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DEEP LEARNING BASED APPROACH FOR CLASSIFICATION AND DETECTION OF PAPAYA LEAF DISEASES

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Abstract : ***In recent years, around the globe the horticulture crop outcomes falling down due to the devastating diseases, this impact will shows on yield of farmers such as quality and quantity of horticulture products, even in developed countries. Therefore, for prevention early observation and discovery of these diseases are very significant. In this paper we built a straight forward Convolution neural network on image classification for plant diseases, specifically for papaya plants, papaya suffering from Leaf Curl of Papaya, papaya mosaic. In a row, we propose for identification and classifying papaya leaves diseases a deep learning-based approach by using ResNet50 architecture as a convolutional neural network to stratify image data sets. Across globe in many disciplines deep learning has been employed .i.e. object tracking, text detection, image classification, action recognition. In deep learning different type of models, among Convolutional neural networks and Deep Belief Networks are frequently used models Convolutional neural networks has been exhibited extreme capabilities on image classification. The proposed model generated results are shown very usefulness of it, even under difficult conditions such as image size, pose, different resolution, illumination, complex back ground and alignment of actual images.***

Keywords: *papaya mosaic, ResNet50, Leaf Curl of Papaya.*

I. Introduction

Plant diseases are real wellsprings of extreme shortage of sustenance and nourishment frailty on our earth. Actually, it is assessed that plant pathogens may represent yearly harvest yield misfortunes of up to 16% globally [14].Furthermore, the momentum answers for battle distinctive sicknesses request the gigantic utilization of product assurance items, which are hazardous for the earth and the humans. For finding and distinguish various types of diseases, magnifying instrument and DNA sequencing-based strategies are powerful. Despite the fact that in created nations a considerable lot of the ranchers around the globe don't approach these diagnostics apparatuses, by far most of them have a smart phone. Truth be told, the Ericsson organization figures that versatile memberships will achieve 9.4 billion of every 2019 and 5.5 billion of these will be Smart phone memberships [13]. Henceforth, a smart phone based instrument that aides in discovering crop ailments in view of catching and dissecting naturally an image of a plant leaf is a good arrangement. In this paper, we venture out such an apparatus. Be that as it may, we bound to our examination to characterize papaya leaves infections. papaya is jeopardized by various sorts of ailments, such as papaya mosaic virus and papaya leaf curl .The mosaic is a pathogenic virus [potex virus].this ailment attacks the all age gathering of papaya plants yet most genuinely on youthful plants .The infected plant show a marked minimizing in growth such as fruits are stretch out and reduced in size (see fig.1 & fig.2).

Fig.1. papaya mosaic

Fig.2. Leaf Curl of Papaya

1.1 **Leaf Curl of Papaya**:

Leaf Curl of Papaya is a DNA infection from the class Begomovirus and the family Geminiviridae. PaLCuV causes extreme sickness in papaya (Carica papaya), yet can now and then contaminate different products, for example, tobacco or

tomato.[21] It can be found in tropical and subtropical areas essentially in India, yet firmly related species have additionally been distinguished in nations, for example, China, Malaysia, Nigeria and South Korea.[5] This infection is transmitted by a creepy crawly vector from the family Aleyrodidae and request Hemiptera, the whitefly Bemisia tabaci. The vector white fly (Bemisiatabaci) spreads this disease. Extreme curling, crinkling and deformation of the leaves indicate the disease. Principally the young leaves square measure affected. Except curling, the leaves conjointly display vein clearing and become more concentrated of the veins. Typically the petioles square measure twisted. In acute cases, discharged defoliation of the affected plant is ascertained. The high-flown plants show a scrubby progress with cut back fruit yield. These maladies can cease the existence of the plant, Left untreated. If, however, they're determined preliminary degree, they will be treated and also the plant is saved. Given the restricted availableness of resources and revel in on papaya pathology around the world, the necessity for a machine to categories and determine papaya maladies mechanically is vital. Also, the zoom of exploitation of clever phones and additionally the net everywhere the globe creates it simply handy to any or all fairly users. For detecting divergent diseases in some plants, like cotton, potatoes, tomatoes and grapes Machine learning and Computer vision techniques are applied. Considered through forge ahead in computer vision, particularly convolutional neural networks (CNNs), that controlled to offer great ends up within the quarter of photo class, we have a propensity to endorse a new system supported CNNs for papaya disorder identity. Our technique, primarily based on ResNet architecture wishes stripped-down image preprocessing the model will draw close perceptible functions immediately from snap shots. The advanced model is prepared to perceive two special kinds of pathologic leaves out of in good condition.

The rest of the paper is ordered as follows: in section 2 we have a tendency to provide the related work. section 3 explains the technical information of the projected approach and also the design of the ResNet convolutional neural network. Further greater, exploratory evaluation and results are stated in section 4. In the end, section 5 summarizes the paper and furnishes the views to future work.

2 Related work

In any case, a primary downside was that the whole photographic material included exclusively pictures in trial (research center) setups, not in genuine conditions in the development field. Sladojevic et al. (2016) [20] built up a comparative system for plant malady discovery through leaves pictures utilizing a comparable measure of information accessible on the Internet, which ncorporated fewer maladies (13) and distinctive plants (5). Achievement rates of their models were between91% and 98%, contingent upon the testing information. All the more as of late, Pawara et al. (2017)[16] thought about the execution of some traditional design acknowledgment procedures with that of CNN models, in plants recognizable proof, utilizing three unique databases of (a somewhat constrained number of) pictures of either whole plants and natural products, or plant takes off, reasoning that CNNs radically beat regular strategies.At last, Fuentes et al. (2017)[8] created CNN models for the identification of 9 distinctive tomato maladies and bugs, with tasteful execution. In this work, particular CNN designs were prepared and surveyed,to frame a mechanized plant ailment location and determination framework,in light of straightforward pictures of leaves of solid and ailing plants.Plant infection cause vital age and financial mishaps in horticultural and ranger service. Continuous changes in horticultural development have aggravated associate degree enthusiasm for one more time of modernized non-risky systems for plant infections space. Afterwards, completely different techniques have swung to computer vision and machine learning procedures to create a brisk methodology for plant maladies recognizable proof at the opportune begin of the reactions. Identification of disease Most of the studies bestowed within the literature follows the steps shown in Fig.3 [2], [6], and [15] identification technique begins and ends with in four steps within the initiative a image acquisition step here entirely healthy and infected plant images area unit captured by completely different digital devices. Then, a lot of examination is required to correct the image and prepare it for later refinement, like image segmentation, augmentation, filtering and color house conversion. Especially, image segmentation methods, like starting point, unit of measurement of times wont to notice boundaries in images. so the framework can all the while foreseeing question limits and arrange them at each position, the parameters of the two systems are shared, which results in a substantially quicker execution, making it reasonable for automated applications. In genuine outside farm settings, a solitary sensor methodology can once in a while give the required data to identify the objective tree leaves under an extensive variety of varieties in brightening, halfway impediments, and diverse appearances. This presents an extraordinary defense for the utilization of multi-modular leaf identification frameworks in light of the fact that shifting kinds of sensors can give reciprocal data with respect to various parts of the takes off. Profound neural systems have just indicated awesome guarantee when utilized for multi-modular frameworks in areas outside horticultural automation[11]

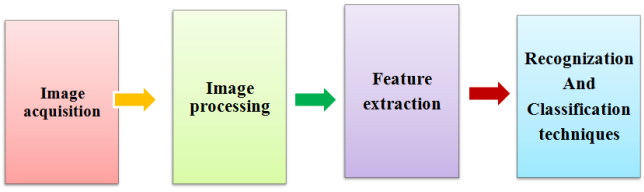

Fig.3. Flow of model.

Inside the component extraction step, features, for example, shading, shape and surface are figured from the picture. At long last, the characterization step is performed. Distinctive orders calculations are utilized as a part of the writing, for example, neural system [17], bolster vector machine [4] and administer basis characterization [6], [18]. In the going with, we present a game plan of the front line to go towards following the general outline in Fig.2. A modernized contraption is shown in [12] to measure the foliar blurring of leaf grounds by the dreadful little creature known as

Corythuchaciliata (SAY). In this examination, for social event tainted plant pictures we utilized couple-charged gadget (CCD) camera. The creators used the propelled shading picture examination partition method in which the primary RGB (Red, Green, Blue) leafs pictures were changed over into HIS and L×a×b shading spaces. The leaves having the contamination are settled in light of the shading contrast between them and the strong get out. The procedure relies upon the usage of the Otsu system to isolate the leaf from its experience and the chlorophyll histogram to recognize stains established by the trim bug. In [2], a shading based look like is familiar with recognizing five sorts of leaf infections which are untimely burn, cottony shape, dim frame, late sear and little whiteness. The viewpoint starts by perceiving green pixels in perspective of the tally of an overall edge as demonstrated by the Otsu technique. Ensuring to a clearing of non - green pixels, the debased regions are packed using the K-suggests strategy. Furthermore, surface features are expelled using the cooccasion framework as a commitment to a neural system framework to perceive the malady. The author in [17] exhibited an diseases recognizable proof approach of a medicinal herb called PhyllanthusEleganSWall (Asin-Asin Gajah) which is utilized to fix malignancy arising in the mammary gland. The suggested system starts by overhauling contrast as a preprocessing division before division and highlights extraction from leaves pictures. By then, two feed-forward neural frameworks which are multi-layer perceptrons and winding reason work RBF were associated with arrange the image into fine or bothersome. Anyway phenomenal systems have achieved awesome gathering realizes recognizing and seeing a part of the ailments, they encounter the evil impacts of a couple of confinements. For example, a division is used as a piece of most strategies as the underlying stage in the leaf disease examination. If the leaf picture is gotten with a dim establishment, the division is immediate and no obstacles should be stood up to. In any case, when the establishment comprises of various leaves or plants, the division may be defective. This larger piece of the systems will disregard to sufficiently remove the leaf from its experience which will provoke conflicting results. Also, some illness signs have relatively little addressed edges and they could a tiny bit at a time obscure into the sound tissue [3]. This may chafe courses of action like shading based methods and threshold's. Additionally, a segment of the strategies depend close by made features, for example, shading histograms, surface properties, shape characteristics and filter that required costly work and relies on expert learning. Regardless, these strategies don't total up well and they are not noteworthy while managing a significant measure of information that could include colossal groupings. For instance, the diminish leaf streak ailments in papaya make particular side effects and henceforth needs all the more prominent techniques to remember them enough. In this manner, in our proposed work we will take a gander at the usage of convolution neural framework structure (CNN) which is a system that maintains a strategic distance from division and hand-made features. Essentially, the closeness of an extensive total of papaya leaves information and exceptional enrolling structure made convolution neural framework system (CNN) an appropriate contender for the present application. In the going with the portion, we tend to detail the orchestrated strategy for papaya diseases prominent check.Studies from the literature reveal that while using pre-trained CNNs for feature extraction, the features are extracted from the layer right before the classification layer (Razavian et al., 2014)[19]

3 Proposed methods

To take care of, said challenges, to classify and establish papaya leaves diseases, we have a tendency to introduce a deep learning-based approach. Fig.4. illustrates the outline of the anticipated structure of framework. The figure demonstrates that the system contains of two primary parts:: deep learning-based classification and image preprocessing. Within the following, inside the accompanying, we clarify particulars about each part.

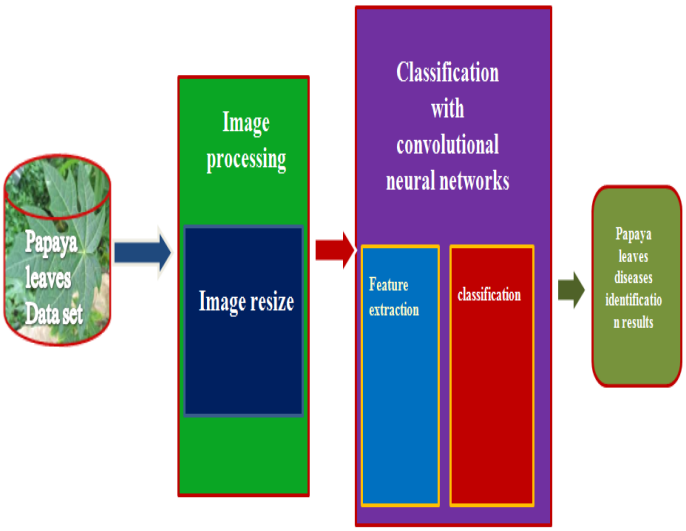

Fig.4. Proposed framework architecture.

3.1 **Image preprocessing**

The dataset kept in either neighbourhood or overall safe having a wide number of images of sound and tainted takes off. By using the pushed quality camera, pictures are gotten. Gotten each photo contains three channels which are RGB (red, green and blue). In our investigations, we will test the fittingness of our way to deal with handle with the red, green and blue images. Sequentially, we play out a preprocessing step; each neural system framework considers 224×224 RGB (red, green and blue) images as an input. Where every image in our dataset is resized to incorporate measure. It will make the yield that shows examination papaya mosaic or Leaf curl of Papaya.

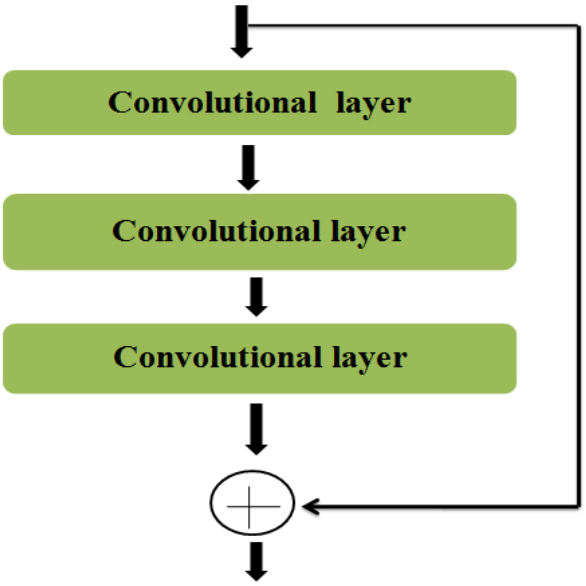

Fig.5. Fragment of the ResNet 50 illustrating the shortcut connection.

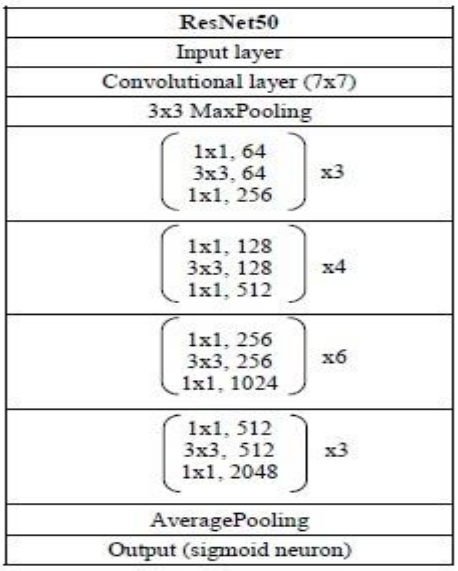

Fig.6. ResNet 50 Architecture.

3.2 Deep learning based classification

In neural systems include completely different neurons organized in layers. The neurons within the connecting layers are associated with one another. These neurons add up of a way to amendment over wellsprings of data (pre-removed and pre-arranged highlights) into relating yield. above all, convolutional neural systems (CNNs) area unit a gathering of multilayered neural frameworks and area unit seen because the important productive starter for important learning approaches wherever varied layers of a pecking request area unit with success organized munificently. CNNs area unit well-known for his or her generosity toward a coffee assortment of inputs, they need short preprocessing for his or her execution. they're additionally ready to get rid of fitting qualities where as at constant time acting division [7], [10]. Additional particularly, within the gift execution, we have a tendency to arrange usage of the ResNet 50 architecture for the convolution neural framework. ResNet 50 the remaining system framework created by Microsoft analysis Asia assemble [9] may be a important feed forward define containing primarily over one hundred layers. The data image is gone clearly through the convolutional layers; in any case, a number of them are excluded and enclosed within the yield of the stacked layers (shortcuts connections). Residual building blocks are previously mentioned to be Parts of the CNN with the alternate ways (Fig. 4). The cutoff affiliations show neither extra parameter nor calculation quality. The ResNet 50 contains of convolution and amid this way, the pooling layers, trailed by several extra squares stacked in the midst of a repetitive progression. Once everything in regards to convolutional layer there is a bunch institutionalization layer At the tip of the framework there is traditional neural framework, gone before by the pooling conventional layer. Significant residual frameworks could be prepared typical sweetening procedures like standard Gradient Descent (SGD) see in fig.5. The ResNet 50 arrange contains concerning 24M trainable parameters. The structure utilized all through the contextual investigation. ResNet 50 configuration presented in fig.6.

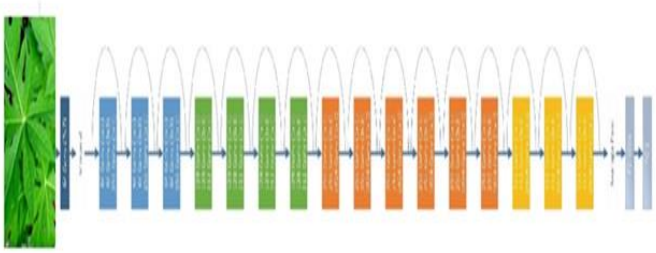

Fig.7. ResNet 50 working layers Architecture

Data set Illustrates the differences between the papaya mosaic and Leaf Curl of Papaya.Contains different visible structures inside the leaf. The training set contains 8900 Leaf Curl of Papaya images and 570 papaya mosaic. The test set have limit with respect to 100 images of the each category.

Pre-processing Scaling.

The dataset incorporate images of arranged resolutions. Consequently, it completely was important to resample the pictures by settling a persevering determination (224×224). As a result of rising the learning technique the estimations of the pixels (0-255) were rescaled to the change of 0 - 1. In addition, after they were scaled to have zero mean and variance measure up to one. Upinspecting and expansion of data. Because of the dataset is exceptionally lopsided what's destructive for the realizing strategy, in order to beat this disadvantage, we have performed relate in an up-examining of underrepresented classification by adding the duplicates of images to shape level with measure of photographs in each classification. To curtail the over fitting, we have a tendency to play out the data extension. Data were expanded by the measure of arbitrary image changes: zoom (inside the range: 90%percent 110% percent), expansiveness and tallness move (0.1 of the picture estimate), revolutions (inside the range: -300 300 degrees) and level and vertical flips.

Implementation details

Learning algorithm The system was prepared utilizing the small scale bunch inclination plummet calculation with Nesterov force. The cluster estimate was set to 16, force to 0.9. The planning computation limits parallel cross entropy work. The learning rate was at first set to 0.01 and was reduced 10 times after every 10 planning ages programming and gear. Using Python System was readied. Keras [1] library running over Theano library [16].Keras grants for straightforward and quick prototyping of the Neural Systems at the period of figurings we make usage of Nvidia CUDA library that licenses parallel enlisting on GPU. Using GPU The frameworks were readied. While data reinforcement movement was performed by CPU. The tests were performed on a figuring unit gave: GeForce GTX 980Ti GPU with 6 GB memory, Intel Core i7-4930K processor, and 16 GB RAM memory. The endmost frameworks structures were rejected in the records of a size around 0.2 GB (ResNet50). At the time of the test, we thought about portrayed CNN organizes on database suited almost 10000 pictures of Leaf Curl of Papaya and papaya mosaic. Since reality that distinctive choice of preparing and testing information change the outcomes, the k-overlay cross-approval with k=5 were connected in an approach to get more correct and close outcomes.

4 Results

At the time of the test, we pondered delineated CNN network systems composes on a database containing not exactly or break even with 10,000 pictures of the papaya mosaic and Leaf Curl of Papaya. These pictures are gotten with different measurements, arrangements, positions, backcloth and lighting up. Because the way that unmistakable decision of getting ready and testing data impacts the outcomes, the k-overlap cross-endorsement with k=5 was related to getting additional right and in every practical sense undefined outcomes the convolutional layers go about as the segment extractors. The essential characteristics of the sufferings are gotten by the convolutional channels all through the part extraction process and upgraded a while later. The dynamic layers of channels evacuate highlights of a more raised measure of thought. The sizes of pictures at coming to fruition areas are as per the going with 224×224 (interesting picture), 224×224, and 56×56 at long last 7×7. It is unquestionably not difficult to see that the huge system understands how to allocate leaf, defilements, contorts in pictures (low-level features). To preferable assess the framework fulfillment the sensitivity (GPR - genuine positive rate) and specificity (GNR - genuine negative rate) calculations were computed. The sensitivity all things considered means the proportion of appropriately ordered Leaf Curl of Papaya cases to the quantity of Leaf Curl of Papaya (1), while the specificity is that the quantitative proportion of appropriately arranged papaya mosaic outline to the measure of papaya mosaic (2):

$$Sensitivity = \frac{GA}{A} = \frac{GA}{(GA + FN)} \quad (1)$$

$$Specificity = \frac{GN}{N} = \frac{GN}{(FA + GN)} \quad (2)$$

where: A is the number of affirmative samples (Leaf Curl of Papaya), N is the number of negative samples (papaya mosaic), GA is the Genuine affirmative: Leaf Curl of Papaya correctly identified as Leaf Curl of Papaya; FA means False affirmative: papaya mosaic incorrectly identified as Leaf Curl of Papaya; GN is Genuine Negative: papaya mosaic correctly identified as papaya mosaic; FN means False Negative: Leaf Curl of Papaya incorrectly identified as papaya mosaic. Clearly, in horticulture applications, the most elevated affect-ability coefficient is attractive, in light of the fact that erroneously analyzed Leaf Curl of Papaya maladies can truly influence the plant well being. The sensitivity, specificity and exactness measures figured in light of examinations did are appeared in the Table I. The analysis of results obtained in Table I Shows that our network

Test set	ACCURACY (%)	SENSITIVITY (%)	SPECIFITY (%)
1	87	0.84	0.70
2	87	0.86	0.68
3	83.5	0.87	0.60
4	83.5	0.99	0.51
5	84.5	0.93	0.56
Average	85.1	0.90	0.61

Table 1. The table shows analysis of results

have gained outstanding classification results. Our model is expert to gain such optimal results by using the ResNet 50 network architecture, even generated graph for this, in figure 8 it will shows over all performance of our model.

5 Conclusions

Now a days horticulture affected by several plant diseases, which mitigates the outcome in terms of quality and quantity. In this paper, we have proposed a system deep learning approach to papaya leaves diseases characterization and classification. Distant from a conventional approach that besides, the lacking diagnostics tools in underdeveloped countries. DCNNs use trainable convolutional layers as the features extractor. Our model can help farmers as decision taking to identify the diseases in the papaya plant. The leaf of the picture required to determine the type of the disease. It has done by the farmer with his smart phone. Our main objective is to detect two famous papaya diseases which are Leaf Curl of Papaya and papaya mosaic by applying deep neural networks. The experimental results have shown that our approach is appropriate for a real-time environment. We expect in our future work to test with different architectures for automatically evaluate the severity of the identified diseases in papaya plants.

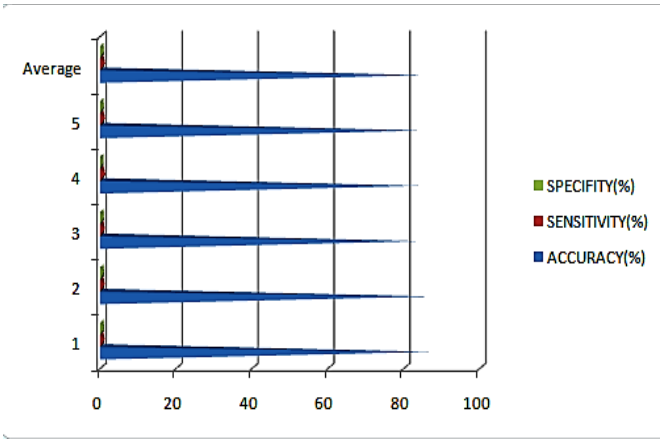

Fig.8. Results of analysis.

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