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A STUDY OF LOW PASS AND HIGH PASS FILTERS USING DISCRETE COSINE TRANSFORM IN AGRICULTURAL IMAGES

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Abstract:

Digital image processing is being used in many domains today. In image enhancement, a variety of methods is now available for removing image degradations and emphasizing important image information, and in computer graphics, digital images can be generated, transformed, and combined for a large varieties of visual effects. This paper provides a advances in filtering methods used to study the plant diseases in image processing. Particularly, this paper deals with analysis of low pass and high pass filters using Discrete Cosine Transform (DCT) in Agricultural images.

Key Words: Digital Image Processing, Low Pass Filter, High Pass Filter & Discrete Cosine Transform (DCT)

1. Introduction:

India is an agricultural country, where 70% of the population depends on agriculture [1]. Farmers have to select the wide range of diversity to select the crops. The cultivation of the crops for optimum yield and quality produce is highly technical. It can be improved by some technical support. The study of plant disease refer to the studies of visually observable patterns of particular plant . Nowadays crops face many diseases. Damage of the insect is the one of the major trait. Insecticides are not always proved efficient. The common practice for plant scientists is to estimate the damage of the plant. One of the traditional approaches followed in practice for recognition of plant disease is the simple naked eye observation of the field of experts which may be time consuming and expensive in case of large fields. There are several ways to detect plant pathologies. Some diseases do not have any visible symptoms associated, or those appear only when it is too late to act. In those cases, the signs can only be detected in parts of the electromagnetic spectrum that are not visible to humans. A smart approach in this case is the use of various remote sensing techniques that are explore in multi and hyper spectral image captures. The methods that adopt this approach often employ digital image processing tools to achieve their goals. In this paper, we have given an analysis of filtering techniques in agricultural images.

2. Image Filtering Techniques:

A. Image Enhancement: Image enhancement is the basic step in image processing. Main purpose of image enhancement is to produce better and quality image. Image enhancement helps to enlarge the intensity value between object and background. Image enhancement is divided into two types, Global method and Local method [5].

B. Smoothing: Smoothing is used to decrease the noise, less blurring, produce a less pixelated image cleaning for the same size without any image size modification in the data. Smoothing is done through density estimates [5]. Smoothing is used in two ways;

- ✓ Extract more information from data as long as assumption of smoothing is reasonable.
- ✓ Provide analyses that are flexible and robust.

C. Filtering: Filters are mainly used to suppress the high frequency image or low frequency images. Filters remove certain frequencies to suppress interfering signals and reduce background noise. Filters do not play in frequency domain. Filters have some demerits, sometimes it loss the information in the image during filter process. Filters may be linear or non-linear, time variant or time invariant, analog or digital, discrete time or continuous time, passive or active, infinite impulse response or finite impulse response.

D. Denoising: Denoising is one of the important image processing tasks. The main properties of image denoising are that will remove noise while preserving edges. Noise is not always random and randomness is an artificial term Number equations consecutively. To overcome these problems we use Denoise. Denoise is to rectify the problem of visually unpleasant, bad compression and bad analysis. Denoising implies explicitly noise removal. Filtering implies one can apply any "filter" into an image (say, image enhancement, edge detection, etc.). In other words, denoising is filtering, but not all filtering is denoising.

3. Proposed Method:

In this paper, we have given a comparison analysis of two filters namely: (1) Low Pass Filter (2) High Pass Filter using Discrete Cosine Transform.

A. Low Pass Filter: The energy of a given image is more primarily concentrated in its low-frequency components. This is due to the high spatial correlation among neighboring pixels. The energy of the image degradation as wideband random noise is also typically more spread to over the frequency domain. By reducing the high-frequency components while preserving the low-frequency components, low pass filter is reduces a huge amount of noise at the expense of reduce a very small amount of signal.

Low pass filtering can also be used together with high pass filtering in processing a given image prior to its degradation by noise. In various applications such as image coding, a primitive image under graded image is obtainable for processing prior to its degraded image can be high pass filtered prior to its degradation. After low pass filtered after degradation, this may result in some improvement in the quality or intelligibility of the resulting image. For example, when the degradation is happened due to the wideband random noise, the effective Signal-to-Noise Ratio (SNR) of the degraded image is much lower in the high-frequency

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components than in the low-frequency components, due to Low pass character of a given typical image. High pass filtering prior to the degradation can improve the SNR in the high-frequency components at the expense of small SNR decrease in the low-frequency components.

B. High Pass Filter: A high-pass filter can be used to make an image appear sharper. These filters emphasize fine details in the image – exactly the filter is opposite of the low-pass filter. High-pass filtering works in precisely the uniform way as low-pass filtering; it just uses a different convolution kernel. In the example below, notice the minus signs for the adjacent pixels. If there is no action in intensity, nonexistence happens. But if one pixel is brighter than its immediate neighbors, it gets boosted.

0	-1/4	0
-1/4	+2	-1/4
0	-1/4	0

Figure 1: High Pass Filter

Unfortunately, while low-pass filtering smooths out noise, high-pass filtering does just the opposite: it amplifies noise. You can get away with this if the primitive image is not highly in noisy; otherwise the noise will defeat the image. MaxIm DL includes a very useful "range-restricted filter" option; you can high-pass filter only the brightest region of the image, where the SNR (signal to noise) is highest. High-pass filtering can also cause small, faint details to be greatly exaggerated. An over-processed image will look particle and artificial, and point sources will have dim donuts around them. So while high-pass filtering can often improve an image by sharpening detail, overdoing it can actually degrade the image quality significantly.

C. Discrete Cosine Transform: There are four established types of Discrete Cosine Transforms (DCT's), i.e., DCT-I, DCT-II, DCT-III, and DCT-IV. The DCT-II is more abroad applied in signal coding because it is asymptotically counterpart to the Karhunen–LoeveTransform (KLT) for Markov-1 signals with a correlation coefficient that is close to one [24]. The DCT-II is often simply referred to as "the DCT". The 2D M X N DCT is defined as follows:

$$C(u,v) = \alpha(u)\alpha(v)\sum_{x=0}^{M-1}\sum_{y=0}^{N-1} f(x,y) \times \cos\left[\frac{\pi(2x+1)u}{2M}\right]\cos\left[\frac{\pi(2y+1)v}{2N}\right] \quad (1)$$

The input image is N by M

C(u,v) is the DCT coefficient in row and the column of the DCT matrix

f(x,y) is intensity of the pixel in row and column and the inverse transform is defined as

$$f(x,y) = \sum_{u=0}^{M-1}\sum_{v=0}^{N-1}\alpha(u)\alpha(v)C(u,v) \times \cos\left[\frac{\pi(2x+1)u}{2M}\right]\cos\left[\frac{\pi(2y+1)v}{2N}\right] \quad (2)$$

In the proposed approach, the DCT is performed on the entire Agricultural image to obtain all frequency components of the image.

4. Image Enhancement Evaluation:

Image quality assessment points to test the degradation in digital images in order to rectify the quality of the resultant image.

A. Pixel Difference Measurement: The mean square error (MSE), signal-to-noise ratio (SNR) and peak signal-to-noise ratio (PSNR)[8]. These measures are easy to evaluate.

- ✓ Mean Square Error (MSE), MSE is computed by mean the squared intensity of the primitive (input) image and the resulting (output) image pixels as in (3).

$$MSE = \frac{1}{NM}\sum_{m=0}^{M-1}\sum_{n=0}^{N-1} e(m,n)^2 \quad (3)$$

Where e(m, n) is the error difference between the original and the contorted images.

- ✓ PSNR (Peak Signal to Noise Ratio), SNR (Signal to Noise Ratio) is a mathematical measure of image quality based on the pixel difference between two images [8]. The SNR measure is an expect quality of rebuild image compared with original image. PSNR is defined as in (4).

$$PSNR = 10\log\frac{s^2}{MSE} \quad (4)$$

Where s = 255 for an 8-bit image. The PSNR is basically the SNR when all pixel values are equal to the maximum possible value.

5. Experimental Results:

A. Image Acquisition: In previous days researchers collected the real time image from various places, Agricultural universities and Laboratories. Nowadays agricultural image data are available online, which can be easily fetched and used for research purpose. In this paper, we acquired images from agro portal sites and TNAU, Coimbatore

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Figure 2: Original Images

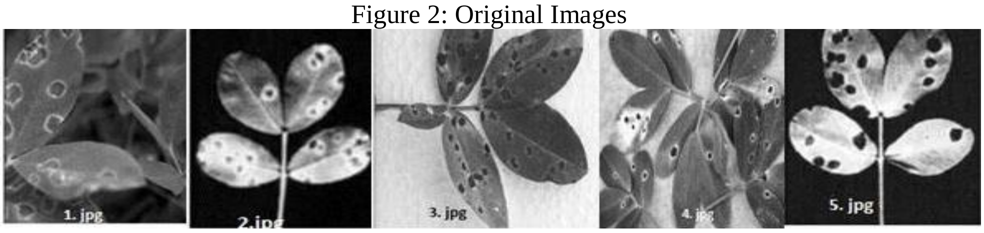

Figure 3: Low Pass Filter Images

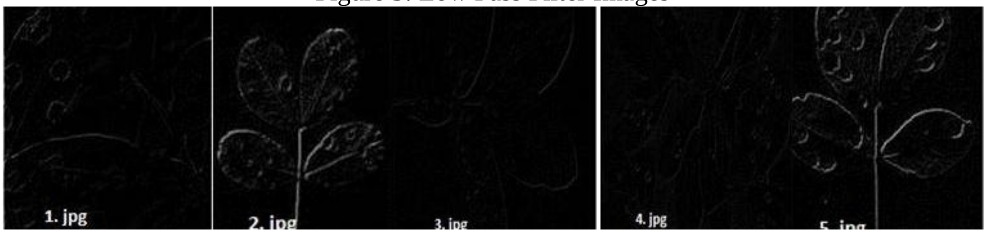

Figure 4: High Pass Filter Images

In this paper, we discussed about low pass and high pass Discrete Cosine Transform (DCT). Now, we had given some results by applying these algorithms in the following tables.

Table 1: SNR & PSNR Values for high pass filter

Images	SNR	PSNR
1.jpg	-4.32491	4.893565
2.jpg	-5.53563	2.074136
3.jpg	2.983557	6.101054
4.jpg	0.79733	5.986133
5.jpg	-3.60865	2.621603

The SNR and PSNR values for the corresponding images are shown in the above table from the resultant high pass filter images

Table 2: SNR & PSNR Values for low pass filter

Images	SNR	PSNR
1.jpg	-3.70692	5.511559
2.jpg	-5.49383	2.115934
3.jpg	9.891748	13.00924
4.jpg	4.550914	9.739717
5.jpg	-3.04869	3.181566

Now, we represent the comparison results for low pass filter and high pass filters in the following figure 4 and 5. Negative Values in SNR is shown that the quality of the image is very low. After image enhancement is applied, quality of image is shrinking gradually.

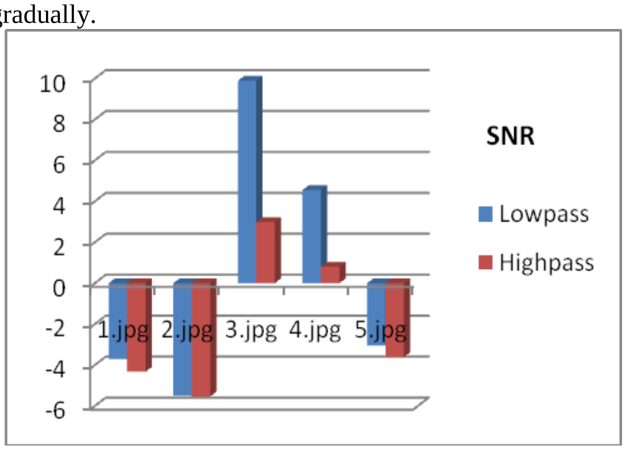

Figure 5: Signal to Noise Ratio

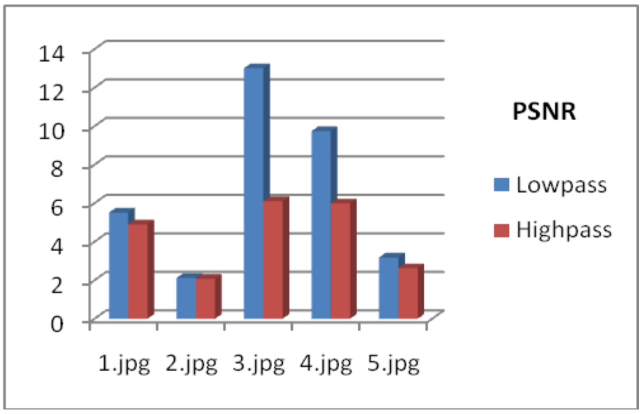

Figure 6: Peak Signal to Noise Ratio

From Figure 5 and Figure 6, we showed that Low Filter DCT shows better results than High Pass Filter DCT.

6. Conclusion:

The image processing is the first step in overall Processing for disease detection. Image processing is done by various operations such as image enhancement, filtering and segmentation these are accomplish to make the image with improved condition and to draw out the region of interest for feature extraction. The result shows that Low Pass Filter using Discrete Cosine Transform is suitable for preprocessing Agricultural Images efficiently

7. Future Work:

The future work for this paper is to be finding better methods for filtering the agricultural images, the various best methods for segmentation, classification and feature extraction for finding the smart way to predict the diseases on various kinds of plants.

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