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DETECTION OF COTTON LEAF DISEASE BY MODIFIED FILTERING TECHNIQUES

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ABSTRACT

The accurate identification of disease symptoms in plants using image processing techniques is a major scientific priority. The creation of a reasonable system for diagnosing plant diseases that can aid producers in their agriculture & growing is urgently required. With the help of cotton plant leaves, this initiative aims to create a framework for the diagnosis of plant diseases. This research presents a method for removing noise from images of cotton plant leaves using hybridized filtering. The proposed architecture combines morphological procedures, including Wiener & Median filters in a modified form. Using morphological operation, the image's perimeter & structure are recovered. Modified median filtering & wiener filters were employed to reduce & improve the noise. The proposed approach is used to calculate the variable's Root Mean Square Error (RMSE), Peak Signal Noise Ratio (PSNR), Mean Square Error (MSE) and Signal Noise Ratio (SNR). The final findings show that the proposed strategy is doing effectively with the upgraded grade.

Keywords: Image Processing; Noise Removal; Hybrid Filter; Cotton Plant

1. INTRODUCTION

The economic foundation of Indian rural areas is farming. India is the second-biggest exporter of vegetables & fruits in the globe and is also a farmland-civilized country. A third of the government's revenue in India originates from sources related to agriculture, & about 70% of the people are dependent on it [1]. To crop production of greater quality with less wastage, suitable crop safeguarding is crucial.Also, it guarantees that more food enters the marketplaces in excellent condition, which aids in lowering the cost of the food. It raises productivity, which improves the nation's economic situation [2–3]. So, it is abundantly evident that agriculture is of crucial importance to both the people and the nation as a whole. Many research investigations have been conducted as a result of these worries [4]. However, the majority of earlier reviews have focused on finding plant diseases [5,6].

With the use of imaging techniques, the illness symptoms that are evident in the plant are automatically detected. Finding abnormalities in plant photos requires the use of digital image processing techniques [7]. To identify the characteristics of a plant, such as a branch, leaves, & fruits, a variety of image processing techniques including filters are used. To develop an effective and clever farming system that can identify the plant's sick parts. Sadly, many different kinds of noises deteriorate the images of cotton plant leaves. These noises include Gaussian, Harmonic, Impulsive, & salt & speckle noise. Two measured values that are uniformly dispersed throughout the image [8–10] make up this noise.

The photos need to have the noise eliminated. Noise is the unintentional interference that is created in the image. Numerous factors can cause noise. Due to the structure of the device used to take the image, noise can be introduced into the image.The noise removal method is a crucial step since noise obstructs the input data in the image, making it impossible to obtain the correct data. It is exceedingly challenging for physicians to make an accurate diagnosis of the ailment without receiving accurate info. Image noises are added to the image when it is being sent and received, which could conceal the factual information.

2. LITERATURE SURVEY

Noise removal g the images has been done throughout the image restoration procedure. The photos contain a variety of noise types with a range of features [11]. Based on the forms of noise found in the image, noise-filtering strategies are developed [12]. There are numerous places where noise and the original signal might combine. Removing noise is crucial in the image analysis approach [13]. The processing of image quality is greatly influenced by the noise-filtering output [14].The method used to remove noise from photos is entirely dependent on the types of noises that cause image corruption. Several both nonlinear and linear strategies have been used in the noise-reducing procedure by utilizing different filters, such as a max filter, min filter, average, and several others [15-16]. Because of their propensity to cause image edge blur, filter methods aren't able to remove impulse noise. Many varieties of noise exist, including Gaussian filter& salt-and-pepper noise. When the number of pixels seems to be either 255 or 0, the salt & pepper noise appears. The method will determine whether or not the value of the center pixel matches 255 or 0 [17].When compared to other strategies, the researcher's proposed median filter is a viable methodology because its image quality is greater. By running the filters' simulated output variables PSNR & MSE, a close investigation is finished [18]. The Researcher also proposed a mean filter, but it was insufficient to remove the inordinate number of impulsive noises. Even though it generally works well, it struggles when impulsive noise & non-impulse noise occurrences turn out to be likely [19].Several crucial activities were carried out on the image while it is being obtained to classify & divide it. There are various filtering techniques are available to reduce the noise in complicated images [20]. In essence, filters are used to reduce noise to enhance quality images.Co-occurrence matrices & wavelet transforms are used most frequently in approaches to image analysis. A matrix used to determine the texture of an image is called a color co-occurrence matrix. The distance measure is used to determine the degree of similarity between two distinct extracted features [21]. Second-order statistics-based GLCM takes into consideration the spatial dependence or co-occurrence of two pixels at particular relative positions. Moreover, a co-occurrence matrix was generated from the angles of 0, 45, 90, and 135 degrees [22]. A tabular format called GLCM uses a haphazard collection of gray-level values. Changing the RGB values to grayscale indeed helps speed up wavelet transformation. To recognize areas of a picture such as textures, colors, tinting, & edges [23–24], the Canny Edge Detection approach is utilized. Canny edge detection is the most commonly employed edge method for detection. The edges can be obtained in a few simple steps. To reduce noise and establish the orientation & amount of the source image, first transform the values into grayscale [25].To produce the image's strong edges, non-maximum suppressing, and the double median filter might be used [26]. Edge monitoring will eliminate edge detection that isn't related to strong edges. Get the borders final, roughly, by the threshold level.A strategy was proposed by the researchers to categorize the nodules in plant images. Following that, early phases are successfully detected using the Self Organizing Technique. Its unstructured neural network technique allows for simple segmentation of the tiny nodules on the leaves of the cotton plant. First, researchers employed a shape-based technique to evaluate an image of a cotton plant leaf before using a GLCM technique to determine statistics for a cotton plant leaf's gray value [27].The cotton plant leaves are finally assigned to the segmented object after being removed. Eventually, classify the benign and malignant cotton plant leaves using a neural network with probabilities [28]. The proposed PNN categorization method's output has a highly accurate rating.A comparison of the FCM and FLICM algorithms was provided by the scientist [29]. The median filter has been employed to pre-process the input image's noise removal & histogram equalization, and also the Improved Expectation Maximization method is utilized to segment the filtered image [30]. This algorithm gradually increases the value while initializing the expectations & maximizing parameters. The new maximization & expectations, and positions should then be calculated. The modules are then extracted using the segmentation technique, & features including area, circumference, & eccentricity are extracted. Final classification method stages to contrast FCM & FLICM's highest performance metrics more favorably [31]. Specificity 92%, accuracy 97%, sensitivities 82%, & reliability 95% are performance metrics.

3. PROPOSED METHOD

Our new method for removing noise from cotton plant leaf photos that are captured using various equipment before being transmitted from one location to another has been proposed in this study. This study also demonstrates image enhancement techniques that allow for clearer image noise removal, which is crucial for accurate disease detection.

Algorithm

The algorithm is given as follows
I/P : Image with Cotton Leaf
O/P: Pre-processed image
Step 1: Using an input of an image

Step 2: Change the image to a grayscale version.

// Neighbourhood(mean of local frame)
$\beta_n = D(U_j)$ // full noise image (mean of global frame)
$\beta_n = D(U_k)$ // calculate noise

$\alpha_h = \sqrt{\frac{\partial_c}{2}}$

// compute median in every pixel
Step 3: Use morphological operations

Step 4: Determine the cutoff value.

R_{local}= Li
$R_{local-1}$, $I_{non-local}$
//Calculate computer images
G(y.z) =$R_{local-1}$*,Li*R_{local} *$R_{non-local)}$
Step 5. The equalization for the histogram.

Step 6. Use the Median Filter's Modified version to keep the image's edges intact.

Li = Median-Filtration
//local
$R_{non-local}$= Non-local filtrations
//computer similarity among pixels
Step 7: Use the Wiener Filter to get a noise-free image.

It will lay out the entire process for our proposed algorithm. Figure 1 outlines the algorithm's whole operation. The input image is next transformed into a grayscale version. A grayscale image is required for additional operations. The main justification for doing this is that any value between the ranges of 0 and 255 will denote a different place in the image. Every image has randomized additions of noise. Researchers are presuming that there is some noise in the supplied image.

Thresholding: To remove noise from noisy photos, thresholding is used. Thresholding strategies come in two different varieties. The threshold value can be calculated using a variety of techniques. We used the "Sobel" operation to calculate the threshold value. The edge detection employed the operator. We used the "special" command to generate the two-dimensional filter after determining the threshold limit.

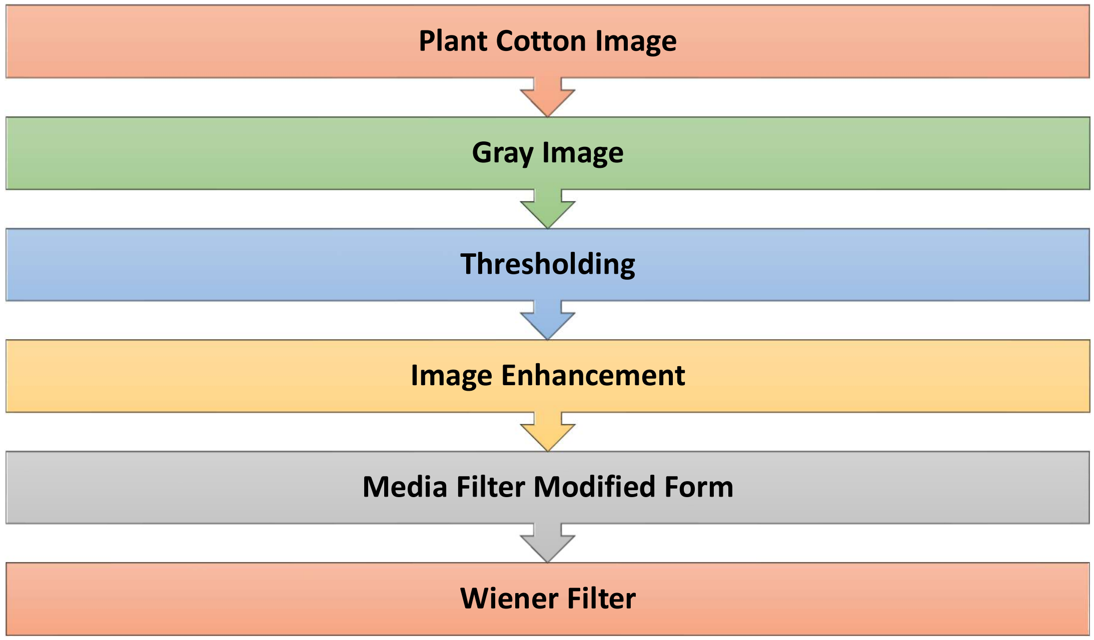


Figure 1: Flowchart of the proposed system

The non-linear filter category includes median filters. It is a non-linear filter with a lot of power. The variance between the adjacent pixels is lessened as a result. Table 1 explains how the median filter operates. As the median value in this instance is 20, it must change the emphasized value to reflect the median value. After using a modified transformation function with various window sizes, we computed the average. Figure 2 illustrates how the improved image filtering functions. It used a crossing mask and even a customized median filter to get the median value. It used the transformation function with the x-mask once more, yielding a new median value. The average of the first two mean and median is then combined with the actual value to create a customized transformation function. The improved median filter is shown in the next figure. Also, it describes how researchers arrived at the average number. Here, it take the median value & calculate the interquartile range rather than picking one median value. The outcomes of maintaining the margins are much more stable as an outcome.

Table 1: Median Filter Operation Explained

9	10	12
19	20	18
38	22	30

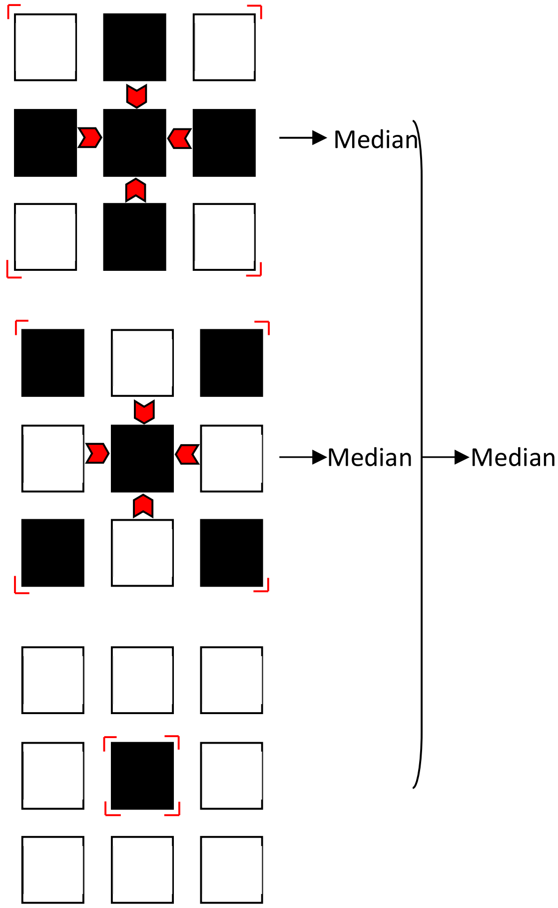


Figure 2: Median filter in a modified form

The following lists the steps in the method for such an improved median filter.

1. Decide on the element's sampling frequency & windows

2. Choose the components based on the filter size.

3. Reorder the chosen components.

4. Choose the midpoint.

5. Choose the diagonal values over the component you've chosen.

6. Choose the components based on the filter size.

7. Reorder the components.

8. Choose the midpoint value.

9. Rearrange these 3 components by adding the outcomes from points 4, and 8, and also the component itself.

11. Choose the midpoint as the adjusted median value.

The functioning of the entire infrastructure of the proposed methodology can be seen in Figure 3. Many filters may be used to remove noise from photos of textile plant leaves. The benefits & robustness of the Wiener filter over other nonlinear filters, researchers selected it in our investigation. By comparing the received data to the intended noise-free signal, noise is reduced. The wiener filter's input is a constant. It achieves the purpose by using the statistical method. Both the message and also the noise are taken to be linear stochastic systems. The wiener filter formula is provided following the table:

$I_n\{u, v\} = W(u, v).J(u, v)$ (1)

Here, the reconstructed image, $I_n\{u, v\}$, and also the received signal $J(u, v)$), are both present. It is used to linearize the image's blurring effect. It facilitates managing the SNR.

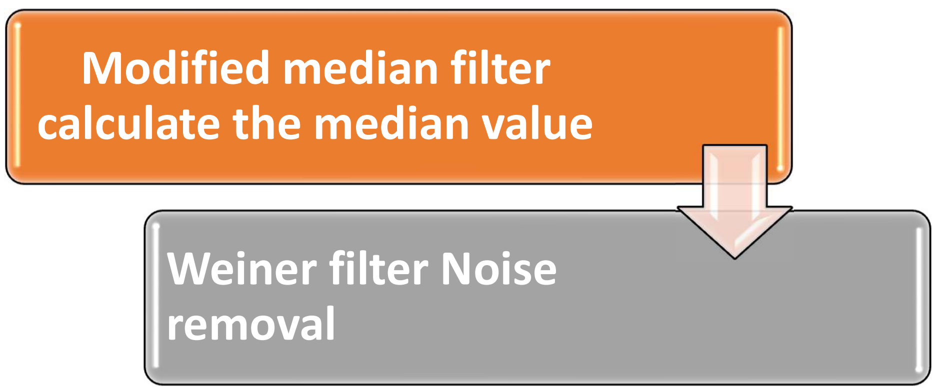


Figure 3: Filter combinations that are proposed

4. EXPERIMENTAL RESULTS

The subsequent Figure 4(a) displays the initial picture. It turn the image into a gray image after acquiring it. Figure 4 (b) displays the gray image's outcome. The outcome of adding random to the image of a cotton plant leaf is shown in Figure 4(c). Images of cotton leaf tissue, including ultrasonography & optically CT scans, are naturally subject to salt & pepper noise, which lowers the quality of the images. It turned the high-frequency noise into a grayscale image to get better outcomes. The following figure displays the gray-scaled image's outcome. Researchers employ the edge detection technique after grayscale-converting the noisy image. The borders of the source images were found using this technique. Figure 4(d) below displays the Gaussian low pass filter's output. Since our goal was to create a system that could lessen the amount of noise while improving the clarity of the main image. It created a hybrid filter specifically for that objective. This hybrid filter combines the Weiner filter and also the Modified Median filter. The distortion is eliminated using the transformation function. It functions similarly to a mean filter while maintaining picture texture features. Also, it keeps the image's fine details, which seem to be important for subsequent actions. Figure 4 (e) displays the outcome of the adjusted median filter.

Figure 4: Outcomes of the proposed algorithm for the removal of noise

4.1 Observations

It evaluated each of the values mentioned above. The following formulas are used to calculate the outcomes of the aforementioned amounts.

$$MSE = \frac{1}{NM}\sum_{x=0}^{N-1}\sum_{y=0}^{M-1}(|f(x,y) - f'(x,y)|^2) \quad (2)$$

$$\sqrt{MSE} = RMSE \quad (3)$$

$$MAE = max|s(i,y) - f'(x,y)| \quad (4)$$

$$SNR = 10\log\left\{\sum_{x=0}^{N-1}\sum_{y=0}^{M-1} f(x,y)^2 \Big/ \sum_{x=0}^{N-1}\sum_{y=0}^{M-1}[f(x,y) - f'(x,y)^2]\right.\; PSNR = 20\log\left\{\frac{(255)^2}{MSE}\right\}\Big\} \quad (5)$$

Decibels are used to compute the SNR & PSNR outcome. In the equations above, $f(x,y)$ stands for the main image & $f'(x,y)$ for the resultant image following the Wiener Filter process. The results of the SNR, MSE, PSNR, and RMSE are displayed in Table 2. Here, the pepper & salt noises are being used. The researchers simultaneously adjust the noise level of intensity & image size shown in Figure 5.

Figure 5: Performance measures of the cotton leaf detection using proposed system

Table 2: The proposed system's performance measures at a fixed noise level

Noise Level	Image size	RMSE	MSE	SNR	PSNR
0.07	493*475	5.82	13.51	11.25	12.95
0.07	487*469	5.99	15.59	11.40	12.68
0.07	433*417	6.12	17.08	11.43	13.51
0.07	379*365	6.18	18.22	11.46	13.38
0.07	298*287	6.21	18.50	11.66	13.35

The outcomes of the SNR, MSE, RMSE& PSNR of a single image are displayed in Table 3 below. Consider an image with dimensions of 297 by 286. We adjusted the noise relative density before computing the aforementioned numbers. The Gaussian distribution of noise is dependent on the standard deviation and mean shown in Figure 6.

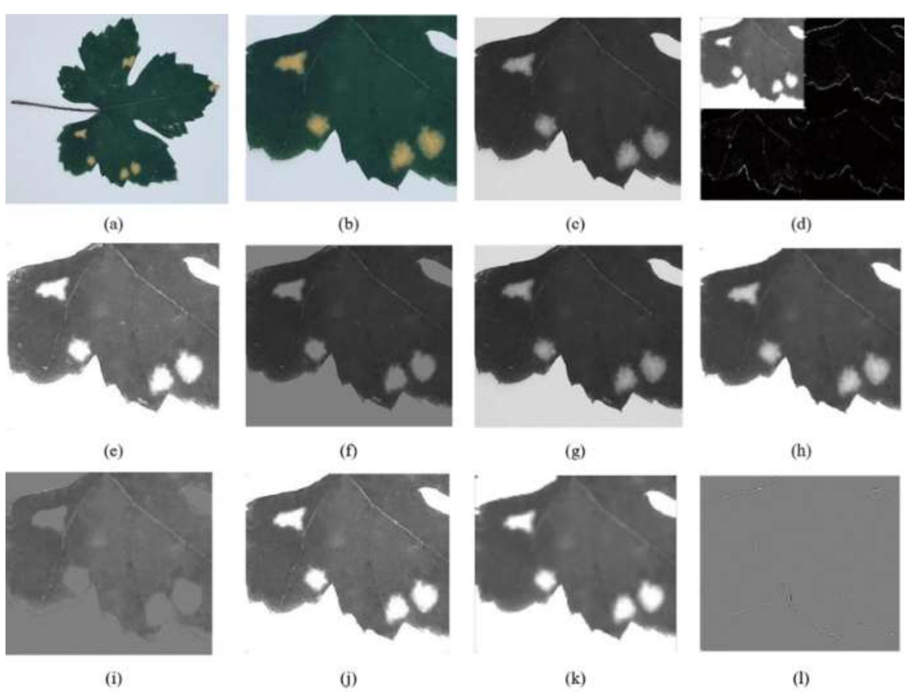
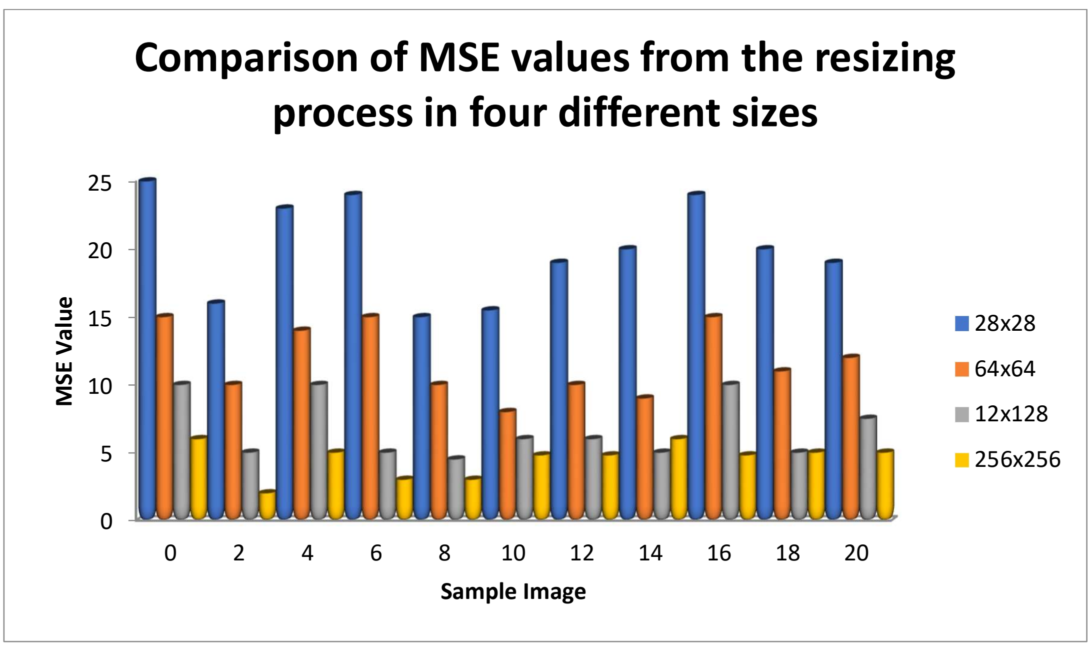


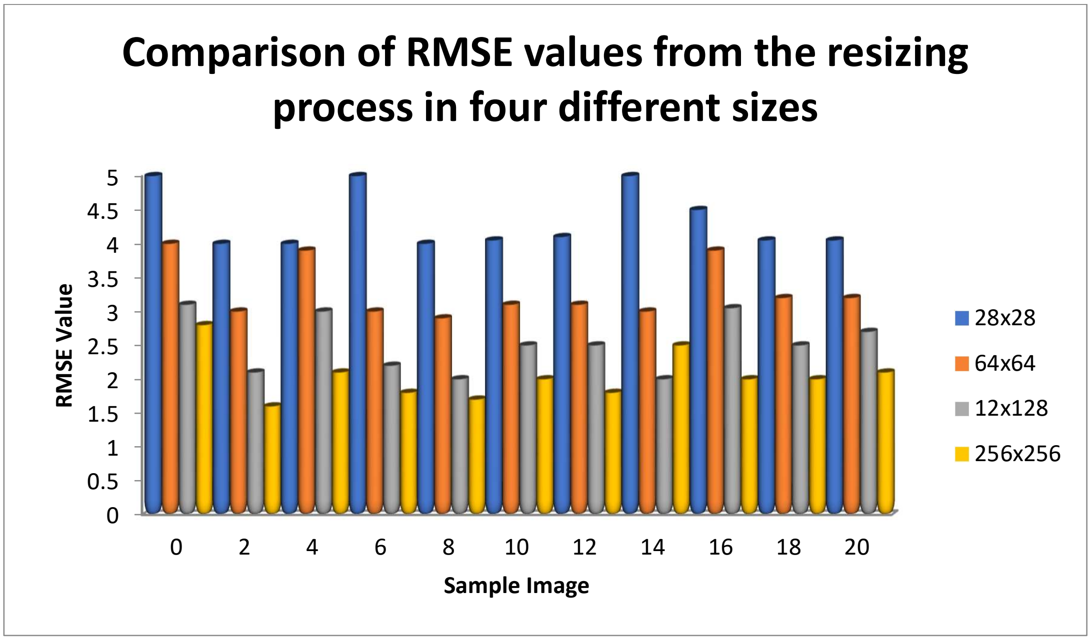
Figure 6: Denoising the cotton plant leaves using proposed system

Table 3: The proposed system's performance measures at a fixed image level

Noise Level	Image size	RMSE	MSE	SNR	PSNR
0.02	297*286	6.14	17.48	11.74	12.44
0.06	297*286	6.18	17.99	11.64	12.39
0.11	297*286	6.19	18.06	11.61	12.38
0.15	297*286	6.19	18.11	11.54	13.37
0.18	297*286	6.23	18.63	11.46	13.31

A graph of the MSE outcomes obtained when using the bicubic estimation technique to resize 20 image samples into 4 distinct image sizes is shown in Figure 7(a). The yellow line represents the MSE values of 20 color photos resized into 256x256 pixels, which is the best option because the MSE value is the minimum. Figure 7(b) displays a graph of the RMSE findings from the bicubic regression analysis used to resize 20 color photos into four different image sizes. The yellow line represents the RMSE value of 20 color photos resized into 256x256 pixels, which is the ideal size because the RMSE value is the smallest. In contrast, Figure 7 (c) displays a graph of the PSNR data obtained after applying the bicubic interpolation method to resize 20 color photos into 4 distinct image sizes. The RMSE value is the greatest, indicating that the enlarged image has the greatest degree of closeness to the actual picture. The yellow line represents the PNSR value of 20 image samples scaled into a size of 256x256 pixels.





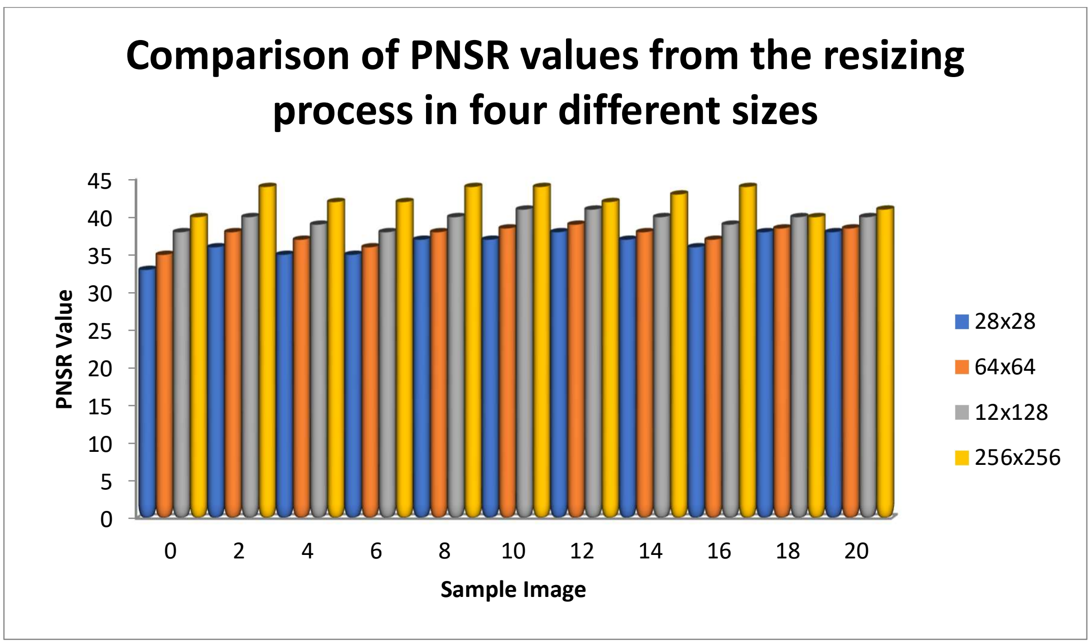


Figure 7: Performance measures of four distinct sizes

5. CONCLUSION

By safeguarding their crops against various illnesses present on their farms, the landowner's society & the agricultural industry can boost crop manufacturing capacity. This is done by spotting disease symptoms earlier on and taking the necessary precautions to manage them. The model's purpose is to recognize the signs of cotton plant illness. Using thresholding approaches, the model successfully split the damaged area of the pictures of leaf extract. It lead us to the conclusion that the proposed methodology is adequate for removing noise from the image. On the other extreme, the quality of the image is unaffected by the hybrid image's existence. Consequently, researchers think that by using this improved technique for the imaging of cotton plant leaves, it can significantly shorten the period required for pre-disease diagnosis. Yet, compared to other filter types, the modified form of thresholding produces better results by maintaining the edges. Researchers could easily see from the output images that the Wiener filter is producing the necessary outcomes for the image.

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