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Implementation of Automation in Bloom Manufacturing Process to Measure Bloom Diameter and Count Using Image Processing Approach

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Abstract

Bloom is a mass of iron, steel or other metal hammered or rolled into a thick bar for further work. In current scenario once the bunch of bloom is formed then each bunch is tagged manually with oil paint containing information such as batch number, diameter and count of blooms within one bunch. At the time of delivery of this bunch to the customers, the manual counting of the bloom within the bunch is done. The manual counting of blooms at different sections may lead to the mismatch between available bloom count in the bunch and the count stored in the data base. This may leads to the unnecessary wastage of manpower and time. Therefore efforts have been made to design and implementation of an automatic technique to measure diameter and count of blooms kept in a bunch using image processing technique. In implemented system, bloom image has been captured using suitable image acquisition device. Using image processing technique, bloom diameter and bloom count within bunch has been calculated.SMS containing final result associated with blooms diameter and count has been send to different sections using SIM 300 GSM modem.

Keywords: Bloom, Diameter and count calculation, GSM modem, Circular Hough Transformation [CHT].

INTRODUCTION

In many industries tube is used to carry fluid or steam. There are two types of tubes, welded tube and seamless tube. The raw component which is used for the formation of seamless tubes is generally called as *'bloom'.* As per demand from customers or in accordance with the diameter blooms are sorted and kept in the form of bunch. The diameter of each of bloom within a bunch is approximately same but the number of blooms in a bunch is not fixed. Once the bunch of bloom is formed then each bunch is tagged manually with oil paint containing information such as batch number, diameter and count of blooms within one bunch. At the time of delivery of this bunch to the customers, the manual counting of the bloom within the bunch is done at storage unit, outward department and at main gate.

Oil paint tagging of each bloom within bunch involves manual efforts. The manual counting of blooms at different sections may lead to the mismatch between available bloom count in the bunch present in the carrier vehicle and the count stored in the data base. This may leads to the unnecessary wastage of manpower and time.

To tackle these situations a prototype system based on image processing has been developed. This system determines diameter of metal bloom and count of blooms in a bunch. The image of bloom bunch could be captured from suitable distance using appropriate image acquisition device. The captured image is then filtered with proper filtering algorithm to reduce noise from image. The application of HT-based based algorithm has been done to detect circular blooms in bloom bunch and to estimate bloom parameters like diameter, count. Once the diameter and the count (total number) of the blooms within the bunch are calculated then this information can be transmitted to the various departments of the company with the help of SIM 300 GSM module.

II.SYSTEM IMPLEMENTATION

Block diagram of implemented work is as shown in Fig. 1.

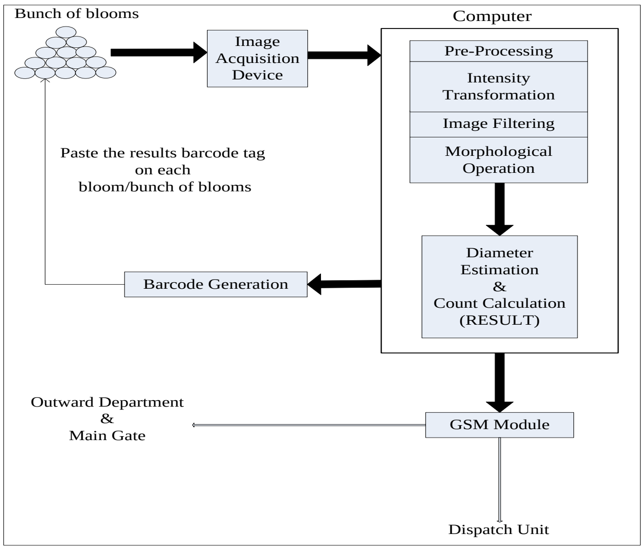

Fig. 1 Block diagram of implemented work

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2.1 Hardware implementation:

2.1.1 Image acquisition device:

While developing a prototype model for blooms diameter and count calculations, images have been captured INTEX IT-105WC, USB web camera having 1/7" CMOS sensor, 8.0 mega pixels capacity. Images are captured at a data rate of 30 frames per second. Further processing is carried out using various functions available in MATLAB.

Fig. 2 INTEX IT-105WC USB web camera used to capture image

2.1.2 GSM Modem:

Today, the mobile market has overtaken the fixed landline installations. GSM modem can accept any GSM network operator SIM (subscriber identity module) card and act just like a mobile phone with its own unique phone number. This is useful to provide service over wide range [5]. RS232 port of modem is used to communicate and develop embedded applications like SMS Control, data transfer, remote control and logging.

SIM 300 module which is a Tri-band GSM/GPRS engine and works on frequencies EGSM 900 MHz, DCS 1800 MHz and PCS1900 MHz SIM300 provides GPRS multi-slot class 10 capabilities and support the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4 is as shown in Fig. 3. SIM 300 provide RF antenna interface with antenna connector [12].

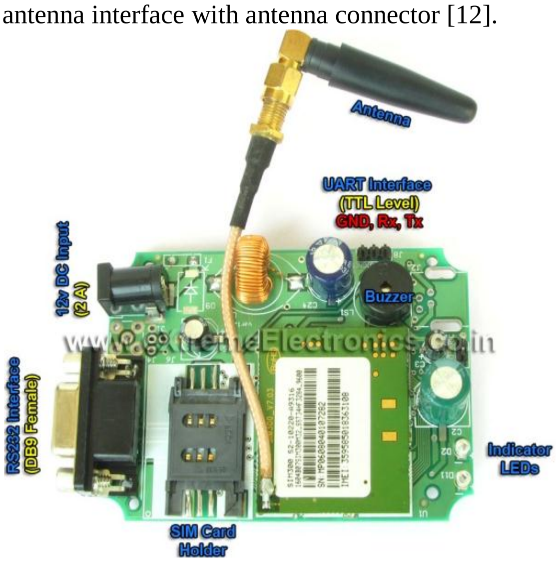

Fig. 3 SIM 300 GSM module

2.2 Software implementation:

2.2.1 Image pre-processing

Image pre-processing is a used to condition or enhance the input image in order to make it suitable for further processing. After acquiring an image with image acquisition device, next step is to pre-process acquired image. In implemented work, pre-processing techniques has been used for enhance contrast of an image and remove the noise from an image.

2.2.2 Circular bloom diameter and count calculation

In the field of pattern recognition, circle detection and calculation of diameter or radius is important and has been extensively studied and applied, such as automatic inspection and assembly, target locating and medical images processing in the past decades. One of the major challenges in computer vision is determining the shape, location, or quantity of instances of a particular object [1]. An example is to find circular objects from an input image. While numerous feature extraction techniques are openly available for circle detection, one of the most robust and commonly used methods is the Circular Hough Transform (CHT) [2] [3].

Though CHT became a common method for circle detection in numerous image processing applications, due to its drawbacks such as required computational time and space, several improvements have been suggested [6].In this application a gradient based Circular Hough Transformation has been used to detect the circular *blooms* and measure diameter of these *blooms*.

III. WORK IMPLEMENTATION

At initial stage, image of bloom bunch is captured from fixed distance with the help of USB camera. During image acquisition process, due to internal camera sensor circuitry, noise could be introduced in an image [10]. This noise is tremendously destructive for further processing [9]. Thus captured image is then pre-processed using median filtering operation to remove noise [8].

As images of bloom bunch has been captured in natural light at different instant of time, intensity of natural light is not same in whole day. This variation in intensity of light going to affect bloom diameter and count result [12]. Hence to tackle such problems, power law intensity transformation has been applied on filtered image.

Experimentally it is seen that, when *gamma* value in power law transformation is less than 1, processed image will be brighter than original image. When *gamma* value is greater than 1, processed image will be darker than original image. So depending upon intensity of external light, gamma value has been adjusted suitably to get best possible result.

In proposed application to detect circular bloom in image and estimate its diameter along with count calculation, gradient based Circular Hough Transformation

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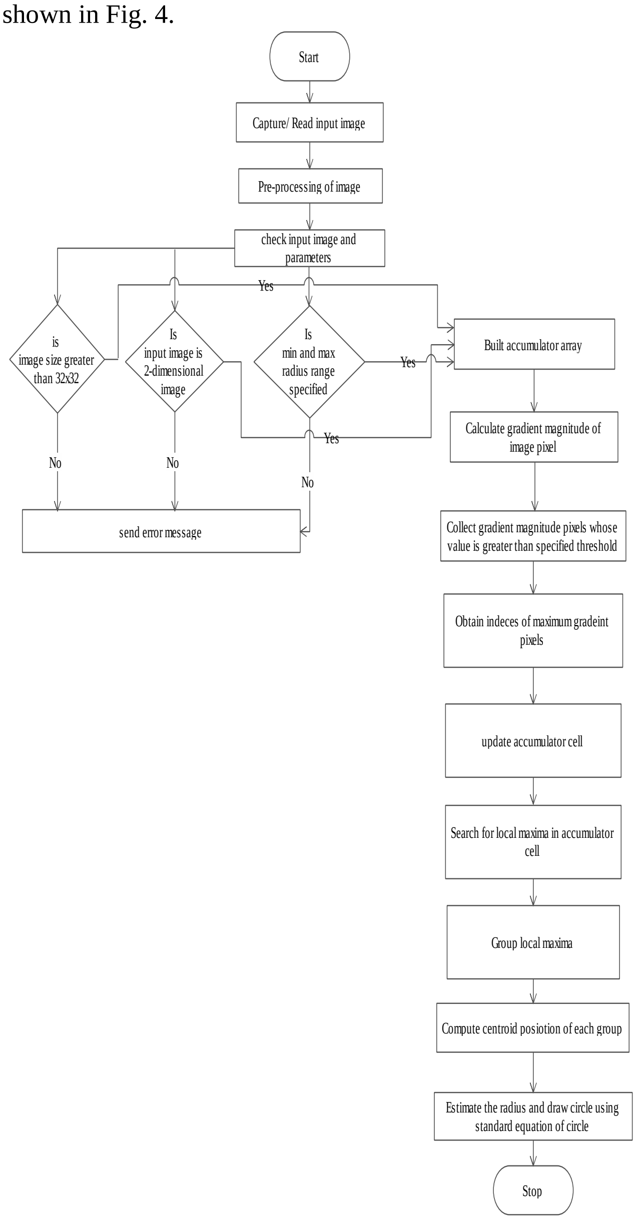
technique is used. At beginning of algorithm, the range of radius of circle to be detected is specified in pixels.

This algorithm works on the gray scale image with minimum image size of 32 x 32. In this approach gradient magnitude of pixels is calculated. By defining proper thresholding value, linear indices as well as subscript of pixels whose gradient magnitude is larger than threshold is obtained. The accumulator array is updated with these indices values. Local maxima within array is grouped together using 8 adjacency followed by centroid determination of grouped maxima pixels.

Once centroid is determined, depending on specified minimum and maximum radius range, actual radius of detected circle is estimated and using standard equation of circle and obtained radius values, circle is drawn in image. The work flow of implemented algorithm is as shown in Fig. 4.



V.

Figure 4 Work flow of implemented work

GSM is useful to send data over wide range with low cost and it supports innovative techniques that are useful in data transmission for variety of industrial application [7]. The work flow of GSM module interfacing with MATLAB is as shown in Fig. 5

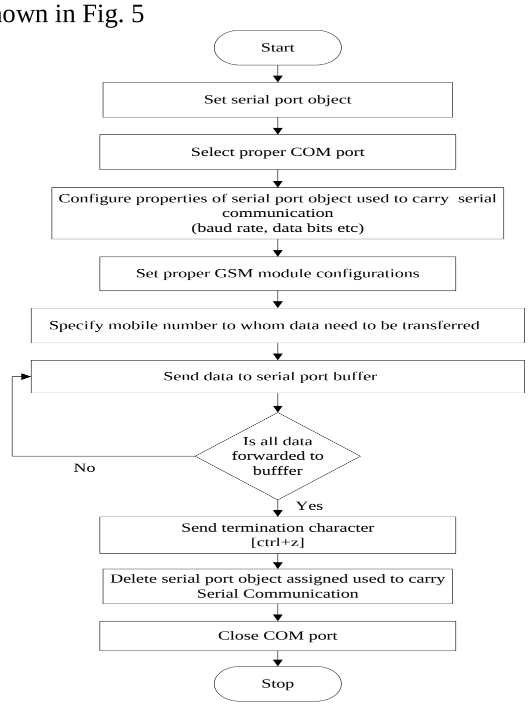


Fig. 5 Flow to interface GSM module with MATLAB

IV. SIMULATION RESULTS

For diameter and count calculation for blooms present in a bunch, HT based algorithm has been used. To apply this algorithm, some bloom images have been captured in laboratory and some images are captured at different instants of time in a day in ware house. The work is carried out on MATLAB R2010a platform and results are presented in this section. Developed Graphical User Interface [GUI] to provide easy accessibility is as shown in Fig. 6.

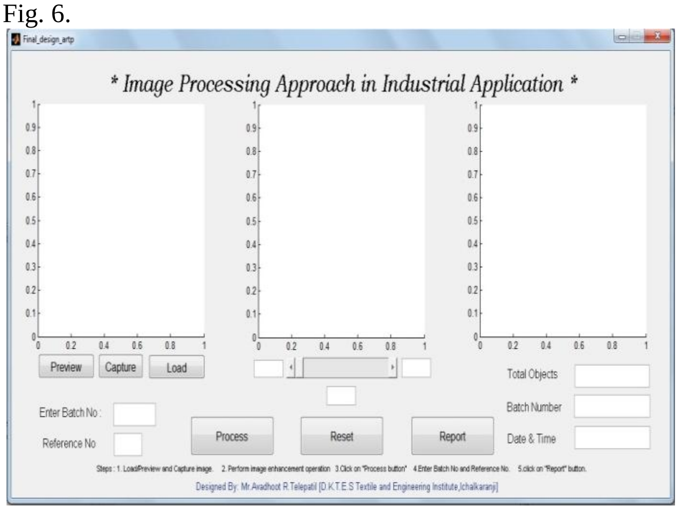


Fig. 6 Graphical User Interface [GUI] for diameter and count calculation

GUI shown in Fig. 6 contains three windows to display work image, intermediate pre-processing stages and final detected output. Using slider, image enhancement of image in pre-processing stages could be done. Manual entry of batch number and reference object number is entered via 'Batch No' and 'Reference No' edit box respectively. After completion of process, result such as entered batch number, total count, date and time of processing has been displayed at indicated edit box in GUI and same information has been transmitted via GSM modem. Use of various pushbuttons in GUI is illustrated in TABLE I.

TABLE I Different pushbuttons with application in developed GUI.

Sr. No.	Name of push button	Description
1	Preview	See preview of bloom bunch arrangement
2	Capture	Capture live image of bloom bunch
3	Load	Load bloom bunch image from database
4	Process	Start process and send SMS at end of process
5	Reset	Reset all windows of GUI

Fig. 7 and 8 shows bloom image captured in laboratory under day light. In Fig. 7 all blooms are in same plane and in Fig. 8, blooms are out of plane. Report associated with Fig. 7 and Fig. 8 is illustrated in TABLE II and TABLE III respectively.

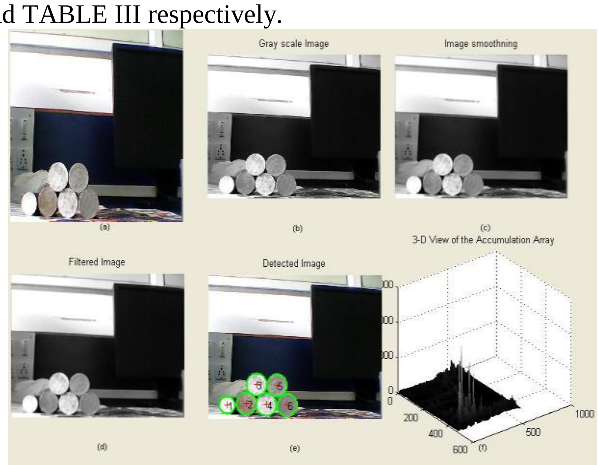


Fig. 7 bloom image with all blooms are in same plane Window (a) RGB image of blooms, Window (b), (c), (d) Intermediate pre-processing stages. Window (e) Illustrate detected blooms and Window (f) Shows the 3-D view of accumulator cell.

TABLE II Number of detected blooms and its diameter in terms of mm (all blooms are in same plane)

No	Measured diameter(in mm)	Actual Diameter(in mm)	Error(in mm)
1	22	22	0
2	28.06	27.8	+0.26
3	28.06	27.8	+0.26
4	28.06	27.8	+0.26
5	28.06	27.8	+0.26
6	28.06	27.8	+0.26

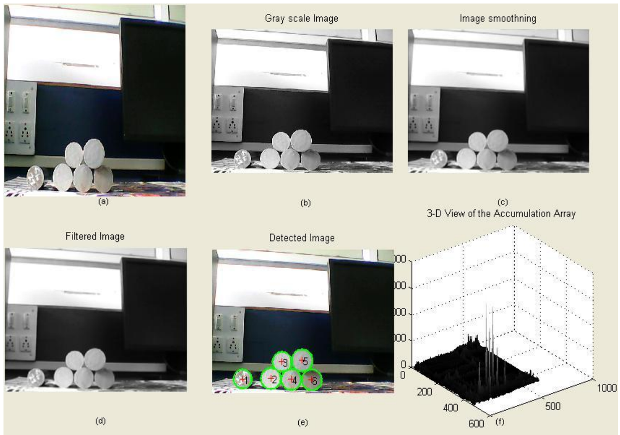


Fig. 8: Bloom image under day light with blooms out of plane, Window (a) RGB image of blooms, Window (b), (c), (d) Intermediate pre-processing stages. Window (e) Illustrate detected blooms and Window (f) Shows the 3-D view of accumulator cell.

TABLE III Number of detected blooms and its diameter in terms of mm (blooms are out of plane)

No	Measured diameter(in mm)	Actual Diameter(in mm)	Error(in mm)
1	22	22	0
2	24.06	25.4	-1.34
3	22.68	25.4	+2.72
4	24.06	25.4	-1.34
5	26.43	25.4	+1.03
6	24.06	25.4	-1.34

In Fig. 8 bloom number 3 is away from camera, bloom number 5 is close to camera and remaining three blooms are in same plane. Analyzing results illustrated in TABLE II and TABLE III, it is seen that when blooms in same plane average error in diameter is constant and for out of plane blooms average error in diameter is not constant.

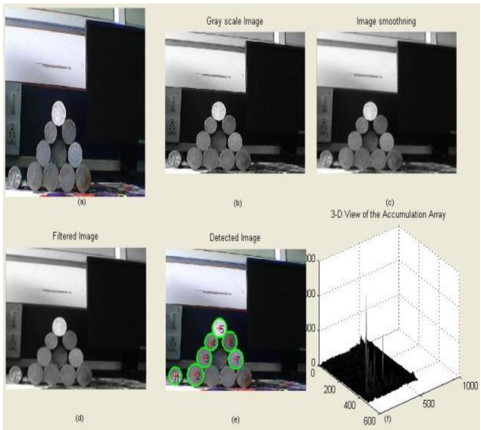


Fig. 9: Bloom image under dim light, Window (a) RGB image of blooms, Window (b), (c), (d) Intermediate pre-processing stages. Window (e) Illustrate detected blooms and Window (f) Shows the 3-D view of accumulator cell.

Bloom image captured under dim light is shown in Fig. 9. Due to poor light intensity out of total 11 blooms only 7 blooms has been detected properly which leads to erroneous result. This problem can be solved by artificial light set. Fig. 10 shows bloom image captured under dim light with artificial light set up in which all the objects has been correctly detected.

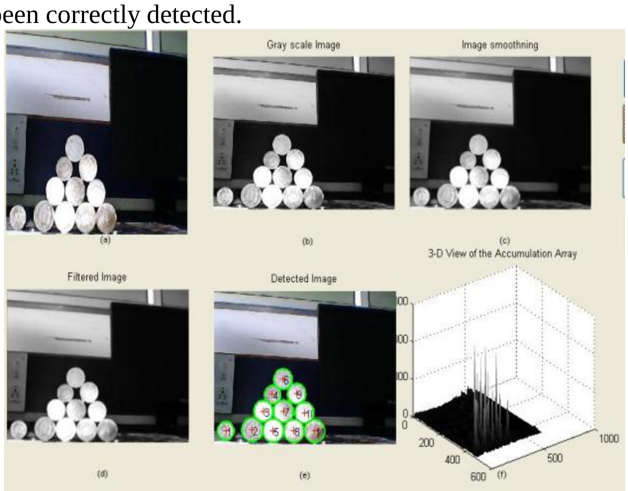
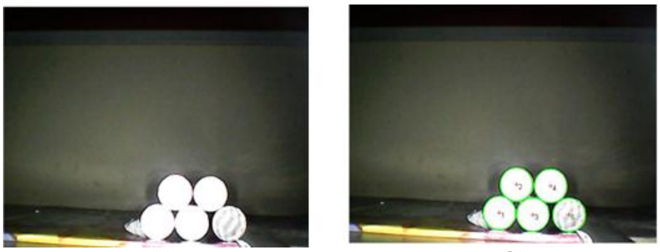


Fig. 10 Bloom image under dim light with artificial light set up, Window (a) RGB image of blooms , Window (b), (c), (d) Intermediate pre-processing stages. Window (e) Illustrate detected blooms and Window (f) Shows the 3-D view of accumulator cell.

Fig. 11 shows bloom images capture at night with artificial source of light. In Fig. 11 all blooms are in a plane and TABLE IV indicates detected blooms with their diameter values.



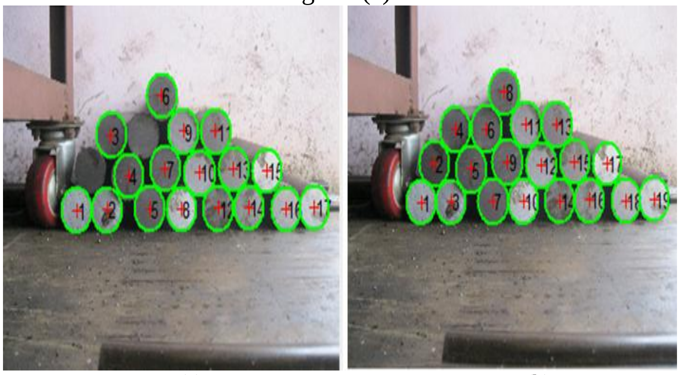
(a) (b)

Fig. 11 Bloom image at night under artificial light condition (all blooms are in same plane)
(a) Original image (b) Final output

TABLE IV Number of detected blooms and its diameter in terms of mm (in night with artificial light and blooms are in same plane)

No	Measured diameter(in mm)	Actual Diameter(in mm)	Error(in mm)
1	22	22	0
2	22	22	0
3	22	22	0
4	22	22	0
5	22	22	0

Fig. 11 shows count calculation result under natural light. This image of bloom has been taken at afternoon under natural light. For intensity transformation when gamma is greater than 1, out of 19 only 17 blooms has been counted as shown in Fig. 11 (a).

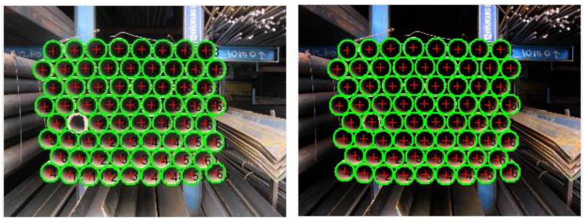


(a) (b)

Fig. 11 Bloom counting under natural light (a) With gamma = 1.4, (b) With gamma = 1

When gamma value is set to 1, all 19 blooms have been detected as illustrated in Fig. 11 (b).

Fig. 12 illustrates bunch of hollow tubes. Image of this bunch is captured at early in the morning. With gamma value in intensity transformation is equal to 1, out of 68 tubes, only 67 tubes has been counted successfully as shown in Fig. 12 (b). When gamma value is changed to 1.8, then accurate counting of tubes has been seen in result.



(a) (b)

Fig. 12 Bunch of tubes (a) Tube count calculation with gamma value = 1
(b) Tube count calculation with gamma value = 1.8

Thus result shown in Fig. 11 and 12 illustrates that at different instant of time depending upon intensity of natural light accurate count calculation could be done with appropriate selection of gamma value in intensity transformation function.

(a) (b)

Fig. 13 Bunch of tubes with non- circular object (a) Bunch of tubes before processing, (b) Bunch of tube after processing

Fig. 13 (a) shows bunch of tubes with some non-circular object kept in ware house. This image is taken at early in the morning under natural light After processing apart from all circular and non-circular objects, only circular tubes has been detected which are lies within specified radius range as illustrated in Fig. 13 (b). In bunch total 14 tubes are present and with gamma value 1.8 all these tubes has been correctly counted.

V. CONCLUSIVE REMARKS

The conclusions drawn from results given by algorithm used for diameter and count calculation of metal blooms in prototype system design to implement automation in bloom manufacturing process using image processing approach are as follows,

1. Diameter and count of calculation of blooms within a bunch is effectively done using image processing approach.
2. As images of blooms are taken at different instants of time in day, intensity of natural light is not same in whole day. It has been observed that this variation in natural light is affecting the results.
3. By applying proper intensity transformation on bloom image, image can be enhanced to improve accuracy in results.
4. During evening time under poor natural light, count result gets affected. Accuracy of result could be improved with artificial light set up.
5. When blooms are in same plane it leads to accurate detection of number of blooms within bunch with uniform maximum average error of ±2 mm in final diameter values. When blooms are not in same plane though count of blooms is accurate, average error in bloom diameter values is non-uniform.
6. Accuracy of result could be improved by,
   a. Arranging blooms in same plane.
   b. Properly adjusting intensity of bloom image using intensity transformation under natural light.
   c. With proper artificial light set up under dim natural light.

REFERENCES

[1] B. Guihong, "Relative image measurement on cigarette filter tip," *The 8th International Conference on Electronics Measurement and Instruments*, pp. 961-964, 2007.

[2] Richard O. Duda and Peter E. Hart "Use of the Hough Transformation to detect lines and curves in pictures" graphics and image processing Communication of the ACM, Volume 15, Number 1, pp 11-15, January1972.

[3] Fatoumata Dembele "Object Detection using Circular Hough Transform" ECE –Design team 3 documentation.

[4] Sirisak Liangwongsan, Boonraung Marungsri, Ratchadaporn Oonsivilai, Anant Oonsivilai "Extracted Circle Hough Transform and Circle defect detection algorithm" World Academy of Science, Engineering and Technology, pp 432-436, 2011.

[5] Radu Dobrescu, Dan Popescu, Maximilian Nicolae, and Stefan Mocanu, "Hybrid wireless sensor network for homecare monitoring of chronic patients", *International Journal of Biology and Biomedical Engineering*, Issue 2, Vol 3, pp 19-26, 2009.

[6] Ali Ajdari Rad1, Karim Faez, and Navid Qaragozlou1 "Fast Circle Detection Using Gradient Pair Vectors" Proc. VIIth Digital Image Computing: Techniques and Applications, Sydney, 10-12 Dec. 2003, pp -879-887.

[7] Srinivasa Rao Bommana, "Integration of GSM Module with PC Mother Board (GSM Trunking)", *technical paper, wipro technologies* pp 1-10.

[8] S. Esakkirajan, T. Veerakumar and C. H. Premchand, "Removal of high density salt and pepper noise through modified decision based unsymmetric trimmed median filter", *IEEE Signal Processing Letters*, vol. 18, no. 5, pp. 287-290, 2011.

[9] R.C.Gonzalez, R.E.Woods "Digital Image Processing" 3rd edition, pp.322-335.

[10] R.C.Gonzalez, R.E.Woods, "Digital Image Processing using MATLAB", 2rd edition, pp.322-335, 2008.

[11] SIMCOM Ltd, "SIM 300 Hardware specifications", 27th December 2005.

[12] S Jayaraman, S Esakkirajan, T Veerakumar, "Digital Image Processing", 3rd edition, pp.267-269, 2011