

Research Paper On Sugarcane Disease Detection Model

Prince Kumar ^a, Mayank Sonker^b and Vikash^c

^{a,b,c}SCSE, Galgotias University

^a princekumar.kumar2713@gmail.com, ^b mayank.exe24@gmail.com, ^c vikashraj9801208@gmail.com

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Abstract: Harvest infections acknowledgment is one of the extensive concerns looked by the farming business. Notwithstanding, late advancement in visual registering with improved computational equipment has cleared path for computerized illness recognition. Results on openly accessible datasets utilizing Convolutional Neural Network (CNN) models have exhibited its suitability. To research how flow cutting edge order models would act in uncontrolled conditions as would be looked nearby, we gained a dataset of five infections of sugarcane plant taken from fields across various districts of Uttarakhand and Bihar, India, caught by camera gadgets under various goals and lighting conditions. Models prepared on our sugarcane dataset accomplished a top precision of 93.20% (on testset) and 76.40% on pictures gathered from various confided in online sources, exhibiting the heartiness of this methodology in distinguishing complex examples furthermore, varieties found in practical situations. Besides, to precisely restrict the tainted locales, we utilized two unique sorts of item discovery algorithms YOLO and Faster-RCNN. The two organizations were assessed on our dataset, achieving a top Mean Average Precision score of 58.13% on the test-set. Considering everything, the methodology of utilizing CNN's on an impressively assorted dataset would prepare for mechanized infection acknowledgment frameworks.

Catchphrases: Computer Vision, Deep Learning, Object Detection

1. Introduction

Farming is the pillar of the Indian economy. Huge commercialization of a farming has made a very negative impact on our current circumstance. The utilization of substance pesticides has prompted gigantic degrees of synthetic development in our current circumstance, in soil, water, air, in creatures and surprisingly in our own bodies. Fake manures give on a transient impact on profitability however a more extended term negative impact on the climate, where they stay for quite a long time subsequent to filtering and running off, tainting ground water. Another negative impact of this pattern has been on the fortunes of the cultivating networks around the world. In spite of this purported expanded efficiency, ranchers in for all intents and purposes each country around the world have seen a decline in their fortunes. This is the place where natural cultivating comes in. Natural cultivating has the ability to deal with every one of these issues. The focal action of natural cultivating depends on preparation, irritation and infectious prevention.

Plant infection identification through unaided eye perception of the indications on plant leaves, consolidate quickly expanding of intricacy. Because of this intricacy and to the enormous number of developed Crops and their current phytopathological issues, indeed, even experienced agrarian specialists and plant pathologists may frequently neglect to effectively analyze explicit sicknesses, and are thusly prompted mixed up ends and concern arrangements. A robotized framework intended to help distinguish plant infections by the plant's appearance and visual manifestations could be of incredible assistance to novices in the horticultural cycle. This will be demonstrated as valuable strategy for ranchers and will alarm them at the correct time prior to spreading of the sickness over huge zone.

Deep learning comprises a new, current strategy for picture handling and information examination, with precise outcomes and huge potential. As Deep learning has been effectively applied in different areas, it has as of late enter additionally the space of agribusiness. So we will apply profound figuring out how to make an calculation for robotized recognition and characterization of plant leaf infections. These days, Convolutional Neural Networks are considered as the main strategy for object location. In this paper, we considered locators in particular Faster Region-Based Convolutional Neural Network (Faster R-CNN), Region-based Completely Convolutional Networks (R-FCN) and Single Shot Multi-box Detector (SSD). Every one of the design ought to be ready to be converged with any component extractor relying upon the application or need.

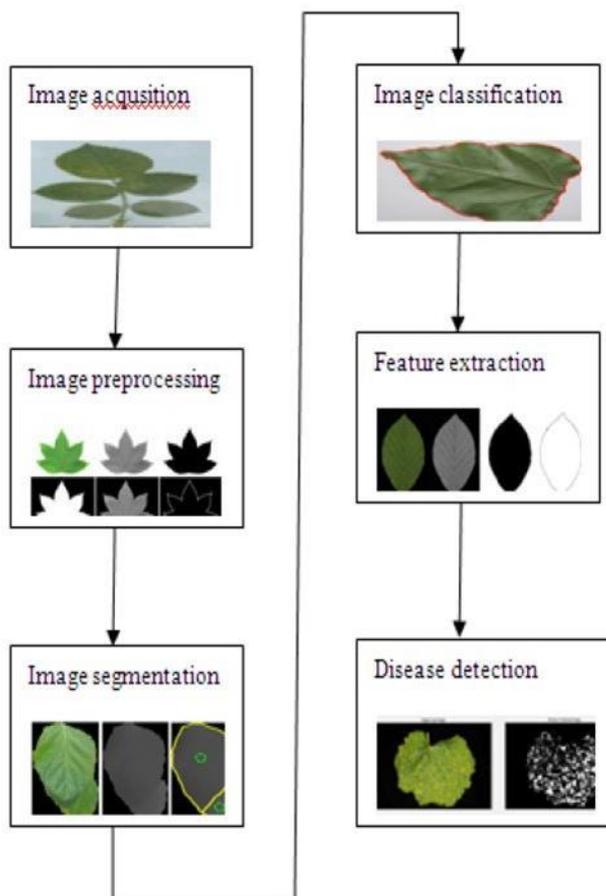


Fig 1: System Architecture

Technical Details--

- Data Preprocessing: The process of cleaning and hence removing all the unnecessary and redundant information from the dataset concerned, is called the method of Dataset preprocessing.
- Some of the preprocessing operations used in our scenario are mentioned and explained below.
- Acquisition of Dataset: We have tried to collect the dataset from Kaggle and UCI Machine Learning Repository. Our primary aim is to first try and train the model for a single type of crop (viz. sugarcane or wheat), followed by the extension of the model to support this functionality for other crops and fruits as well with increased efficiency.
- After acquiring the necessary data for this experiment we have tried to filter out the irrelevant and redundant data from the same using some preprocessing and feature extraction techniques.
- For preprocessing, we have used Grayscale Pixel Values as Features, and considered the Mean Pixel Value of Channels, for filtering out and extracting data from the edges of the images in the dataset.
- Finally, after the dataset is cleaned, it is now ready to be fed into the learning algorithm, which comprises the core architecture of the model.
- Additionally, we have used the method of automated Segmentation via. OpenCV to automate the process of filtering out the data. We used a technique that analyzes the masks based upon the color, saturation, and even the structure of the leaf under consideration.

Data Elicitation and Gathering--

For this experiment, we have tried to gather the data using multiple sources:

- Manual Approach: We have tried to click the photographs of the images of leaves that were suspected of having certain disease, as well as some rotten ones which we believe would provide a little bit of bias to the

overall data present with us.

- From Kaggle: We have also extracted the dataset from Kaggle itself which contains low resolution images of the leaves of various crops that need to be considered for this experiment.
- From UCI Machine Learning Repository: Further, to provide additional supplements/variance to the data, we have also included the images of sugarcane leaves which would in turn provide the much needed variance in order to lead the dataset to perform better for the proposed model.

To fulfill the objective of this model, the data that is required for training the algorithm contains has to be an assorted collection of approximately 4500 images of leaves of the plants whose conditions are to be considered for the sake of this model. The images present in the database are 80 by 80 pixels colored.

During the preprocessing of the data, the colored images are then converted to greyscale features by the use of OpenCV and image filters.

Additionally, all the noise present in the data is then removed with the help of Gaussian Filters and segmentation techniques. All of this is done to make our dataset ready in order to be fed into the model and hence to train it.

Related Work--

As of late CNNs [6] have shown a gigantic headway and are being applied in various spaces including crop sickness discovery. Mohanty et al. [21] utilized two deep learning structures GoogleNet [9] and AlexNet on sugarcane disease dataset to distinguish several infections accomplishing a pinnacle precision of 99.35% at test-time. Dealing with the equivalent dataset [23] shows a test precision of 90.4% utilizing a VGG-16[24] model. Another work additionally utilizes a profound learning framework to recognize 13 sorts of infections in 5 yields utilizing pictures from web accomplishing a precision up to 96.3%.

Sugarcane Dataset--

Albeit every one of the works referenced above show productive outcomes however the issue with these works is that either the pictures were downloaded from web or the pictures were taken in controlled climate in research facility, scrutinizing their applicability in true where we may experience various varieties in pictures. has likewise referenced that the precision of their work drops generously to 31.4% when testing is done on pictures taken under various conditions from the one under which training pictures were taken (research center conditions). To experience all these, we acquire a more reasonable dataset of sugarcane for certifiable relevance.

The dataset contains 2940 pictures of sugarcane leaves having a place with 6 distinctive classes (comprising of 5 infections and 1 sound). These incorporate significant infections that effect the harvest in India. Every one of the pictures were taken in common habitat with various varieties. The pictures were taken at different development fields including University of Agrarian Sciences, Mandya Bangalore and close by ranches having a place with ranchers. All the pictures were taken utilizing telephone cameras at different points, directions, backgrounds representing the majority of the varieties that can show up for pictures taken in genuine world. The dataset was gathered with the organization of experienced pathologists (segment6). For confining the tainted spots on the leaves (object location) relating to four sicknesses, we physically explained the dataset. The vast majority of the pictures in the dataset contain numerous tainted spots of changing examples. Every one of these spots were independently explained utilizing various fixes appropriately. The appropriation of the pictures into various classes is nitty gritty in Table 1.

S.No.	Class	Count
1.	Cercospora Leaf Spot	215
2.	Helminthosporium Leaf	226
3.	Rust	104
4.	Red Dot	302
5.	Yellow Leaf Disease	155
6.	Healthy	539

Table: Distribution of images into different classes

Implementation, Experimental Setup and Details--

The experiment is composed of three major phases in which the entire model is aimed to be built, and is made ready for classification.

We have made use of the Deep Convolutional Neural Networks for the said classification task.

And for this, we have focused on two crucial architectures of NNs. The AlexNet and the GoogleNet architecture with respect to the CNN model.

CNNs stand for Convolutional Neural Networks is one of the types of Neural Networks which are extensively used for image classification purposes. CNN uses the concept of application of visual cortex which helps it in gaining a high level of accuracy, with constant precision rates, while working with images. CNN used fewer number of

parameters as compared to a fully connected network by repeating the same parameters multiple number of times.

2. Comparative Analysis--

As far as precise recognition of disease in crops is concerned, so many techniques have been developed and are being continuously researched in this domain to get as much accurate results as possible.

The various methods that have been employed in performing this experiment are: Support Vector Machines (SVMs), Discrete Wavelet Transform (DWT), and fine-grained image processing applications.

3. Literature Review--

The current scenario of Plant based disease detection task in a complicated environment

basically consist of three aspects: diseased

leaf image segmentation, feature

extraction and disease identification.

1. Distinguishing proof of leaf illness in the pepper plants utilizing delicate processing procedures. This paper the pictures are taken and will be given the information as hereditary sciences. As picture preparing will give the ideal outcomes in the horticultural items. For the most part pepper plants are influenced by cotton leaf illness

2. Recent Machine Learning based methodologies for sickness location and order of rural items. In this paper recognizes the infections in the plant, vegetables, natural products by utilizing svm classifier the pictures are to be ordered fast and exact recognition and arrangement of plant illnesses and grouping of plant sicknesses in this paper they are proposing trial answers for increment the exactness upto 90%.

3. sugarcane leaf sickness identification and seriousness assessment dependent on fragmented spots picture. In this paper the assessing the seriousness dependent on the influenced district everywhere on the harvest and the amount it is influenced and steps to control the misfortune by discovering it in the beginning phase itself.

Due to the requirement for high hardware resources and traditional neural network models of high quality and quantity of data sets in the training process, the training wastes much time that is not conducive to

the promotion and use of the model. In this paper, we recommend a transfer learning model for identification combined with the pretrained model, using the dataset of disease leaves to train the model.

4. Proposed Methodology--

Plants are defenseless to a few problems and assaults brought about by infections. There are a few reasons that can be characterizable to the impacts on the plants, messes because of the ecological conditions, like temperature, stickiness, nourishing overabundance or misfortunes, light and the most widely recognized

illnesses that incorporate bacterial, infection, and parasitic sicknesses.

Those illnesses alongside the plants may shows extraordinary

actual attributes on the leaves, for example, a progressions in

shapes, colors and so on Because of comparative examples, those above changes

are hard to be recognized, which makes their acknowledgment

a test, and a prior discovery and treatment can maintain a strategic distance from

a few misfortunes in the entire plant. In this paper, we are examined to utilize late indicators like Faster Region-Based Convolutional Neural Network (Faster R-CNN), Region-based Completely Convolutional Networks (R-FCN) and Single Shot Multibox Detector (SSD) to discovery and order of

plant leaf illnesses that effect in different plants. The difficult a piece of our methodology isn't just arrangement with infection identification, and additionally known the contamination status of the illness in leaves and attempts to give arrangement (i.e., name of the reasonable natural composts) for those worry illnesses.

A. Quicker Region-Based Convolutional Neural Network (Quicker R-Cnn) Quicker R-CNN is one of the Object discovery frameworks, which is made out of two modules. The principal module is a profound

completely convolutional network that proposes districts. For preparing

the RPNs, the framework considers secures containing an item or not, founded on the Intersection-over-Union (IoU) between the object proposition and the ground-truth. At that point the subsequent module is the Fast R-CNN locator that utilizes the proposed locales. Box proposition are utilized to edit highlights from something similar transitional component map which are in this manner took care of to the rest of the element extractor to foresee a class and class-explicit box refinement for every proposition. Figshows the fundamental design of Faster R-CNN. The whole interaction occurs on a solitary bound together organization, which permits the framework to share full-picture convolutional highlights with the identification network, hence empowering almost sans cost area proposition.

OVERVIEW OF THE SYSTEM

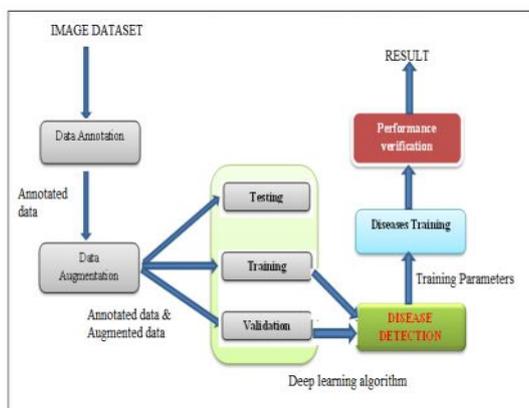


Fig. 3. System design

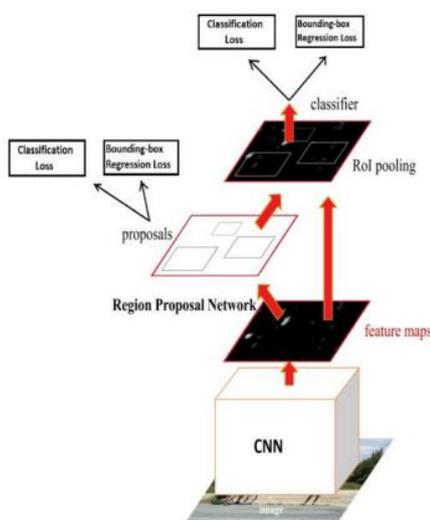


Fig. 2. Basic architecture of Faster R-CNN

B. Local Based Fully Conventional Network

(R-FCN)

We build up a system called Region-based Fully Convolutional Network (R-FCN) for object identification. While Quicker R-CNN is a significant degree quicker than Fast RCNN, the way that the area explicit part should be applied a few hundred times for each picture drove to propose the R-FCN (Region-based Fully Convolutional Organizations) strategy which resembles Faster R-CNN, yet rather than

editing highlights from similar layer where locale recommendations are anticipated, crops are taken from the last layer of highlights preceding forecast. R-FCN object discovery technique comprises of: (i) locale proposition, and (ii) area grouping. This methodology of pushing editing to the last layer limits the measure of per-locale calculation that should be finished. The article discovery task needs limitation portrayals that regard interpretation difference and in this manner propose a position-touchy editing system that is utilized rather than the more standard ROI pooling tasks utilized in object location. They show that the R FCN model could accomplish equivalent exactness to Faster R-CNN regularly at quicker running occasions.

C. Single Shot Detector (Ssd)

The SSD approach depends on a feed-forward

convolutional network that delivers a fixed-size assortment of bounding boxes and scores for the presence of item class examples in those crates, trailed by a non-most extreme concealment step to create the last identifications. This organization

can manage objects of different sizes by joining expectations from various element maps with various goals.

Moreover, SSD exemplifies the measure into a solitary organization, evading proposition age and in this manner saving computational time.

IV. Exploratory Result

In our framework handling begins with Data assortment, through some the pre-preparing, include extractor steps to be permitted and afterward at last identify the illnesses from picture. Fig shows the outline of our proposed framework.

D. Information Collection

Dataset contains pictures with a few infections in numerous various plants. In this System we think about a plants like sugarcane. Ailing leaves, solid leaves every one of them were gathered for those above crop from various sources like pictures download from Internet, or

essentially taking pictures utilizing any camera gadgets or any else.

E. Picture Pre-Proposing

Picture explanation and growth Picture explanation, the assignment of naturally creating depiction words for an image, is a critical segment in different picture search and recovery applications. In any case, in this framework, we physically clarify the territories of each picture containing the infection with a jumping box and class. A few infections may seem to be comparative relying upon its contamination status.

Comment cycle may ready to mark the class and area of the tainted zones in the leaf picture. The yields of this progression are the directions of the bouncing boxes of various sizes with their relating class of illness, which therefore will be assessed as the Intersection over-Union (IoU) with the anticipated outcomes during testing. Figure shows the commented on picture.

Pictures are gathered from different sources were in different arranges alongside various goals and quality. To

improve include extraction, pictures are proposed to be utilized as dataset for profound neural organization were pre-handled to acquire consistency. Pictures utilized for the dataset were picture

resized to 256×256 to diminish the hour of preparing, which was consequently registered by composed content in Python, utilizing the OpenCV system.

In AI, just as in insights, overfitting

shows up when a factual model portrays arbitrary commotion or mistake instead of basic relationship . The picture growth contained one of a few change procedures including relative change, point of view

change, picture revolutions and power

changes (difference and brilliance upgrade, shading, clamor).

F. Imaging Analysis- -

Our framework fundamental objective is to identify and perceive the class infection in the picture. We need to precisely distinguish the article, just as recognize the class to which it has a place. We expand object identification structure to adjust it with various element extractors that recognize infections in the picture.

Quicker R-CNN

Quicker R-CNN for object acknowledgment and its Region Proposal Network (RPN) to assess the class and area of item that may contain an objective applicant. The RPN is utilized to create the item a proposition, including their class and box arranges.

R-FCN

Like Faster R-CNN, R-FCN utilizes a Region Proposal Network to produce object proposition, however as opposed to trimming highlights utilizing the RoI pooling layer it crops them from the last layer before expectation.

SSD

SSD creates secures that select the top most convolutional include maps and a higher goal highlight map at a lower goal. At that point, a succession of the convolutional layer containing every one of the recognition for each class is added with spatial goal utilized for expectation. Consequently, SSD can manage objects of different sizes contained in the pictures. A Non-Maximum Suppression technique is utilized to contrast the assessed results and the ground-truth.

G. Feature Extraction

There are some conditions that ought to be taken into consideration when choosing a Feature Extractor, like the type of layers, as a better number of parameters increases the complexity of the system and directly influences the speed, and results of the system. Although each network has been designed with specific characteristics, all share an equivalent goal, which is to extend accuracy while reducing computational complexity. during this system each object detector to be merged with a number of the feature extractor. The system performance is evaluated first of beat terms of the Intersection over-Union (IoU), and therefore the Average Precision (AP) that's introduced within the Pascal VOC Challenge

$$\text{IoU}(A, B) = |A \cap B| / |A \cup B| \quad (1)$$

where A represents the ground-truth box collected within the annotation, and B represents the anticipated results of the network. If the estimated IoU outperforms a threshold value, the predicted results considered as a real positive, TP, or if not as a false positive, FP. TP is that the number of true positives generated by the network, and FP corresponds to the amount of false positives. Ideally, the amount of FP should be small and determines how accurate the network to affect each case is. The IoU may be a widely used method for evaluating the accuracy of an object detector. The Average Precision is that the area under the Precision-Recall curve for the detection task. As in the Pascal VOC Challenge, the AP is computed by averaging the precision over a group of spaced recall levels $[0, 0.1, \dots, 1]$, and the mAP is that the AP computed over all classes in our task.

$$AP = \int_0^1 p(r) dr \quad (2)$$

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$$pinterp(r) = \max_{\tilde{r}: \tilde{r} \geq r} p(\tilde{r}) \quad (3)$$

where $p(\tilde{r})$ is that the measure precision at recall \tilde{r} . Faster R-CNN for every object proposal, [14] we extract the features with a RoI Pooling layer and perform object classification and bounding-box regression to get the estimated targets. We used batch normalization for every feature extractor, and train end-to-end using a picture Net Pre trained Network.

To perform the experiments, our dataset has been divided into training set, validation set and testing set. Evaluation is performed on the Validation set then training is process is performed on the training set then final evaluation wiped out testing phase. As within the Pascal Visual Object Classes (VOC) Challenge [17], the validation set may be a technique used for minimizing over fitting and may be a typical thanks to stop the network from learning. We use the training and validation sets to perform the training process and parameter selection, respectively, and therefore the testing set for evaluating the results on unknown data.

5. Conclusion--

In this paper, we have implemented an approach based on image processing paired with Deep Learning (Convolutional Neural Networks)

to first detect and then classify leaves according to diseases they possess.

The acquisition of the dataset is achieved by considering the RGB filtered versions of the leaf image.

In the preprocessing phase, we have tried to remove the noise from the images using filters. Image feature extraction is performed so as to get the features of disease symptoms of the leaf under consideration.

The task of image classification is performed by using the Convolutional Neural Networks (CNNs).

From our experiment, we have been able to get the required results with a satisfying level of accuracy and precision score, all due to the effective nature of CNN for this image classification task.

Hence, we say that the system proposed by us is efficient enough to determine the diseases in crops efficiently.

References

1. To help ourselves with a kick-start for this project, there are certain resources and white papers which we have taken our references from. Those along
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