Performance Evaluation Of Image Processing Filters Towads Strawberry Leaf Disease

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***Abstract*—** The early identification of the plant leaf-disease is vital towards profitable harvest yield in the agri-field. Numerous researches have been carried out to detect the leaf disease on the agricultural land. specialists have done the plant distinguishing proof in India as plant supply oxygen for relaxing. there has been wide variety of disease has been presented on different plant. The assurance of the infection on bacterial spot and yellow shading leaf is trying in the farming field. The essential rationale is to distinguish the illness of the leaf as opposed to arranging it. The characterization of the infection requires huge target capacities to deal with it. In this work, the strawberry leaf disease of leaf spot, leaf scorch and leaf blight has been used as the input image. various noise filtering methods has been used to compare the best filter towards the leaf disease detection. The experimental results on the proposed separating model has been assessed regarding PSNR and MSE incentive to clarify and demonstrate the precision of the sifting models utilized in this work.

***Keywords*—** Gradient filter, Robert Filter, Prewitt Filter, Gaussian based filters, Canny Filter, MSE, PSNR

I. INTRODUCTION

In today's world, the agricultural land mass is more than just a source of food. Agriculture production is extremely important to India's economy. As a result, in the field of agriculture, disease identification in plants is important [5]. The use of an automated disease detection technique is useful in detecting a plant disease in its early stages. For example, in the United States, a disease known as little leaf disease is a dangerous disease that affects pine trees [3]. The affected tree's growth is stunted, and it dies within 6 years. It has an influence in Alabama and Georgia, as well as other areas of the southern United States. Early identification in such situations may have been beneficial. Image processing encompasses a wide range of techniques. Multiple processing steps are involved, including image data collection, pre-processing, segmentation, analysis, image description, identification, and classification from the real world [1].

Centered on the Internet of Things Image processing and machine learning are two emerging fields that have been sparked by recent events, especially in the development of artificial and intelligent systems that mine data and material using images [18]. Powdery Mildew (Odium Mangifera), Anthracnose (Colletotrichum gloeosporioides), Die Back (Botryodiplodia (Lasiodiplodia), Phoma Blight, Bacterial canker, Red rust, sooty mould, and other diseases commonly affect crops . As a result of the increasing use of web application and expertise combined with computer science approaches such as image processing, artificial intelligence, neural networks, machine learning algorithms, fuzzy logic, genetic algorithms, digital signal processing, and so on, the evolution of these types of diverse arrangements regarding the main claims has improved[4].

Contagious illnesses of the leaf may happen when the primary leaves unfurl in late-winter and proceed until torpidity in the pre-winter [2]. On profoundly vulnerable assortments, these illnesses can cause critical monetary harm. The essential harm from leaf sicknesses is a deficiency of power through diminished leaf territory. In the event that flare-ups of these leaf sicknesses become critical, the plants will become debilitated bringing about expanded vulnerability to root infections and winter injury [6].

II LITRATURE REVIEW

In 2015 [20] proposed the method genetic algorithm for detecting the leaf disease the performance metric has been evaluated using computation time of the process and the outcome of the result shows that the proposed method produced the optimum result for detecting the leaf disease.

In 2016 [18] deals with the method K-means Clustering, Neural Networks for detecting the leaf disease the performance metric has been evaluated using accuracy of the process and the outcome of the result shows that the proposed method produced the 95% accuracy for detecting the leaf disease.
In 2018 [7] experimented with the convolution neural network for detecting the leaf disease the performance metric has been evaluated using accuracy of the process and the outcome of the result shows that the proposed method produced the accuracy achieved for 5-layer for detecting the leaf disease in 95.05% for 15 epochs and 89.67% for 20 epochs.
In 2017 [20]experimented with the SVM for detecting the leaf disease the performance metric has been evaluated using a Error rate of the process and the outcome of the result shows that the proposed method produced the less ER for detecting the leaf disease.
In 2018 [13]experimented with the K means clustering, Support Vector machine (SVM) and GLCM for detecting the leaf disease the performance metric has been evaluated using accuracy of the process and the outcome of the result shows that the proposed method produced the accuracy achieved for detecting the leaf disease in 98.3%..
In 2017 [16]experimented with the segmentation method for detecting the leaf disease the performance metric has been evaluated using accuracy of the process and the outcome of the result shows that the proposed method produced the accuracy achieved for detecting the leaf disease in 90.96%..
In 2019 [23]proposed with the K means clustering detecting the leaf disease the performance metric has been evaluated using accuracy of the process and the outcome of the result shows that the proposed method produced the accuracy achieved for detecting the leaf disease in 98%.
In the proposed work more concentrated on image pre-processing for reduction of noise using various filtering methods. the image preprocessing helps to enhance the feature extraction and classification of the leaf disease. The image pre-processing method takes places for image enhancement.

III IMAGE PRE-PROCESSING

The image filtering techniques have been used extensively in this work. Average filtering, Median filtering and weighted filtering enhances the quality of the disease, detection after usage of pre-processing techniques such as noise reduction and image enhancement techniques.[11] Mostly occurring noises in the digital images are Additive noise which can also be termed as Gaussian Noise which is usually characterized by corruption of some portion of image by leaving the remaining pixels unaffected, Multiplicative noise which is referred as Speckle noise[10]. The noise reduction technique eliminates the noisy segments by preserving the image details for further computations.[15]

IMAGE GRADIENTS

Data can be separated from images using image gradients. For this purpose, angle pictures are created from the first image (most commonly by convolving with a channel, one of the simplest being the Sobel channel). In a given guidance, each pixel of an inclination picture quantifies the adjustment in power of the equivalent point in the first picture. Slope pictures in the x and y bearings are registered to get the full scope of heading.[13]

Edge recognition is one of the most well-known applications. Pixels with large inclination values become possible edge pixels after slope pictures have been recorded. Edge pixels are pixels with the highest slope values toward the angle, and edges can be followed in the direction of the inclination bearing. The Canny edge locator is an example of an edge recognition calculation that uses angles.[19]

Strong aspect and surface coordinating can also be done with picture inclinations. Different lighting or camera properties may cause two pictures of the same scene to have drastically different pixel values. As a result, organising calculations can overlook fundamentally similar or indistinguishable highlights [8]. One way to deal with this is to use slope pictures from the first pictures to find out surface or highlight marks. Since these inclinations are less vulnerable to lighting and camera adjustments, organising errors are reduced.

Roberts-Filter

The Roberts-Filter is use to recognize edges based applying a horizondal-fiter and verticle-Filter in grouping [9]. The two channels are applied to the picture and added to shape the end-product. The two channels are essential convolution-filter of the structure:

Vertical filter

Horizontal filter

A1	A2
A3	A4

Filter mask

0	1
-1	0

1	0
0	-1

where the channel is fixated on A1 with A2 being pixel[x+1][y] and A3 being pixel[x][y+1], and so forth then the formula to figure the consequent new A1 pixel is

pixel = abs(A1-A4)+abs(A2-A3)----------(1)

which is them braced to the 0-255 territory.

The genuine formula utilizes the level and vertical parts into the last structure

pixel = SQRT((X*X)+(Y*Y)) ----------(2)

where X = abs(A1-A4) and Y = abs(A2-A3) ----------(3)

in any case, for execution reasons we surmised the outcome and forget about the last recipe. The Roberts Edge identifier is quick since the channel is little yet it is additionally dependent upon impedance by commotion. On the off chance that edges are not sharp the channel will tend not to identify the edge.

Prewitt-filter

The Prewitt-filter is used in grouping to classify edges based on the application of a level and verticle-filter. The two filters are applied to the image and attached to the final product to form it. The two filters are the structure's fundamental convolution channels.:

Horizontal filter

1	1	1
0	0	0
-1	-1	-1

Vertical filter

-1	0	1
-1	0	1
-1	0	1

Filter mask

A1	A2	A3
A4	A5	A6
A7	A8	A9

where the filter is focused on A5 with A4 being pixel[x-1][y] and A6 being pixel[x+1][y], and so on then the forumla to ascertain the subsequent new A5 pixel is

pixel = (A1+A2+A3-A7-A8-A9)+(A3+A6+A9-A1-A4-A7)----------(4)

which is them cinched to the 0-255 territory. Note that the real forumla utilizes the even and verticle segments into the last structure

pixel = SQRT((X*X)+(Y*Y))----------(5)

where X = (A1+A2+A3-A7-A8-A9) and Y = (A3+A6+A9-A1-A4-A7) ----------(6)

be that as it may, for execution reasons we rough the outcome and forget about the last procedure.

GAUSSIAN FILTER

Gaussian filter assumes a significant part in separating various types of surfaces [17]. The straightforwardness of the calculation, simplicity of execution, and the heartiness of the outcomes make this sort of filtration the first decision for filtration in quite a while. The direct Gaussian channel is exceptionally mainstream in surface portrayal, it has been broadly utilized among **specialists**, and it has become a mechanical filtration standard. Gaussian channels can be applied to the info surface by convolving the deliberate surface with a Gaussian weighting capacity.

Canny filter

The Canny edge locator is an edge recognition programme that employs a multi-stage calculation to locate a broad range of edges in images. John F. Watchful designed it in 1986. Shrewd has devised a computational theory for edge detection, which explains why the method works. A multi-stage edge finder is the Canny filter. To process the force of the gradients, it uses a channel that is based on the subsidiary of a Gaussian [12]. The Gaussian reduces the impact of the commotion in the picture. By removing non-most extreme pixels of the slope size, possible edges are weakened to 1-pixel bends. Finally, using hysteresis thresholding on the angle size, edge pixels are retained or removed. The Canny has three movable boundaries: the Gaussian's width (the noisier the frame, the wider the width), and the hysteresis thresholding's low and high edges.

Canny edge recognition is a technique for recognising edges in a picture while suppressing noise. The fundamental advances are as per the following:

Stage 1 - Grayscale Conversion

Stage 2 - Gaussian Blur

Stage 3 - Determine the Intensity Gradients

Stage 4 - Non-Maximum Suppression

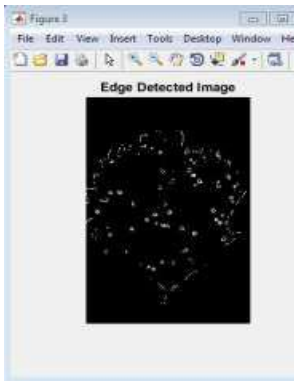
Stage 5 - Double Thresholding

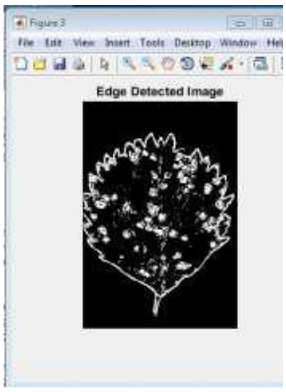
Stage 6 - Edge Tracking by Hysteresis

Stage 7 - Cleaning Up

IV EXPERIMENTAL RESULT AND ANALYSIS

The input image of strawberry leaf with leaf spot, leaf scorch and leaf blight has been used as experimental image collected from kaggle. The simulation has been carried out using MATLAB, the noises have been removed using different filtering methods of Gradient based (Robert Filter, Prewitt Filter) and Gaussian based filters (Canny Filter. Fig 1 represents the leaf spot image as a input image and noise has been removed by different filtering methods.



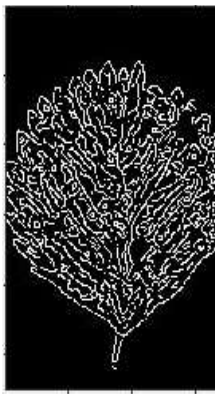
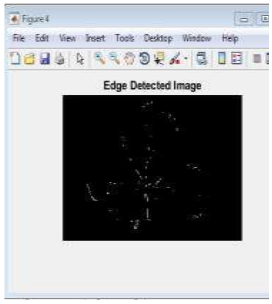
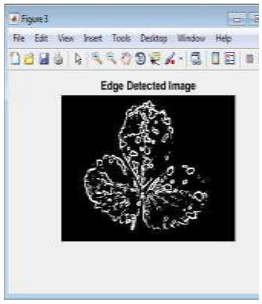


Fig:1 (a) leaf spot input image (b) output image: Roberts-Filter (c)output image: Prewitt-filter (d) output image Canny filter

. Fig 2 represents the leaf scorch image as a input image and noise has been removed by different filtering methods. And described in fig 2 b, c and d.



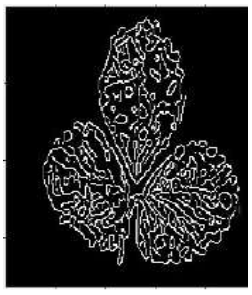


Fig:2 (a) leaf scorch input image (b) output image: Roberts-Filter (c)output image: Prewitt-filter (d) output image Canny filter

Fig 2 represents the leaf blight image as a input image and noise has been removed by different filtering methods. And described in fig 2 b, c and d.




Fig:3 (a) leaf blight input image (b) output image: Roberts-Filter (c)output image: Prewitt-filter (d) output image Canny filter

Table 1 : Performance Comparison Of MSE And PSNR

DISEASE NAME	MSE			PSNR		
	CANNY	ROBERT	PREWITT	CANNY	ROBERT	PREWITT
Leaf Scorch	88.76	99.71	89.16	28.68	28.2	28.66
Leaf Blight	89.44	100.12	94.94	28.65	28.16	28.68
Leaf Spot	85.96	96.64	86.77	28.82	28.31	28.78

PSNR

The table 1 represents the quality of the image has been compared using image quality matrix, Mean Square Error (MSE) and Peak Signal to Noise Ratio (PSNR).figure 4 represents the MSE for 3 filters.

Experimental result shows that the MSE value for Canny Filter is lower than Prewitt and Robert. Figure 5 represents the PSNR for 3 filters .The PSNR value is higher for Canny Filter. This shows that the Canny Filter is efficient than other two filters.

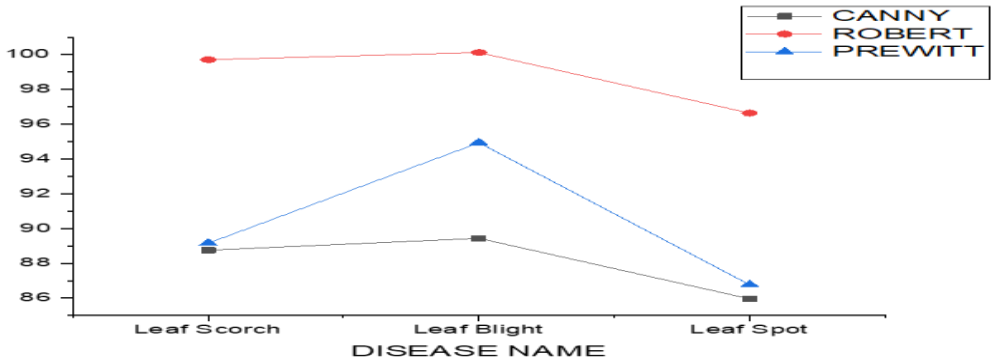


Figure 4 Performance evaluation MSE with canny, Robert and Prewitt filter

Edge detection masks based on the Prewitt operator are one of the most well-known and well-understood methods for detecting edges in images. In Robert edge detection, the vertical and horizontal edges are extracted separately and then combined for edge detection, while Canny edge detection is a multistage algorithm that looks for local maxima to detect a large range of edges in images. In this work strawberry leaf disease has been efficiently worked with by canny filter method. The figure 4 ad figure 5 describes the comparison results.

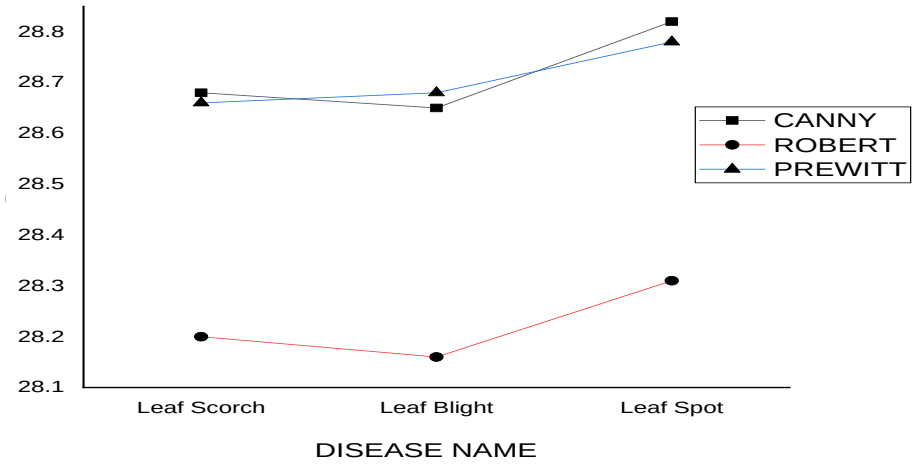
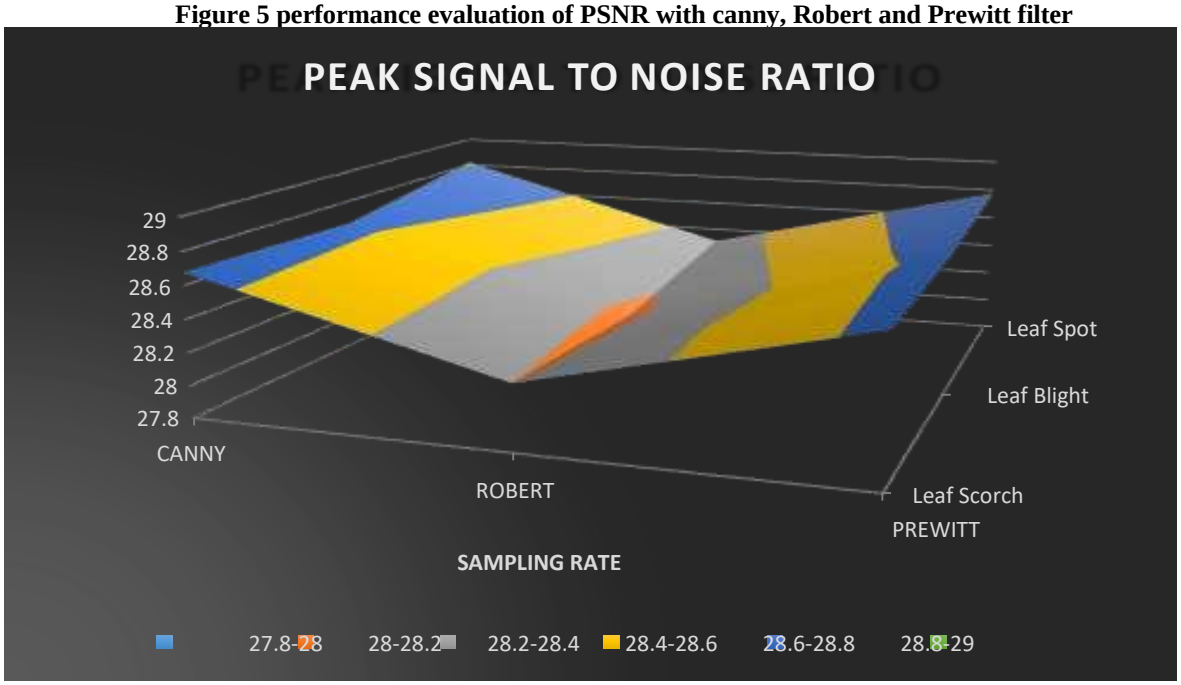
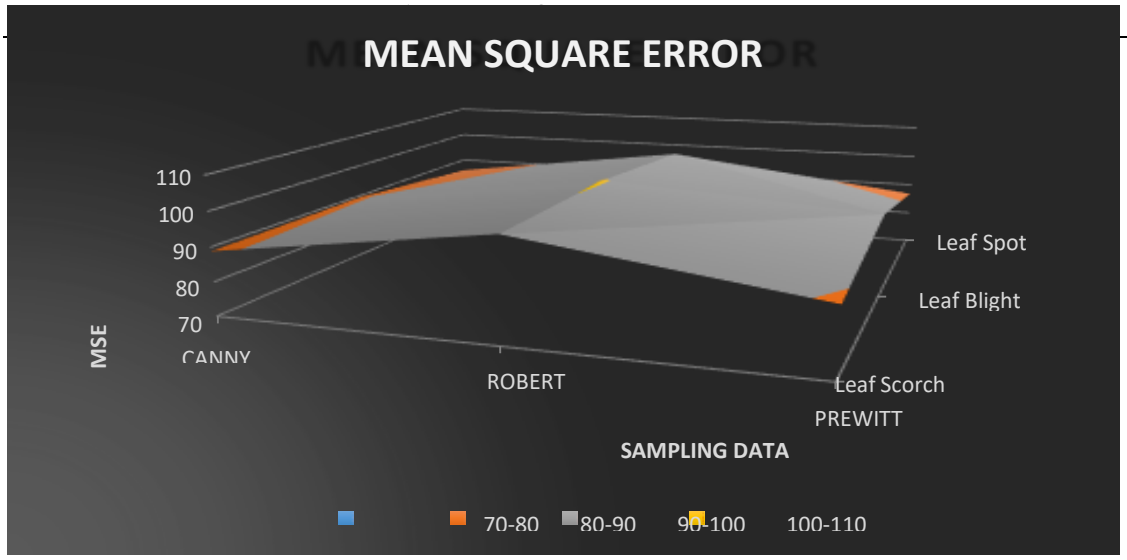


Figure 5 performance evaluation of PSNR with canny, Robert and Prewitt filter





The three significant leaf infections that are brought about by organisms have a comparable sickness cycle and are controlled along these lines. Leaf spot, leaf burn and leaf blight are the most widely recognized leaf sicknesses and they all overwinter in contaminated dead or living leaves. They all produce spores that spread the illness by causing new diseases during wet, warm conditions. In this work the digitally captured image having noise background is initially filtered using various type image filters of Gradient based (Robert Filter, Prewitt Filter) and Gaussian based filters (Canny Filter. Fig 1 represents the leaf spot image as an input image and noise has been removed by different filtering methods. Experimental result shows that the MSE value for Canny Filter is lower than Prewitt and Robert. The PSNR value is higher for Canny Filter. This shows that the Canny Filter is efficient than other two filters. For real time solutions, there is a need to develop the mobile based applications which will guide the farmers to detect the disease in plant leaves on their own. For future enhancement Identify a greater number of diseases and also Identify diseases for variety of plants.

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