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Flower Detection and Counting Using Morphological and Segmentation Technique

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***Abstract*— This paper discuses the prominent and efficient method for detecting and counting the number of flowers from the flower images captured by digital camera. The proposed method uses Gaussian low-pass filter and morphological operations for pre-processing the flower images to remove the non flower region and enhancement of fine details. The flower region from input image is segmented using global threshoding technique using OTSU's algorithm. Experiment is conducted in MATLAB on two distinct databases of marigold flower images, the results have shown that the accuracy is over 92% to detect and count the number of flowers from flower images.**

***Keywords*— Flower detection and counting, Flower segmentation, Flower recognition.**

I. Introduction

There are about 250,000 named flower species in the world, every day we can see many blooming flowers in the roadside, garden, park, mountain path, wild field, green houses etc. [1]. Now a day the use of technology in the field of agriculture is increasing day by day for reducing the manpower and increasing the production capacity. Generally the flowers production is taken in greenhouses and fields for the revenue purpose by farmers. Produced flowers sold in market by the farmers in the form of bunch. But in the market these flowers sold in the form of units; hence the profit gain by the agent is more than the farmer; because a farmer doesn't know how many (in units) flowers are there in his greenhouse. So to overcome this problem, image processing application can be used to automatically detect and count the number of flowers available in the greenhouse.

This paper gives a novel approach to automatically detect and count the number of flowers in an image of greenhouse captured by digital cameras. The digital image of flowers in greenhouse can be taken by either high resolution smart phone or digital cameras. This input flower image is pre-processed using Gaussian low-pass filter and morphological operations for noise removal and image enhancement. The global threshoding approach is used for region segmentation of individual flower and counts the number of flowers in a given input image.

II. Related Work

Recently the flower recognition system based on image processing was proposed by Tanakorn et.al [1]. Author used the edge and color characteristics of flower images to classify the flowers and deployed Hu's-seven-moment algorithm to acquire edge characteristics. The k-nearest neighbour is used to classify the flowers.

The interactive flower image recognition system was proposed by Tzu-Hsiang et.al [2], the proposed system draw an appropriate bounding window that contains the interested flower region, depending on that the boundary tracking method is developed to extract flower regions as accurately as possible.

In [5], Das et al. proposed a new approach for indexing a specialized database by utilizing the colour and spatial domain knowledge available for the database; and provided the solution to the problem of indexing images of flowers.

In [6], Asma et al. used a novel method to isolate the flower region from the background using OTSU's thresholding on lab color space for segmenting flower region. Thresholding was performed, separately, on the three component L, a and b, and the best result is selected.

In [7], Yuri et.al used Graph cut method which provides the technique to identify certain pixels as background or object as segment part using contrast dependent prior Markov random field (MRF) cost function.

In [9], John et.al proposed a method for identification of ROI using the edges in the images depends on the natural uncertainty principle. Author used C-Means algorithm avoid ambiguity to decide the flower type to categorize the flowers as flowers with many petals, flowers with clear one petal and rounded flowers.

In [10], Hong et.al has done the segmentation based on color clustering and domain knowledge to extract flower regions from flower images. He also used the color histogram of flower region to characterize the color feature of flower and two shape-based features set.

III. Methodology

The methodology used for detecting and counting the number of flowers from greenhouse image taken by digital camera is described in following steps.

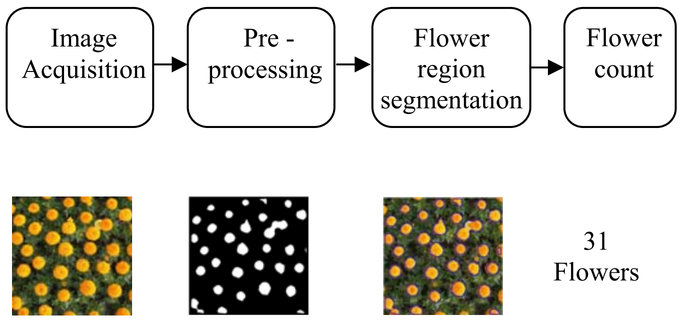

Fig. 1 Flow diagram of the proposed flower image detection and counting system

A. Image Acquisition

The flower image from greenhouse is captured from top side of flowers in greenhouses with one to two meter distance using *Sony Cyber shot W810 20.1MP* camera in overcast environment. The captured image of marigold flower is in size 1200X1600 in a jpeg format.

B. Pre-processing

After taking the marigold flower image, pre-processing is done on the input image to remove noise and to extract only the flower region. In the discussed method, the Gaussian low-pass filter is used with the predefined size and standard deviation. Input image is converted into binary form based on thresholding level. The Otsu's method is used to choose the threshold to minimize the intra class variance of the black and white pixels.

$$h_g(n1,n2) = e^{\frac{-(n_1^2+n_2^2)}{2\sigma^2}} \quad (1)$$

$$h(n1,n2) = \frac{h_g(n1,n2)}{\sum_{n1}\sum_{n2} h_g} \quad (2)$$

$$I1 = I + h \quad (3)$$

$$I2 = \text{binary}\ (I1, \text{level}) \quad (4)$$

Where,

n1=15, n2=15, σ =7.

h = pre-defined Gaussian low-pass filter.

I = original image.

I1 = result image (after applying h) i.e. filtered image.

I2 = binary image.

level = threshold value calculated using Otsu method.

C. Flower Region Segmentation

The canny method is used to find out the regions of the flowers in an image, because in the binary image white pixels indicate the area of the flowers. After that the mask is created depending on the edge and put that mask on original image

e = edge of I2 using canny method.

I3 = I + m

Where,

m = coloured edge mask.

I3 = flower region segmented image.

D. Flower Count

To count the number of flower in an image firstly the bounding boxes are created for every connected edge in an image; after that the total number of bounding boxes are counted and stored. Finally the count in stored variable is the number of flowers detected and counted.

IV. Experimental Results

A. Flower Image Database

In this paper, two distinct marigold flower image databases are used to evaluate the performance of the proposed method. First is the primary database (DB1), the images of the marigold flowers are captured manually from the greenhouses using Sony Cybershot W810 20.1MP digital camera from the top side, the distance between surface of the flowers and camera is 1 to 2 meter. This primary database contains 50 marigold flower images of 1200X1600 sizes. The Second database is the secondary database (DB2), in which the marigold flower images are collected from the standard and authorized websites, such as www.shutterstock.com and www.burpee.com, these images were in different sizes. Before doing experiment, the flower images are resized into 500x500 pixels of both the databases to get the prominent results. Finally the experiment is carried out on 50 samples of each primary (DB1) and secondary (DB2) database images in MATLAB.

B. Experiments

Experiment is carried out on 50 marigold flower images of primary database and 50 marigold flower images of secondary database. The results of Flower Detection and Count using proposed method are given in the Table 1.

TABLE I
RESULTS OF FLOWER DETECTION AND COUNT FROM FLOWER IMAGES

Sr. No.	Image Name	TNF	D&CF	NDF	FDF	POD	PND	PFD
DB1								
1	MF1	4	39	0	35	100	0	89.74
2	MF2	9	8	1	0	88.89	11.11	0
3	MF3	7	7	0	0	100	0	0
4	MF4	6	6	0	0	100	0	0
5	MF5	9	7	2	0	77.78	22.22	0
6	MF6	7	7	0	0	100	0	0
7	MF7	21	23	0	2	100	0	8.7
8	MF8	4	4	0	0	100	0	0
9	MF9	21	20	1	0	95.24	4.76	0
10	MF10	23	22	1	0	95.65	4.35	0
11	MF11	30	30	0	0	100	0	0
12	MF12	14	14	0	0	100	0	0
13	MF13	17	14	3	0	82.35	17.65	0
14	MF14	8	42	0	34	100	0	80.95
15	MF15	30	28	2	0	93.33	6.67	0
16	MF16	25	22	3	0	88	12	0
17	MF17	31	30	1	0	96.77	3.23	0
18	MF18	22	6	16	0	27.27	72.73	0
19	MF19	33	32	1	0	96.97	3.03	0
20	MF20	21	20	1	0	95.24	4.76	0
21	MF21	26	25	1	0	96.15	3.85	0
22	MF22	50	45	5	0	90	10	0
23	MF23	6	24	0	18	100	0	75
24	MF24	4	5	0	1	100	0	20
25	MF25	10	10	0	0	100	0	0
26	MF26	10	10	0	0	100	0	0
27	MF27	26	23	3	0	88.46	11.54	0
28	MF28	9	7	2	0	77.78	22.22	0
29	MF29	5	5	0	0	100	0	0
30	MF30	6	6	0	0	100	0	0
31	MF31	16	14	2	0	87.5	12.5	0
32	MF32	20	19	1	0	95	5	0
33	MF33	21	18	3	0	85.71	14.29	0
34	MF34	20	20	0	0	100	0	0
35	MF35	7	6	1	0	85.71	14.29	0
36	MF36	7	7	0	0	100	0	0
37	MF37	7	6	1	0	85.71	14.29	0
38	MF38	7	5	2	0	71.43	28.57	0

Sr. No.	Image Name	TNF	D&CF	NDF	FDF	POD	PND	PFD
39	MF39	3	3	0	0	100	0	0
40	MF40	5	5	0	0	100	0	0
41	MF41	30	29	1	0	96.67	3.33	0
42	MF42	14	13	1	0	92.86	7.14	0
43	MF43	3	2	1	0	66.67	33.33	0
44	MF44	9	6	3	0	66.67	33.33	0
45	MF45	40	37	3	0	92.5	7.5	0
46	MF46	5	5	0	0	100	0	0
47	MF47	9	9	0	0	100	0	0
48	MF48	8	6	2	0	75	25	0
49	MF49	6	6	0	0	100	0	0
50	MF50	9	7	2	0	77.78	22.22	0
DB2								
51	MF51	12	12	0	0	100	0	0
52	MF52	14	12	2	0	85.71	14.29	0
53	MF53	5	5	0	0	100	0	0
54	MF54	17	17	0	0	100	0	0
55	MF55	5	5	0	0	100	0	0
56	MF56	25	24	1	0	96	4	0
57	MF57	30	30	0	0	100	0	0
58	MF58	17	13	4	0	76.47	23.53	0
59	MF59	32	30	2	0	93.75	6.25	0
60	MF60	40	39	1	0	97.5	2.5	0
61	MF61	25	22	3	0	88	12	0
62	MF62	50	52	0	2	100	0	3.85
63	MF63	25	21	4	0	84	16	0
64	MF64	40	39	1	0	97.5	2.5	0
65	MF65	32	32	0	0	100	0	0
66	MF66	45	45	0	0	100	0	0
67	MF67	50	50	0	0	100	0	0
68	MF68	40	38	2	0	95	5	0
69	MF69	45	45	0	0	100	0	0
70	MF70	70	41	29	0	58.57	41.43	0
71	MF71	25	21	4	0	84	16	0
72	MF72	20	21	0	1	100	0	4.76
73	MF73	30	28	2	0	93.33	6.67	0
74	MF74	7	7	0	0	100	0	0
75	MF75	25	24	1	0	96	4	0
76	MF76	25	20	5	0	80	20	0
77	MF77	10	7	3	0	70	30	0
78	MF78	31	31	0	0	100	0	0
79	MF79	10	8	2	0	80	20	0
80	MF80	10	10	0	0	100	0	0
81	MF81	20	21	0	1	100	0	4.76
82	MF82	20	18	2	0	90	10	0
83	MF83	20	22	0	2	100	0	9.09
84	MF84	44	44	0	0	100	0	0
85	MF85	21	18	3	0	85.71	14.29	0
86	MF86	30	26	4	0	86.67	13.33	0
87	MF87	21	21	0	0	100	0	0
88	MF88	8	7	1	0	87.5	12.5	0
89	MF89	19	14	5	0	73.68	26.32	0
90	MF90	23	21	2	0	91.3	8.7	0
91	MF91	40	36	4	0	90	10	0
92	MF92	5	5	0	0	100	0	0
93	MF93	19	19	0	0	100	0	0
94	MF94	7	7	0	0	100	0	0
95	MF95	23	92	0	69	100	0	75
96	MF96	14	14	0	0	100	0	0
97	MF97	6	6	0	0	100	0	0
98	MF98	8	8	0	0	100	0	0
99	MF99	27	27	0	0	100	0	0
100	MF100	27	22	5	0	81.48	18.52	0
Average =						**92.30**	**7.69**	**3.72**

Where:

- TNF = Total Number of Flowers.
- D&CF = Detected & Counted Flowers.
- NDF = Non Detected Flowers.
- POD = Percentage Of Detection.
- PND = Percentage of Non Detection.
- FDF = False Detection of Flowers.
- PFD = Percentage of False Detection.
- POD = (D&CF) / (TNF)*100.
- PND = (NDF) / (TNF)*100.
- FDF = MOD(TNF-D&CF).
- MF1- MF100: Marigold Flower 100 samples.

V. Conclusions and Future Work

This paper has presented a novel method for detecting and counting the number of flowers from flower images of a greenhouse. The proposed method for automatic detection and counting of marigold flowers is an efficient and robust with accuracy of 92%. The farmer and agents can use this application to count and verify the number of flowers available in the greenhouse easily and quickly with affordable cost.

This work is extended in future for removing flowers overlapping, classification between the buds and flowers for accurate estimation of production. Also this application can be extended towards the detecting and counting the mixed category flowers in a greenhouse by detecting and recognizing each flower category and its count.

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