Foreign Fiber Detection in Cotton using HSI Approach for Industrial Automation

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ABSTRACT
Foreign fibres in cotton have seriously affected the quality of cotton goods. The classification and identification of foreign fibres in cotton is the basis of automated inspection of foreign cotton fiber. Application of Support Vector Machine (SVM) for analysis of foreign fibres in cotton. One of the advantages of SVM is that, with limited training data, it can generate results similar or better than other methods. The SVM algorithm is used for automated object detection and characterization. Specifically, the SVM is applied in its basic nature as a binary classifier where it classifies two different folders one having the cotton image and second one contains thesupervised images. The algorithm aims at effectively detecting an object from its background with the minimum training data. The synthetic image containing noises is used for algorithm testing. Furthermore, it is implemented to perform remote sensing image analysis such as identification of Island vegetation, water body, and oil spill from the satellite imagery. It is indicated that SVM provides the fast and accurate analysis with the acceptable result. Furthermore the introduction of CNN has been apply to the proposed technique to this presentation offers a new method for using templates that match the templates of Convolution Neural Network. The CNNs are running simultaneously to train template images. All Information about image template is send to neural network that has been convoluted the image with saved template in very fast manner. It is accuracy while scanning an image and convolutes the pixel with pure image pixel and finds the exact difference in between them. The test picture is a cotton production image containing the foreign image and find out the impurities in running a production line of cotton with high accuracy. This thesis has a complete demonstration of detection system for the foreign fibers in raw cotton. The accuracy of the result is evaluated by the regression analysis of the outcomes like the time of simulation and the size of pictures in pixel speared over the horizontal and vertical area. The results of the proposed analysis have shown that the time is unpredictable for the given set of images. The logistic regression has exponential nature that suggests that the simulation time is drastically increases as the area of cotton size increases. The accuracy provide by proposed technique is very near to hundred percent.

General Terms
Recognition, Color Space , Image Processing, Algorithm, Simulation.

Keywords
Foreign Fiber, Image Pixels, Template Matching Process, Convolution Neural network.

1. INTRODUCTION
Features of respective image template can be used to identify proper analysis. The study of features of a cotton fibers is one of the important aspects of our research. The most popular clothes in the world is cotton. It is used to produce natural fiber and various types of cotton fabric. The quality of cotton fiber deteriorates due to various foreign fibres, such as plastic film, nylon, jute, dry cotton, bird feathers, paper and silk, nylon, polypropylene and others. Contamination of raw cotton can be performed on all steps, from the initial phase to last phase. Since cotton impurities was selected with hand by rural women like human hair, pollution caused by pieces. In addition of the foreign fiber including storages, plastic film, jute, hair, polypropylene gum and rubber clock is a serious threat to the textile and cotton industries. These selections of impurities and type of impurities are first determinate with their size, shape and colour[2].

1.1 Challenges
There were several challenges encountered when attempting to develop our algorithm, because cotton images can demonstrate a wide degree of variation in both shape and texture. Appearance variations are caused by individual differences, the detection of foreign fibers due to changes in shape and size, as well as lighting variations. These issues are explained more in the following points:

- The foreign fiber detection problem is challenging problems as depends on many factors, some of them are visual and many others are non-visual such as size, shape, colours and numbers.
- The visual features that can help in evaluating shape, size, and colour of foreign fibers are affected by position & orientation.
- The difficulty of acquiring large-scale databases, which covers enough template range with various images of both pure cotton and foreign fibers, makes the estimation tasks more difficult to achieve[1].

1.2 Process Overview
Modern cotton processing is very industrialized production line automation[1].Cotton is separated from raw seeds and then process to processing units. One certain cleaning and elimination of pollution can be occurring during flushing. Cotton is usually in raw cotton seeds[2]. That's it we mainly target the yarn production level Application Sync Detection Computer Protection system. In the yarn production line, cotton can be refined with the process of filter line and moved by blowing through the sledge. Automatic pollution detection and removal the system is integrated on this line. Insert the camera constantly monitor the location of mobile cotton and collect photos.

Figure 1: Selected Cotton is delivered in a cup for yarn production.

1.2.1 Image processing system suitable for analysis of foreign fibers.
When the picture apply through algorithm is completed, a portion of cotton is often detected due to the air turbine flow is much faster than the capturing capacity of camera during the processing of foreign fibers. Due to the fast scanning process it is some time not captures the foreign elements. Due to implementation of larger data set the problem can be short out.

1.3 Similar work on foreign fibers detection
We can classify computer processing methods for sorting the impurities of cotton. Based on colour/intensity detection method, the pixel value of image has been modulated so that the external elements rather than the cotton have been detected easily. Most methods are available, some pictures are pre-processed after the main deal in the steps, the usual threshold determines which pixels belong to it contaminants. Post-processing steps such as morphological filters, area increase, and connection part analysis and so on are also com monly used reference [6]. One is given a good overview of the system starting with the sensor inspiration, blowing away foreign objects. Short the review also found [7]. Research has taken place the efficiency of different wavelengths [8][9]. Before cotton fabric can be very diverse, a wide range ,the strategy may need to cover all categories of the actual system of contaminants.

1.4 Selection of Colour Space
1.4.1 RGB Color Space
The RGB color model is the most basic and the most used hardware for image processing. The cotton image form using RGB has also very suitable for detection process of hardware. The RGB model uses the three basic components of Red, Blue and Green for representation of the color. In this system, all colors are justified in the RGB color bar. The RGB color range, however has a major disadvantage; the most important is that it is not intuitive, so it is difficult to know the value of a cognitive property of its RGB value. The RGB has very distinguish feature that is incorporated with detection process of any machine learning algorithms.

1.4.2 HSI Color Space
HSI means hue, saturation and intensity. The HSI model differentiates extra components from image screens into the image. Therefore, it is a tool for assisting imaging with a variety for colour modeling. Currently, in many computer visual systems, many computer divisions apply. An example of computer vision systems, the real-time automatic detection and identification system are HSI (for example Hue,saturation and intensity) and others like RGB. This model applies to the detection of foreign fibers[9].

1.4.3 YCbCr Color Space
External cotton fiber analysis algorithm in the following model compares HSI and YCbCr color. The advantage of the YCbCr model is that it can work with chromium lighting and exposure, in particular by using useful information from the original image as much as possible. The original image is in the form of RGB, so the color scheme must change. There are many colors, where luminance and crumbling components are separated, such as YCbCr, HSV etc. This methodology accepts the YCbCr color scheme. Under this scheme the pixel value of RGB space into luminance Y,chrominance of blue Cb,and chrominance of red Cr in the YCbCr[9].

The conversion formula used is:

$Y= 16+ (65.481 R+ 128.553G+ 24.966B)$

$Cb= 128+ (-37.797 R – 74.203 G + 112.0 B)$

$Cr= 128 + (112.0 R – 93.786 G -18.214 B)$

2. TEMPLATE MATCHING PROCESS
A template matching process uses pixels, samples, models or textures as pattern. The recognition function computes the differences between these features and the stored templates. It uses correlation or distance measures. Although the matching of 2D images was the early trend, now-a-days 3D templates are more common. The 2D approaches are very sensitive to orientation or illumination changes. One way of addressing this problem is using Elastic Bunch Graphs to represent images. Each subject has a bunch graph for each of its possible poses. Image features are extracted from the test image to form an image graph. This image graph can be compared to the model graphs, matching the right class. The introduction of 3D models is motivated by the potential ability of three dimensional patterns to be unaffected by those two factors. The problem is that 3D data should be acquired doing 3D scans, under controlled conditions. Moreover, in most cases requires the collaboration of the subject to be recognized.Therefore,in applications such as surveillance systems, this kind of 3D data may not be available during the recognition process. This is why there is tendency to build training sets using 3D models, but gathering 2D images for recognition. Techniques that construct 3D models from 2D data are being developed in this context[11].

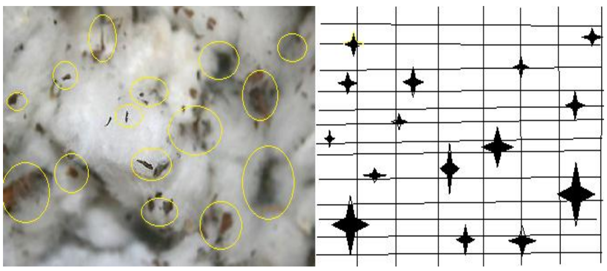

Fig 2.1: Explain how the pixel in grid based image pattern

3. TEMPLATE MATCHING ALGORITHM UNDER CONVOLUTION NEURAL NETWORK
One of the basic ways to match a template is to use a wrapper mask (template) designed specifically for the specific functionality of the search image we want to detect. The technology can be easily executed on gray images or edge images. Where the image structure matches the mask

structure, the package output is higher, with larger image values multiplied by larger mask values.

A pixel in the search image with coordinates (x_s, y_s) has intensity $I_s(x_s, y_s)$ and a pixel in the template with coordinates (x_t, y_t) has intensity $I_t(x_t, y_t)$. Thus the absolute difference in the pixel intensities is defined as $\mathbf{Diff}\ (x_s, y_s, x_t, y_t) = |\ I_s(x_s, y_s) - I_t(x_t, y_t)\ |$.

$$\text{SAD}(x,y)\sum_{i=0}^{trows} \sum diff\ (x+i, y+j, i, j)$$

The mathematical representation of the idea about looping through the pixels in the search image as we translate the origin of the template at every pixel and take the SAD measure is the following:

$$\sum_{i=0}^{sraw} \sum_{y=0}^{scols} SAD(x,y)$$

S_{rows} and S_{cols} represent the rows and columns of the search image, T_{rows} and T_{cols} represent the row and column in the template respectively. In this method, the lowest SAD estimates the best location of the template within the search image. This method is easy to implement and understand, but it is one of the slowest methods. To achieve fast and reliable detection of cotton few fast learning algorithm is apply over the pixel detection and matching process of pattern [10].

4. SIMULATION WORK

This paper test on few pictures of cotton contains foreign elements of different shape and size as shown below

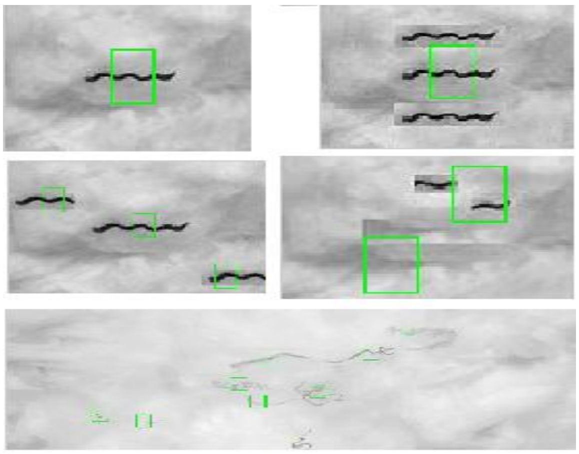

Fig 4.1: Showing the detection of foreign fibers in various pictures.

Table 4.1: Simulation Time with image size

JPG type Image	Size of Image	Run Time
IM1	394*297	25.171159 seconds
IM2	400*299	39.059348 seconds
IM3	400*300	19.720187 seconds
IM4	400*299	41.145979 seconds
IM5	107*71	729.939435 second s
IM6	151*103	739.733252 seconds
IM7	100*74	78.483827 seconds
IM8	100*75	84.375377 seconds
IM9	100*75	776.946775 seconds
IM10	92*72	946.153321 seconds
IM11	100*75	93.474568 seconds
IM12	200*149	726.856718 seconds
IM13	612*316	2613.554263 seconds
IM14	82*125	92.293305 seconds
IM15	117*75	788.713112 seconds
IM16	117*75	715.927785 seconds
IM17	150*104	262.320985 seconds
IM18	150*113	126.564441 seconds
IM19	150*77	264.749882 seconds
IM20	250X129	831.777286 seconds
IM21	287*190	7.702109 seconds.
IM22	289*294	16.666348 seconds.
IM23	219*278	8.360727 seconds.
IM24	101*75	522.083893 seconds.
IM25	99*74	110.340971 seconds.
IM26	98*73	555.019722 seconds.
IM27	103*77	627.730198 seconds.
IM28	195*145	1478.361938 seconds.
IM29	151*113	1063.502750 seconds
IM30	257*193	67.181400 seconds.
IM31	150*113	222.446148 seconds.
IM32	299*224	211.756350 seconds.
IM33	53*39	55.911605 seconds.
IM34	302*225	959.809065 seconds.
IM35	203*151	278.065141 seconds.

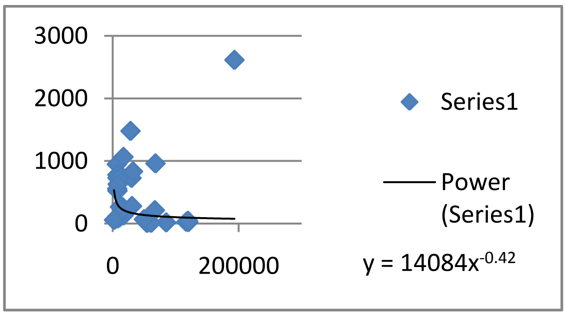

Fig 4.2: Line of regression

As per various picture were experimented through simulation model and it is found that the size of picture don't depend upon the execution time. It depends upon the location of foreign fibers and the number of their occurrence. The detection of successive pictures found to be great and detect the foreign elements every time. This graph is experimental presentation of execution of time and area which is the basic information of data trends. This shows expectancy of time of new picture through the line.

5. CONCLUSION

Template matching has been a constant challenge in the field of vision on a computer for many decades and is still unresolved. With the introduction of depression networks, a new method of coordinating project templates has been developed. The method chosen for this article is to use adaptation methods to learn about local information template. This new image detection method has been adopted more effectively with foreign fibers detection on the layer of cotton. Image as a templates, image matching up for test image both taken for the simulation in MATLAB. One behaves as a data base and one as a test element that is match up with the data base of the templates. The main step of this method is to recognize foreign fibers on cotton fibers. The size of all foreign fiber images is monochromatic. An object element occupies only a very small portion of the entire volume image. It is very hard to find such small elements of fiber on the layout of cotton.

A various image of cotton and non cotton images has been saved in separate folder then the test picture has been taken to match up with the data base. Then SVM will find the exactness of matching with templates images saved in folders. The color image segmentation introduced with the regional growth algorithm has better adaptability. The effectiveness of foreign fiber detection algorithms has been proven on various test images. Some quantitative image segmentation methods are used to evaluate the results. Future prospective of this technique is to implement it as a commercial level to enhance the automatization problems in mass production of cotton. This will also enhance the quality of cotton production level.

At last this paper introduces best way to find the unwanted element through SVM and Convolution Neural network. This has experimented on almost 35 images with time and area. This find

6. FUTURE SCOPE

We can explore more algorithms and techniques for the feature extraction and classification of cotton contaminants to further improve the accuracy of the identification system.

We can further improve the system by reducing the complexity. The main objective could be to find the best algorithms which optimize the performance and complexity.

The accuracy of classifier can also be enhanced by using more and equal number of training pattern.

7. ACKNOWLEDGEMENTS

I take this opportunity to express my heartfelt gratitude and sincere thanks to my project supervisor Dr. Koj Sambyo Assistant Professor and Head of the Department of Computer science Engineering, National Institute of Technology, Arunachal Pradesh for his constant guidance, suggestion and gracious encouragement at my very crucial stage of this dissertation work without him it could not become successful.

I sincerely thank all those people who gave me suggestions while working on this project. I am highly thankful to Amit Kumar, my parents, friends, and faculty members who were there all the time and gave support to my endeavor from behind the scene.

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