A Review on in Field Cotton Recognition for Cotton Harvesting Robot based on Image Processing Technique

Alakh Patel
Department of ECE
Babaria Institute of Technology, Varnama

Jaymin Bhalani
Professor, Department of ECE
Babaria Institute of Technology, Varnama

ABSTRACT
India is second largest country in production of cotton but it face problem like harvesting due to lack of skilled human labour. Solution of this problem is to do harvesting using cotton harvesting robots based on machine vision. Image processing technique has become very important in a wide variety of application. In farming is can be used to recognize cotton in field. Various image segmentation techniques are used for this operation. In field cotton recognition is challenging task because cotton plant contain various components like stem, leaves etc. Also open environment gives challenge to recognition task. Camera used to capture image of cotton plant, different camera view, illumination level at time of image capture etc. plays important role in the recognition of cotton in filed. Primary focus is to recognition of cotton in every environmental condition and also every possible mature cotton need to be detected. This review paper will give information about the possible image processing technique for recognition of cotton in field and it give future work done in the same topic.

Keywords
Cotton Recognition, image segmentation, cotton harvesting robot.

1. INTRODUCTION
Technology has large impact on agriculture productivity. Whether it is mechanical or computer technology, both have large application in agriculture. It can be used from plantation of crop to harvesting of crop. Image processing is the analysis and manipulation of a digitized image, especially in order to improve its quality. Digital image process is the use of computer algorithm to perform image process on digital pictures. It permits various algorithms to be applied to the computer file and might avoid issues like the build-up of noise and signal distortion throughout process. Digital image process has important role in agriculture sector. From crop diseases detection to crop fruit detection, image processing has various applications in farming field. One emerging application of it is to detect mature fruit by means of fruit harvesting in farm. Cotton harvesting robot is one example of it. Image processing technique can be used to detect cotton flower on plant which can be harvest by machine rather than human. This paper gives review of image processing technique for cotton recognition in filed.

Various image segmentation techniques can be used to detect cotton flower in image. Image segmentation is the techniques are used to partition an image into meaningful parts have similar features and properties. Segmentation gives simplification i.e. representing an image into meaningful and easily analysable way. The main goal of image segmentation is to divide an image into several parts or segments having similar features.

Parameters like illumination level, stem and leaf of plant, different camera angle have impact on cotton detection process. As this operation is in open environment is face most of problem from sun illumination level. Open environment gives challenge to detection process as camera can also capture background behind cotton plant. Image processing technique need to differentiate between stem, leaves and cotton flower. Figure 1 shows captured images of cotton flower in field. From images, it is observed that cotton flower does not have defined shape so it is difficult to apply pattern recognition for detection of cotton flower. Also different illumination level can be seen in captured images. Some image captured with high sun light while other are captured at low sun light.

Figure 1. Captured Cotton Flower Images

2. TECHNIQUES ON IMAGE SEGMENTATION FOR COTTON RECOGNITION
Cotton recognition is emerging application in terms of use of image processing in agriculture. India is second largest country in production of cotton and harvesting of cotton is done by skilled human labour. So agriculture sector needs new technology to replace this traditional harvesting.

Image segmentation provides various methods to detect cotton in an image. It include thresholding, clustering based method, region growing method etc. some of them are described below.

2.1 Thresholding Method
In this method, image pixels are divided with help of intensity level of an image. It can be used to differentiate between background and foreground object. The simplest thresholding methods replace each pixel in an image with a black pixel if the image intensity is less than some fixed constant T or a

white pixel if the image intensity is greater than constant. Objects are lighter than its background. Selection of this method depends upon our prior knowledge.

2.2 Edge Based Segmentation Method

A connected pixel that is found on the boundary of the region is called an edge. It is generally indicates the segmentation method based on the edge in an image. The simple methods apply some edge detection methods before segmentation. Some edge detection methods are gradient operators and Hilbert transform. Then the other methods only based on the concept of edge instead of using edge detection methods, for instance, watershed segmentation algorithm.

2.3 Region Based Segmentation Method

Region-growing methods rely mainly on the assumption that the neighbouring pixels within one region have similar values. The common procedure is to compare one pixel with its neighbours. If a similarity criterion is satisfied, the pixel can be set to belong to the cluster as one or more of its neighbours.

The selection of the similarity criterion is significant and the result is influenced by noise in all instances.

One region-growing method is the seeded region growing method. This method takes a set of seeds as input along with the image. The seeds mark each of the objects to be segmented. The regions are iteratively grown by comparison of all unallocated neighbouring pixels to the regions. Another region-growing method is the un-seeded region growing method. It is a modified algorithm that done not require explicit seeds.

2.4 Clustering Based Segmentation Method

The clustering based techniques are the technique, which segments the image into cluster having pixel with similar characteristics. Data clustering is the method that divides the data elements into cluster such that elements in same cluster are more similar to each other than others. There are two basic categories of clustering methods: Hierarchical method and partition based method. The hierarchical methods are based on the concept of trees. In this the root of the tree represents the whole database and internal nodes represent the clusters. On the other side the partition based methods use optimization methods iteratively to minimize an objective functions.

2.5 Watershed Based Method

The watershed based method uses the concept of topological interpretation. In this the intensity represents the basins having hole in its minima from where the waters spills. When water reaches the border of basin the adjacent basins are merged together. To maintain separation between basins dams are required and are the borders of region of segmentation. These dams are constructed using dilation. The watershed methods consider the gradient of image as topographic surface. The pixels having more gradient are represented as boundaries which are continuous.

3. LITERATURE REVIEW

Cotton is one of the most important fiber and cash crop of India and plays a dominant role in the industrial and agricultural economy of the country. As mention earlier in introduction, traditional cotton harvesting can be replace using cotton harvesting robots based on machine vision. Various researchers developed algorithm for cotton recognition in field.

Mulan Wang [1] proposed a research for intelligent cotton picking robot based on machine vision. In this, on the basis of the statistical analysis, a visual model for recognition of mature cotton was established and further optimized method increase the speed of operation.

Yong Wang [2] proposed machine vision based cotton recognition for cotton harvesting robot. This method is based on color subtraction information of different parts of cotton. In order to increase accuracy rate of cotton recognition, dynamic freeman chain coding is used to remove noise.

Yong Wang [3] proposed object recognition on cotton harvesting robot using human visual system. In this an algorithm based on the characteristic of HVS is proposed. In algorithm, the image was partitioned into many blocks of equal size.

Rao [4] proposed design of automatic cotton picking robot with machine vision using image processing algorithm. In this a new cotton recognition method using a single camera is proposed, which is based on color subtraction of different parts of cotton plant.

Mahua Bhattacharya [5] proposed Expert system design for cotton harvesting using shape and fractal features. They proposed image processing and soft computing based tools for analysis of the images of cotton bolls which are exactly in the mature form to be picked up.

Yanan Li [6] proposed in field cotton detection via region based semantic image segmentation. This paper reports on a novel in field cotton detection via region based semantic image segmentation with two perspective of observation, including unsupervised region generation and supervised semantic labelling prediction.

A new method of cotton identification was also established by studying the differences between cotton fruit, cotton leaf and cotton stem, based on which a vision model was set up to identify ripe cotton from its surrounding [7]. Research on cotton picking robot based on machine vision had been done in last few years and established the visual model of discrimination of mature cotton according to the obvious difference between the surface color of mature cotton and background color in early cotton field, on the basis of the statistical analysis and experiments [8]. Wang Yong established the visual model that recognizes the mature cotton in natural outdoor scenes by using the chromatic aberration information based on the statistical analysis with SPSS [9].

4. CONCLUSION

Thresholding is simpler method for cotton recognition in image but it has high noise factor and it does not perform well in image with high sunlight. Shape and fractal based method give acceptable result but it involve complexity in algorithm. Method based on human visual system gives good result when number of sub-block images is 4x4. Otherwise, the segmentation will be failure because too many background joining in ROI. So all above mention method can be used to recognize cotton flower but with some apply condition. One could develop algorithm which is robust in all condition whether it is noise or problem of high sunlight or occlusion of cotton with other one. Future work will be done in the same

direction by considering only color components of cotton flower image by using gamma correction or gamma adjust to find white cotton object.

5. REFERENCES

[1] Wang, Mulan, Jieding Wei, Jianning Yuan, and Kaiyun Xu. "A research for intelligent cotton picking robot based on machine vision." In Information and Automation, 2008. ICIA 2008. International Conference on, pp. 800-803. IEEE, 2008.

[2] Wang, Yong, Xiaorong Zhu, and Changying Ji. "Machine vision based cotton recognition for cotton harvesting robot." In International Conference on Computer and Computing Technologies in Agriculture, pp. 1421-1425. Springer, Boston, MA, 2007.

[3] Wang, Yong, Xiaorong Zhu, Yongxing Jia, and Changying Ji. "Object Recognition on Cotton Harvesting Robot Using Human Visual System." In International Conference on Computer and Computing Technologies in Agriculture, pp. 65-71. Springer, Berlin, Heidelberg, 2011.

[4] Rao, U. S. N. "Design of automatic cotton picking robot with Machine vision using Image Processing algorithms." In Control, Automation, Robotics and Embedded Systems (CARE), 2013 International Conference on, pp. 1-5. IEEE, 2013.

[5] Bhattacharya, Mahua, Medhabi Verma, Vivek Shukla, S. S. Kohli, and P. Rajan. "Expert System Design for Cotton Harvesting Using Shape and Fractal Features." In Proceedings of the International Conference on Image Processing, Computer Vision, and Pattern Recognition (IPCV), p. 1. The Steering Committee of The World Congress in Computer Science, Computer Engineering and Applied Computing (WorldComp), 2013.

[6] Li, Yanan, Zhiguo Cao, Hao Lu, Yang Xiao, Yanjun Zhu, and Armin B Cremers. "In-field cotton detection via region-based semantic image segmentation." Computers and Electronics in Agriculture 127 (2016): 475-486.

[7] Chin, Roland T., and Charles R. Dyer "Model-based recognition in robot vision." ACM Computing Surveys (CSUR)18, no. 1 (1986): 67-108.

[8] Sasaki, Hironobu, Naoyuki Kubota, Kousuke Sekiyama, and Toshio Fukuda. "Multiple object detection for intelligent robot vision by using growing neural gas." In Micro-NanoMechatronics and Human Science, 2009 MHS 2009. International Symposium on, pp. 80-85. IEEE, 2009.

[9] Wang, Yong, Ming-xia Shen, and Chang-ying Ji. "Study on the recognition of mature cotton based on the chromatic aberration in natural outdoor scenes." Acta Agriculturae Zhejiangensis 19, no. 5 (2007): 385.

[10] Anjna, Er, and Er Rajandeep Kaur. "Review of Image Segmentation Technique." International Journal 8, no. 4 (2017).

[11] Wang, Weixin, Duanyang Qu, Benxue Ma, and Yage Wang. "Cotton Top feature identification based on machine vision & image processing." In Computer Science and Automation Engineering (CSAE), 2011 IEEE International Conference on, vol. 1, pp. 681-685. IEEE, 2011.