuallabelingprocessofthe imagescollectioninthedataset.NimaTeimouri,MadsDyr mann,PerRydahlNielsen,Solvejg KoppMathiassen,GayleJ.Somerville,andRasmusNyholm Jørgensenpresentedpaperonweed identificationusingCNN.Theyoutlinedanewmethodwh ichestimatestheweedspeciesand growth stages of these in some images automatically. According to various environmental conditions, image of weeds that are grown in the same type of crops are collected. The parameters that are considered maybe the typesof soils, dark light, medium light and resolution areconsidered. Asetofimagesaretakenfortrainingoutofwhichitseparatesi ntonineclasses.

Thenthenextsetsofimagesaretakentoevaluatetheperfor manceoftheproposednetwork.

Everythingisdifferentiatedwiththatoftheparametersconsi dered.Maximumaccuracyof78% isobtainedforthePolygonumspeciesand46%forblackgras s.Obtainedabout70%accuracy forfindingthenumberofleaves.Thenewmethodwhichisp roposedhasagoodhighabilityto estimate,the,weedspecies.

SYSTEM EXISTING

A. ExistingSystem:

Theunstructureddatausuallycouldtakealongdurationfor ustoanalyze it and mine relevant information which will be used for the analysis of the system. The corporate identify the incredible potential that can result from wasting this valuable informationandareincreasinglyadapttomodernintelligen cesystems.Inordertoprocessthe hugevolumeofdataandextracttheuniquepatternsthemos tcommonArtificialIntelligence techniques used for processing the data is machine learning algorithms. Deep learning domain is a subset of machine learning and follows a hierarchical level of artificial neural networkstodotheprocessofpatternidentificationlikeide ntifytheweed.

B. ProposedSystem:

Nowdays,agricultureisaveryimportantfieldwhereevery bodyhasto payattentiontohelpthefarmers.Populationgoesonincreas inginrecentyearsandtherefore thefarmproductsrequirementskeeponincreasing.Theref orefarmyieldplaysanimportant role.Newmethodsareemergingnowadaytokeeptheyield highbyconsideringtheimpact that is causeddue to environment factors. One ofthe important steps in increasing the yield is totreattheweedasitdirectlyassociatedwiththecropyield. Soherewecondertheweed identification in the farm field using deep learning technique. In deep learning we use convolutionalneuralnetworktoidentifytheweed.

SYSTEMARCHITECTURE

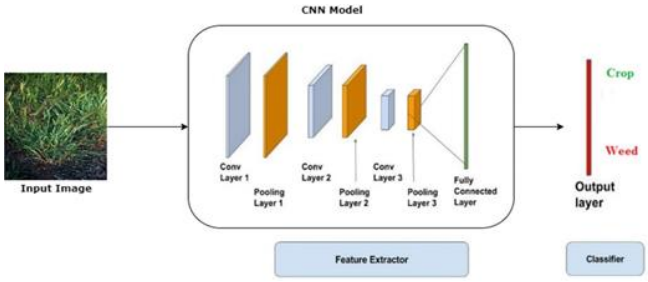


FIG4.1CNNmodelisfullyconnected withpooling layers

V.SOFTWAREANDHARDWAREREQUIREMENTS

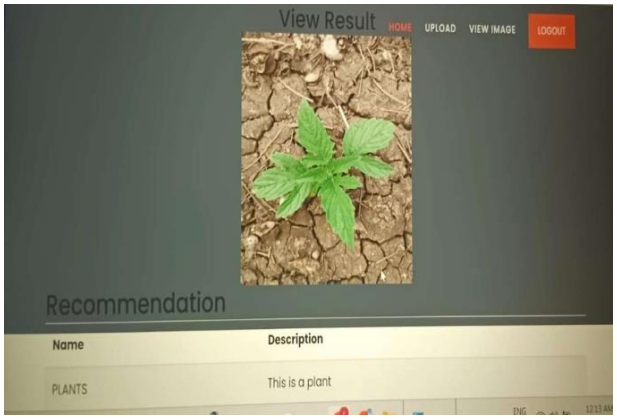
Hardwarerequirements:

Processer	:	AnyUpdateProcesser
Ram	:	Min4GB
HardDisk	:	Min100GB

Softwarerequirements:

OperatingSystem	:	Windowsfamily
Technology	:	Python 3.6
Front-End	:	PyQt5
IDE	:	PyCharm

RESULT



The dataset contains various features extracted from the given image dataset to calculate whetheranimageincludeanyindicationofweedornot.Thefeaturesthatwereextractedrepresentthe individual anatomical part.The method that were utilized for imageanalysis and construction of 64colorfeaturesand45textureattributesarebasedongreylevelco-occurrenceofmatrix.

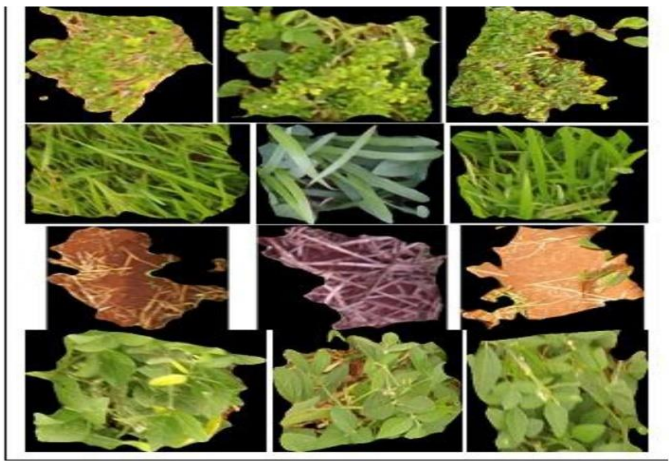


FIG: Imagedataset

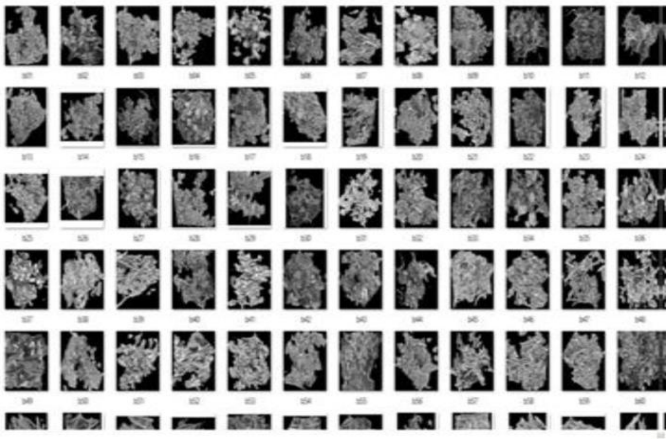


Fig:GrayscaleImage

CONCLUSION

Featureextraction concept utilized for reducing the amount of computing and storage resources requiredtodescribeandprocessalargesetofdata.Inthepro posedwork,CNNclassification modelisusedtoextracttheimportantfeaturesandtheextracte dsignificantfeaturesareusedfor effective training of the model. The proposed model gives anaccuracy of62%.In the nearfuture, stepsmaybetakentoimprovetheaccuracyandtoevaluatet hemodelwithotherparameters.

Theresearchmethodologyproposedin this articlewouldbe extendedfurtherto other cropsand weedswithhighdensefieldcontainsdifferentcategoriesof crops.

FUTURESCOPE:

Featureextraction concept utilized forreducing the amountofcomputing and storage resourcesrequired todescribeandprocessalargesetofdata.Inthefuturework,R NNclassificationmodelisusedtoextract theimportantfeaturesandtheextractedsignificantfeaturesa reusedforeffectivetrainingofthemodel.

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