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# Potato Crop Leaf Disease Spot Detection Using Color Features

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***Abstract:***
Diseases in crops cause serious problem in agriculture field and produce economic loss. Farmers identifying of leaf diseases is the crucial and one of the major early-stage concerns. Detection of disease spot accurately helps the farmers to spot the disease pant and take the remedial step to cure the disease. So there will not be any economic loss to the farmers. The aim of this paper is to let the farmers to detect the potato crop disease spot using colour thresholding method for different color models and comparing the result and concluding the efficient method for detecting the disease spots in the potato image using image processing tools.

**Keywords:**Color thresholding, HIS, YCbCr, diseasespots, L*a*b.

## 1. Introduction

The crop disease decreases the production and quality of the crop. The crop diseases and plant pets dramatically get increased in recent times. Due to this plant and crop diseases formers are facing great economic loss. Even diseased crops and plants reduce the nutrients presented in. So, human life span is also started decreasing due to these diseases in crops. So early detection can help the farmers to rescue them from economic loss and produce the quality crops. Then people could able to get the good nutrient rich crops. Image processing techniques give the great support to detect the diseases in plants and crops.

A novel approach introduced in this paper for disease spot disease detection in the potato leaves. There are plenty of methods in image processing to detect the diseases.Our approach to segment the disease spots in the potato leaf using color features. Color thresholding model is used for converting the infected potato image into various color models in this method. Here in each model keeping one threshold value, disease spots are detected. Then finally taken the disease spots in the original image and compared with each model of disease spots detection and then concluding with efficient method. So, using this approach formers could able to identify percentage of disease spot in their potato plant and could able to implement the effective rescue plan.

## Literature Review

There are so many researches happening in the field of agriculture. N.Sasirekha, N.Swethasummarized the knowledge of plant leaves disease and also explored the idea about hierarchies in the plant leaf diseases. They also shared the techniques used to detect the plant leaf diseases[1]. An approach for image recognition system for linear recognition system is used. Also, an improved histogram segmentation method used to calculate threshold automatically. Iterative Method, Otsu Method, and 2-Mode Method are common for threshold segmentation.At the same time linear regression also can be modified.It has efficient accuracy and greater efficiency[2]. In image segmentation, Canny algorithm can be used for edge detection. Also edge can be detected by adjusting gradient magnitude and kernel gradient. There are some other edge detection methods for segmentation purpose[3].The authors had compared the crop leaf color with the leaf color chart(LCC) and used the algorithm for color prediction of paddy crop. Then they used mathematical models to identify the crop diseases[4].The explanation about YCbCr and how it is going to be found in the image for segmentation is described clearly in this approach[5].The authors used the automated method to classify diseases on potato leaves. Also they used L*a*b method to analyse the color in the images which helps to isolate the color and disease spots in leaf[6].The authors developed an application to detect rice diseases early using image processing techniques and SVM.Also they proposed algorithm for detecting disease spots using Otsu method and they extracted the shape and texture features. Finally SVM classifier has been used to classify diseases[7].A framework for detecting plan diseases, images have been segmented using K-means clustering and passed to pre-trained neural network. The authors could detect plant diseases with 93% accuracy[8].An ordered palette construction is used based on HIS color system .They had briefly explained about HIS color space [9].

The approach used the new technology using mobile images and the leaf symptoms were categorized using HPCCDD proposed algorithm .Here RGB image is used to identify diseases, the image segmentation is done to detect disease spots. They used Sobel ,Canny filter techniques to identify disease spots[10].The authors had proposed early diagnosis of disease, they used the novel approach such as s percent intensity histogram, percent differential histogram, Fourier transform, and wavelet packet. Finally used genetic algorithm for feature extraction and got the accuracy more than 82.5%[11].The authors had summarized the color segmentation techniques based on monochrome approaches operating in different color spaces. Finally they discussed about usage of different color spaces[12].A hybrid algorithm like genetic algorithms and neural network to increase rate of recognition is used.This is an innovative,efficient and fast algorithms to help to detect the diseases.

## Methodology

This methodology focuses the novel method for potato crop leaf disease spot detection using RGB model. The steps involved in this methodology are

- Image capturing
- Image Pre-processing
- Image segmentation and applying color thresholding,
  Transfer from RGB model to
  a. $YC_bC_r$ model
  b. HSI model
  c. L*a*b model
- Finally ,I t compares and analyse the effective method for disease spot detection

**Image Pre-Processing :** Image is taken using camera. Image is saved in the JPEG format. It is

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pre-processed and converted as RGB color model. The region of interest is simply disease spots.

**Image segmentation:** In the prposed method color thresholding method is used to convert into $YC_bC_r$, HSI and L*a*b color model.First Y $C_bC_r$ color model color model conversion is done. It is much suitable for videos. Here Y represents brightness level element and $C_b$ represents the blue minun luma & $C_r$represents the red-minus-luma. This color model was often used in literature for different applications such as face detection [14], blood cell segmentation [15].

$$Y = 0.299 * R + 0.587 * G + 0.114$$
$$C_b = -0.168 * R - 0.331 * G + 0.500$$
$$C_r = 0.500 * R - 0.418 * G - 0.081$$

(1)

The HSI color space is very important and attractive color model for image processing applications because it represents colors similarly how the human eye senses colors.The HSI color model represents every color with three components: hue ( H ), saturation ( S ), intensity ( I ). Conversion of RGB to HIS model can be done using following formula

$$H = \begin{cases} \theta & \text{if } B \le G, \\ 360 - \theta & \text{if } B > G, \end{cases}$$

where $\theta$ is:

$$\theta = cos^{-1}\{\frac{\frac{1}{2}[(R-G)+(R-B)]}{[(R-G)^2+(R-B)(G-B)]^{1/2}}\}$$

$$S = 1 - \frac{3}{R+G+B}[\min(R,G,B)]$$

$$I = \frac{1}{3}(R+G+B)$$

In this method finally L*a*b* color space is done and in L*a*b* color space a* and b* components were to represent color information it gives the efficient segmentation from the image.

$$X = 0.4124 * R + 0.3576 * G + 0.1805 * B$$
$$Y = -0.2126 * R + 0.7152 * G + 0.7220 * B$$
$$Z = 0.0193 * R + 0.1192 * G + 0.9505 * B$$

In L*a*b, L gives Brightness , a* gives the value color from green to red and B gives the value of color starting from blue to yellow. Equation for conversion is as follows:

Conversion formula for L*a*b is as follows:

$$L = 116 * f(\frac{Y}{Y_n}) - 16$$
$$A = 500 * (f(\frac{X}{X_n}) - f(\frac{Y}{Y_n}))$$
$$B = 200 * (f(\frac{Y}{Y_n}) - f(\frac{Z}{Z_n}))$$

where function $f$ is defined as:

$$f(t) = \begin{cases} \sqrt[3]{t} & \text{if } t > \beta^3, \\ \frac{t}{3\beta^2} + \frac{4}{29} & \text{otherwise} \end{cases}$$

where $\beta = \frac{6}{29}$. Constants $X_n, Y_n$ and $Z_n$ are equal to 95.047, 100.000 and 108.883, respectably.

In this methodology images are applied with color thresholding for RGB model using MATLAB.We could able to recognize that, not possible to spot disease spot in potato leaves.Next conversion is happened from RGB to $YC_bC_r$using color transform formula. Disease spot detection is little more accurate than this case to RGB model. But In $YC_bC_r$., some disease spots are missed. In next step RGB image was converted into HSI color model and disease spots were detected but on H component of filtered HSI color area. We could able to see, diseases were discovered correctly better than $YC_bC_r$., But few disease spots in leaf are not clear to idea, so it could able to give little more accuracy than $YC_bC_r$.. The next step is done in L*a*b color model. Disease spots are segmental by applying color threshold on component A of filtered laboratory color area The disease spots were completely recognized using L*a*b model compare to remaining three model using color threshold method.

The following figure shows the experimental result

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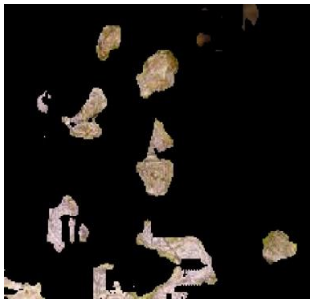
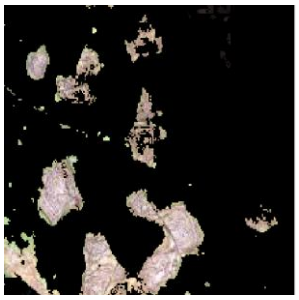
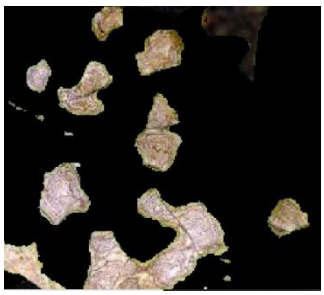
*Fig 1: Potato leaf infected Disease Spot detection using RGB colormodel*

*Disease Spot detection using* $YC_bC_r$ *colormodel / Disease Spot detection using* HIS *colormodel*



*Disease Spot detection using* L*a*b *colormodel*

The disease spots were completely recognized using L*a*b model compare to remaining three model using color threshold method.

**Result and Analysis**

In this work color thresholding on potato leaf using MATLAB.We got the following results

- Threshold on RGB disease spot detection is not accurate & not useful.
- Threshold on $YC_bC_r$ disease spot detection, we could able to detect the disease spot better than RGB but not much accurate
- Threshold on HSI model disease spot detection, we could able to recognize the disease spot better than $YC_bC_r$ which was not clear enough
- Threshold on L*a*b model disease spot detection, we could able to detect the disease spot accurately compare to other color models. fig 2 is our L*a*b analysis result for color thresholding by keeping a threshold on a which gave the accurate result compare to remaining models.

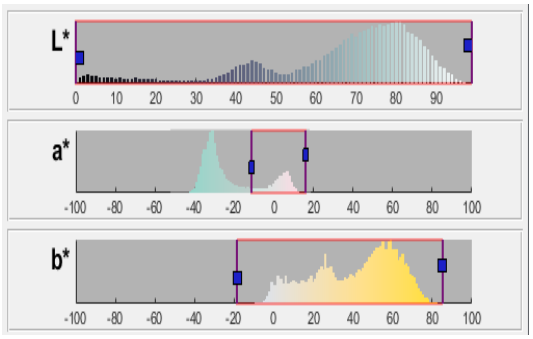



fig 2-vlaues of L,a,b in infected potato leave

In original input image disease spot with brown color is 6.4%,

Percentage of disease spots detection in the potato infected leave using different color modelsas follows

$$\text{Accuracy} = \frac{\text{Percentage of disease spots detection in input image using color threshold model}}{\textit{Percentage of disease spots in input image}}$$

| Color model | Percentage of disease spot brown color range | Accuracy |
|---|---|---|
| $YC_BC_R$ | 3.7% | 59% |
| HIS | 3.8% | 59% |
| L*a*b | 6.2% | 97% |

**Conclusion**

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This work is aimed to detect the disease spot detection using color features for potato leaves. Color thresholding using MATLAB applied on potato leaves, so we could able to get the potato leaves in four different color model RGB, $YC_bC_r$,HIS and L*a*b. Then in each model has been kept threshold on one variable and we could be able to detect the disease spots.Finally we compared the result from all the other model and conclude that among four color models L*a*b is giving efficient and 97% accurate result.

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