



Detection of Plastic Mulching Films in Cotton using HSI color space

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ABSTRACT

A manual vision detection system is used in earlier days of detection of plastic mulching films in the cotton. With the arrival and the advancement of technology, A machine vision system is being used under which an image processing based software programs are there which will run the target image in different ways. This paper represents the detection of plastic mulching films in cotton using HSI color scheme. In this HSI color scheme, an image is being analyzed in three different parameters that is Hue, Saturation and Intensity and the result will formed by the combination of these three parameters. This will effectively detect the additionally added plastic mulching films in the cotton.

Key words: Plastic mulching film, Color schemes, HSI, Manual vision system, machine vision system

INTRODUCTION

Basically cotton is a soft fibre and often spun into yarn and thread. The crop of this cotton is covered with the plastic mulching film to prevent it from the external atmospheric conditions such as rain, dust and sunlight. This plastic mulching film is usually of different colors such as white, black, transparent or any other color according to the need. But this film must be detached from the cotton field before the cultivation of the cotton because the separation of plastic mulching films from the cotton fibre is an essential procedure during the cultivation of the cotton field so that it should not be mixed with the cotton. In earlier days, the manual vision of plastic mulching film in cotton is usually in use, but its result was observed with the less accuracy and the time consumed process. And due to the entrance of technology to the detection systems and to the advancement of this plastic mulching film detection system, machine vision system is introduced, under which we took a target image and using the specially designed software programs, that image is being analyzed and the required particles are being identified. This type of detection has also been termed as an intelligent visual inspection. [1]

Color Identification

The color selection of the plastic mulching film is essential, as the color will also perform an atmospheric condition such as discussed below. [1]

Black- it is the most used color of plastic mulching film. Black color provides heat to the bottom area of the crop by absorbing the solar heat; also it provides a barrier to the light towards weed pressure. The manufacturing cost of this black color film is also less.

White- white color is having a tendency to reflect the light so it is the coolest color among all other colors. And often used in climates that are exceedingly hot.

Clear/Transparent- as this is transparent so the light will pass through it very easily i.e. sunlight will fall on the soil easily hence it is also used for solarization. And by this effect soil is then heated and results in killing weed spores and bacteria living in the bed.

White/Black- it will have a combinational benefit of black film and white film. White color provides coolness and black will provide light absorption. It is used in hot climates.

Metalized- it is used to provide extra light to the plant. As it reflects light which will keep aphids and white flies to stay away from the field? It provides a narrower range of soil temperature between the heat of the day and the cold of the night.

Other Colors- there are a variety of other colors which will formed usually by mixing two or more colors, hence its cost is comparatively high as compare to other colors. It may be used in various applications such as in the laboratory, but still not perform well in the field due to discoloration of copper applications, dust and fading.

Methods of Detection of Plastic Mulching Film in Cotton

1. **Manual Vision System** - this is the earliest and oldest method of detection of plastic mulching film in the cotton field. In this, the detection is done by the people manually and this is a time consuming process, also the accuracy of this manual vision is very less as very small sized film particles sometimes may be skipped to detect.

2. **Gravimetric Mechanical Vision System** - it is a system which will deal with mechanical machine work. In this mechanical part such as conveyor belt and encoders are to be used. As the number of mechanical parts is lesser the efficiency and higher the cost of the project.

3. **Electro Optical Vision System** - this is the most common method used nowadays. It is a combination of both hardware system and software system. On the hardware part we use a camera and a computer and on the software part we have software's such as Mat lab. With the help of the camera, the image of the target area is placed into the computer and using software we detect the undesired object in the target image.

4. **Ultrasonic Vision System** - in this ultrasonic wave is used to detect the plastic mulching film in the cotton. We radiate ultrasonic waves from one end to pass through the cotton. The waves blocks at the points where the plastic mulching film exists, as it does not pass through it. And the left waves will pass through the cotton. As ultrasonic waves are harmful for the human being's health so this method is not in use.

Performance Parameters

1. **Time Consumption** - The time consumption needed to be a less and thesis work are to be done on the basis of the time taken to complete the operation. Time taken at different stages will be calculated.

2. **Ease of Operation** - The complexities in performing the operation needed to be less and also lesser the complexity, higher the performance of the system.

3. **Performance Consistency** - The performance level of the system should be consistent. The consistency of the system by applying the algorithm on the different images needs to be checked.

4. **Speed of Detection** - The speed of detection of the system depends upon the time taken to complete the operation. Lesser the time taken, greater will be the speed of the operation.

GENERAL DESIGN OF THE SYSTEM

Diagram of Plastic Mulching Film Detection System

This is based on the Machine Vision detection system as shown in Fig. 1, which mainly consists of an image capture system, Plastic Mulching Film detection system and a control execution module. A use of light source is also used to get the image in a clear and good quality. The first step is to obtain the image signal of the target from the camera. Secondly, this image signal is then converted to digital form using the A/D convertor and then sent to special image processing system, where an objective feature is extracted according to the target image. Finally, the driven actuator spouts out the Plastic Mulching film in the cotton based on the judgment which is obtained through design criterion.

Steps of Plastic Mulching Film Detection System

1. Image acquisition
2. Image processing

1. Image acquisition

The Basic identification of the plastic mulching film is based on the image acquisition and the image recognition. The image acquisition subsystem is shown in the fig 1. Using the high definition color camera, color pictures are captured in the presence of full light generated by the LED lighting source and fed this taken images to the computer system. The research identifies the plastic mulching film in fiber with different color to the cotton. Steps of image acquisition are as follows. Bundled pure cotton having plastic mulching film of different color in it is selected and placed over a platform to take sample images of it to process. Our experiment takes 10 different samples with different angles of the sample cotton.

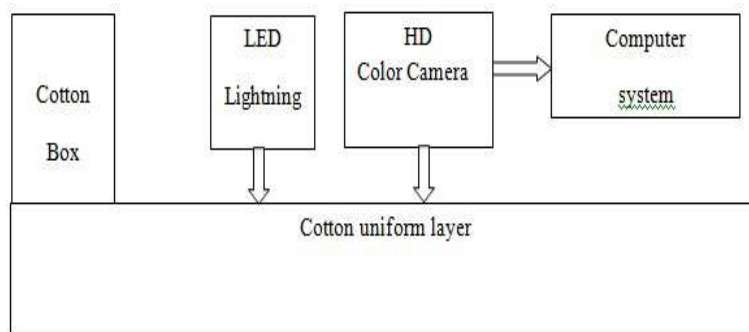


Fig 1 Image acquisition subsystem diagram

2. Image processing

In order to have an effective extraction of plastic mulching film in the cotton, the plastic mulching film regions are segmented from the cotton images. The image of the cotton mixed with plastic mulching films are captured and fed to the computer system through the HD color camera. This picture of cotton is drawn on the computer software to extract the different parameters such as hue saturation and intensity. This will make some segmented regions of the plastic mulching films in the cotton segmented region.

Algorithm of Plastic Mulching Film Detection

This method transforms the image from RGB to HSI color space to obtain hue component H, Saturation component S and intensity component I, then we deal with all these three component images. The hue will give us the attribute of the visual sensation to one of the perceived colours; Red, yellow, green and blue or a combination of two of them. Intensity component is the total amount of light passing through a particular area and the Saturation component gives the purity of that color. By the combination of these all components, any addition of plastic mulching film in the cotton has easily been seen in the resulting picture. Refer fig 2.

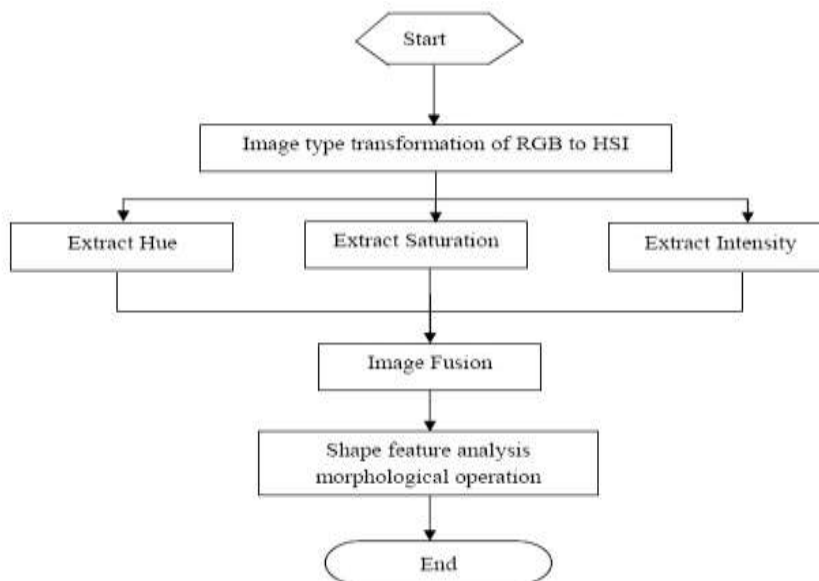


Fig. 2 Algorithm of Plastic mulching film detection system

Selection of Color Space

Selecting the appropriate color is the primary stage for color image processing and selecting the proper color space can save the calculations and avoid missing information.

1. RGB Color Space

RGB color space is the most fundamental and commonly used color space of color image processing. In this, image acquisition devices will collect the color information in the RGB value, which is also seen in the display devices. In RGB, there are three basic component values of R, G and B to represent the color. Since this RGB color space is having shortcomings such as it will not identify the same color object in the same color background. Therefore the RGB color space model is one of the most uneven color space due to the visual difference between the two colors and this RGB color space is also sensitive to noise in low intensity area.

2. HSI Color Space

Basically, this color space will lead in the addition and subtraction of color components in form of Hue, Saturation and intensity. Hue is the attribute of the visual sensation of colours either Red, yellow, green and blue or a combination of any two of them. Where, Intensity is the total amount of light passing through a particular range of area. And Saturation represents the purity of color. This color space has tendency to identify a color object with the same color background, i.e. a white color object is identified in the white background and this is also the objective of this research.

EXPERIMENTS AND RESULTS

Sample Image is Being Taken in the RGB Color Format

This sample images taken in the RGB color format is run through the appropriate software used in the research to obtain the result. In this few pieces of plastic mulching film is spread over the cotton and this will be identified in the research observation. (Fig. 3 and 4)



Fig. 3 Sample image 1



Fig 4. Sample Image 2



Fig 5. Hue output of image 1



Fig 6. Saturation output of image 1



Fig. 7 Intensity of image 1

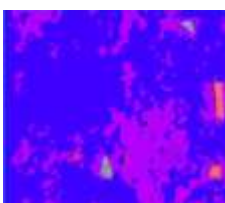


Fig. 8 HSI output of image 1



Fig. 9 Hue output of image 2



Fig. 10 Saturation output of image 2



Fig. 11 Intensity of image 2

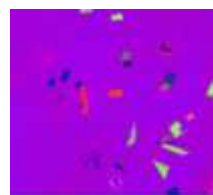


Fig. 12 HSI output of image 2

Images Formed During the Experiments

In the figures, the fig 5 is the hue output of the sample image 1, it is the combination of different colours such as Red, yellow, green and blue. The Fig 6 is the saturation output of sample image 1, it is the purity of color. The Fig 7 is the Intensity output of sample image 1; it is the total amount of light passing through a particular area. Fig 8 is the HSI output of sample image 1.

In the figures, the fig 9 is the hue output of the sample image 2, it is the combination of different colors such as Red, yellow, green and blue. The Fig 10 is the saturation output of sample image 2, it is the purity of color. The Fig 11 is the Intensity output of sample image 2; it is the total amount of light passing through a particular area. Fig 12 is the HSI output of sample image 2.

CONCLUSION

This paper analyzes the characteristic of plastic mulching film in the cotton and finds that the most impurities are colored. In the start RGB image is taken as the input image and the added plastic mulching films is not very much

easy to see in the RGB color pattern if the white color plastic mulching film is added in the white color cotton, but in the research using HSI color pattern scheme white colored plastic mulching film is easily being identified. Hence the detection of the Plastic mulching film in the cotton using HSI color space is successfully examined.

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