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Betel Leaf Disease Detection Using Histogram of Oriented Gradients and Multiclass SVM

Dr. S. K. Jayanthi[1], C.Lalitha[2]

Head and Associate Professor, Dept. of Computer Science, Vellalar College for Women, Erode, Tamilnadu, India[1]

Research Scholar, Department of Computer Science, Vellalar College for Women, Erode, Tamilnadu, India[2]

ABSTRACT*:* Betelleaves contain many remedial and medicinal health benefits. During cultivation, betel vine is mainly affected by various diseases. The key feature of this work is to identify the diseases in earlier stage using image processing techniques. Different stages of healthy and diseased betel leaf digital images have been transformed into l*a*b model using CIELAB color space. Watershed transformation algorithm is used for segmentation. Histograms of Oriented Gradients (HOG) technique has been used to extract the features. Then diseases are identified by using multiclass SVM classifier. Finally based on the evaluation metrics sensitivity and specificity, the proposed method depicted an improved accuracy of 95.85% compared to the existing one which is of 82.35% accuracy.

KEYWORDS*:* CIELAB Color Space Model; Watershed Segmentation; Histogram of Oriented Gradients; Multiclass Support Vector Machine.

I. INTRODUCTION

Plant diseases cause periodic outbreak of diseases which leads to large scale death and famine. Since the effects of plant diseases were devastating, some of the crop cultivation has been abandoned. The naked eye observation of experts is the main approach adopted in practice for detection and identification of plant diseases. Betel leaves have stimulant and anti-flatulent activities. They have been used as a mouth freshener and an aphrodisiac. It is used in a number of traditional remedies for the treatment of stomach ailments, infections and as a general tonic. Betel vine plays a significant role in the social and cultural aspects of India.

During cultivation betel vine is very much affected by diseases such as Foot Rot, Leaf Rot and Powdery mildew. It occurs in a very virulent form and if not controlled, causes widespread damage and even total destruction of the entire betel vine plantations. The farmer is not able to identify the disease at an early stage to initiate preventive action due to the non-availability of modern technology. This has been the base to develop a new tool to identify the disease well in advance to enhance the cultivation.

II. RELATED WORK

Barbedo [2016] explored a novel algorithm for semi-automatic segmentation of plant leaf disease symptoms and described a wide variety of plant leaf diseases from 19 plant spices. It manipulates the histograms of H from HSV colour space and 'a' from the L*a*b* colour space colour channels. Finally they proved that 'a' channel is better than H Channel in accuracy.

Piyush Chaudhary et al. [2012] proposed a colour transformation algorithm for disease spot segmentation in plant leaf. The effect of CIELAB, HSI and YC=bCr colour space in the process of disease spot detection has been analysed. 'A' component of CIELAB colour space, 'H' component of HIS colour space and 'Cr' component of YCbCr colour space is used to detect the disease spot. Finally it has been proved that 'A' component of CIELAB colour model gave the better solution for disease spot segmentation.

KaneshVenugoban et al. [2014] offers a framework to classify images of paddy field insect pests. Further the histogram of oriented gradients (HOG) descriptor was applied for feature extraction to extract the gradient values.

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Finally the results were tested and showed that HOG descriptor significantly outperforms well compared to local-invariant features SIFT and SURF.

Dubey et al. [2012] explored that the detection and classification of apple fruit diseases, namely, scab, apple rot and apple blotch has been performed by using Multiclass Support Vector Machine (MSVM) also gave better results.

This section has reviewed the various research works and algorithms related to plant leaf disease detection. The overall literature survey says that various methods and classification techniques are applied for classifying betel images into healthy or diseased. Color Space Transformation detects the affected parts. But in the proposed, Watershed algorithm is used for segmentation to show better solution in betel leaf disease classification.

III. METHODOLOGY

Watershed segmentation, HOG and Multiclass support vector machine are used to detect betel leaf diseases and the architecture of the proposed system is shown in fig. 3.1

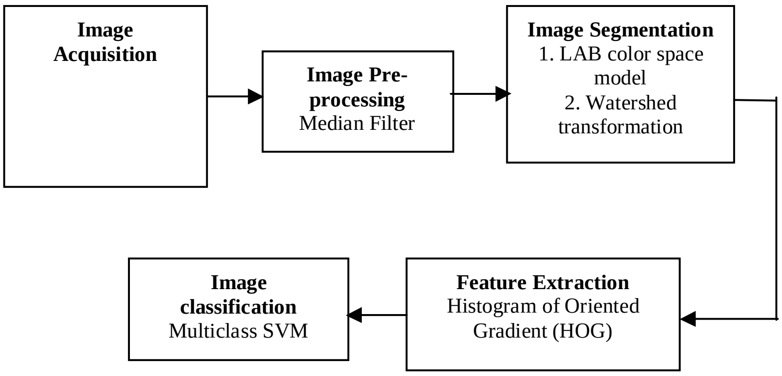

Fig 3.1 Architecture of the proposed system

Images were acquired from the agriculture farm using digital camera with the resolution of 5312* 2988. Both the healthy and diseased betel leaves are collected for processing as shown in Fig 3.2.

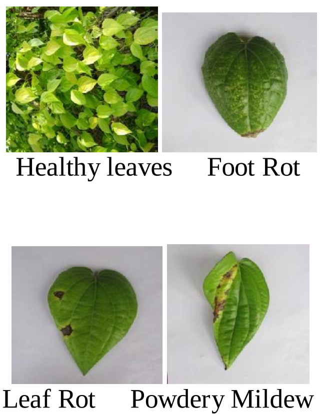

Fig 3.2Samples of betel leaf

The proposed work consists of four phases in detecting betel leaf diseases.

- Preprocessing using Median Filter
- Segmentation using Watershed Algorithm
- Feature Extraction using HOG

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- Classification using Multiclass SVM classifier

Median Filter removes the noise and process the image efficiently. The median filter is operated by sorting all the pixel values from the window into sorted order, and then replacing the center pixel by middle pixel value among the sorted values. The RGB image is transformed into l*a*b model using CIELAB colour space. In that component A is extracted. The most segmentation was done in colour space model.

WATERSHED SEGMENTATION

Color transformed image is given as input to the Watershed transformation algorithm which is used for segmentation. Watershed means line that divides areas drained by different river systems. The watershed separates the image region by determined boundaries. Edge detection is done by using sobel operator and the gradient magnitude is calculated. Then the regional maxima of opening-closing by morphological reconstruction are determined. The reconstructed leaf image is superimposed on input image. The dilated image is obtained by cropping maximal marker level region. Finally watershed transformation is done to obtain the segmented betel leaf image.

HOG

HOG features are obtained by orientation histograms of edge intensity in local region. The betel vine leaf is segmented into small connected cells for gradient calculation. The extraction of gradient value contains the following steps:

Gradient Computation

Gradient is a directional change in the intensity value of an image. The magnitude m and direction θ are computed by the following expressions, respectively.

$$m = \sqrt{dy^2 + dx^2}$$

$$\theta = \arctan\left(\frac{dy}{dx}\right)$$

Orientation Binning

- Create the cell histograms and cells themselves be either rectangular or horizontal.
- Histogram channels are evenly spread over 0 to 180 or 0 to 360 degrees depending on whether the gradient is “unsigned” or “signed”.

Descriptor Blocks

The blocks are divided into two types,

- R-HOG
- C-HOG

R-HOG represents the square grids and the C-HOG represents the centered grid. These cells are angularly divided.

Block Normalization

By combining all generated histogram the large histogram is obtained. In order to reduce the influence of variations in illumination and contrast, L1-norm is adopted in this work. The large histogram is normalized by

$$\boldsymbol{V} = \frac{\boldsymbol{V_k}}{||\boldsymbol{V_k}|| + \epsilon}$$

whereV_k is the vector for combined histogram, ε is a small constant, and v is the normalized vector, which is a final HOG feature of betel leaf.

MULTICLASS SVM

Multiclass Support Vector Machine Classifier is used to classify the betel leaf diseases. Diseased and non-diseased betel leaves are trained based on the gradient values. During testing, gradient values of untrained betel leaf are given as input to the classifier and are classified as foot rot, leaf rot, powdery mildew and no disease. If the given values are nearer to these classes, then the classifier identified that untrained betel leaf belongs to that class.

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IV. RESULTS AND DISCUSSION

The results are discussed in this section through experimental analysis based on the existing and proposed work.

A. *Experimental Analysis:*

The process of theproposed work contains the following steps:

Step 1: Images were acquired from the agriculture farm.

Step 2: **P**re-processing is done by using Median filter.

Step 3: The RGB image is transformed into l*a*b model using CIELAB colour space**.** The Fig 4.1 shows the transformation from RGB space to CIELAB space.

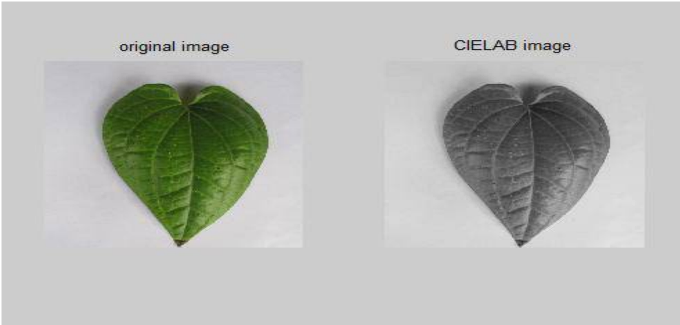

Fig 4.1 CIELAB colour model of betel leaf

Step 4: The l*a*b color transformation betel leaf is segmented using Watershed Transformation Algorithm**.** The watershed transform of betel leaf segmentation is shown in Fig 4.2.

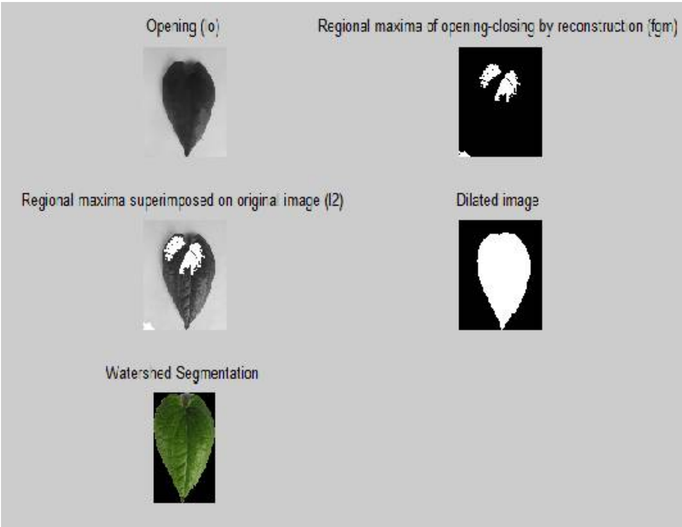

Fig 4.2 Extracted betel leaf after watershed segmentation

Step 5: From l*a*b transformation A component is extracted. Gradient and magnitude values are extracted in various directions based on their corners, blobs, edge pixels of both healthy and diseased betel leaves using Histogram of Oriented Gradients (HOG) technique.

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The gradient values of both healthy and diseased leaf is shown in table 4.1

Table 4.1 Gradient Values for Diseased Betel Leaf and healthy leaf

GRADIENT VALUES FOR DISEASED BETEL LEAF AND HEALTHY LEAF									
Block	**Healthy**	**Foot Rot**	**Leaf Rot**	**Powdery Mildew**	**Block**	**Healthy**	**Foot Rot**	**Leaf Rot**	**Powdery Mildew**
1	0.17504572	0.28549571	0.29317559	0.27509384	**42**	0.58818863	0.27928663	0.29683336	0.33302753
2	0.15226528	0.28485336	0.30901195	0.30961553	**43**	0.36890855	0.30867568	0.32501323	0.36579574
3	0.5893951	0.45049197	0.44463638	0.4379017	**44**	0.17021126	0.33841333	0.32603321	0.30675464
4	0.12597603	0.26975318	0.26213537	0.23060229	**45**	0.1062719	0.34031029	0.32995675	0.2843276
5	0.47451096	0.41563797	0.41427664	0.46727576	**46**	0.07359669	0.34440248	0.33698742	0.3751409
6	0.22363135	0.25511526	0.27319429	0.28228288	**47**	0.33476261	0.28702897	0.30824148	0.32383823
7	0.38261735	0.32558588	0.33257052	0.360041	**48**	0.12643746	0.3229202	0.34566979	0.33470091
8	0.32349263	0.34532639	0.32428451	0.31968157	**49**	0.1215002	0.38911258	0.37339432	0.32772465
9	0.23806136	0.31390764	0.30018532	0.2316498	**50**	0.32564869	0.39338136	0.36026262	0.33569596
10	0.06108604	0.27278032	0.28356569	0.31057367	**51**	0.75596465	0.30500408	0.32093426	0.36366648
11	0.09358229	0.28115167	0.30072595	0.31522852	**52**	0.39144786	0.29113105	0.31302283	0.31703735
12	0.77391584	0.44609258	0.45367983	0.43970734	**53**	0.12591116	0.29409717	0.29493798	0.2847739
13	0.14034407	0.30030064	0.28648984	0.25886916	**54**	0.07124012	0.35253626	0.33874533	0.32925554
14	0.20585894	0.29511766	0.28324684	0.32078592	**55**	0.34364686	0.35143103	0.33154361	0.28100812
15	0.38620957	0.31397718	0.30878788	0.34251965	**56**	0.57932757	0.31120417	0.31783921	0.40581385
16	0.38299372	0.37402457	0.3795978	0.38396134	**57**	0.3084991	0.30417168	0.30964619	0.26414203
17	0.15232274	0.37371745	0.35320621	0.3202773	**58**	0.14301304	0.27780357	0.26909007	0.23949485
18	0.08602053	0.30351845	0.31115419	0.27126401	**59**	0.47469151	0.44343093	0.42917958	0.48871073
19	0.01784564	0.3193064	0.31271942	0.36310042	**60**	0.31312999	0.2245679	0.26718159	0.25822913
20	0.02636341	0.26432481	0.27134707	0.30033339	**61**	0.26068612	0.44553837	0.44071031	0.47744695
21	0.9444721	0.43953402	0.4530552	0.4369547	**62**	0.12921618	0.29803973	0.30298137	0.22182765
22	0.0502963	0.28793702	0.29177455	0.2648083	**63**	0.15033015	0.27486537	0.28134369	0.21570274
23	0.14605782	0.34677496	0.32997694	0.30616752	**64**	0.15086098	0.34935722	0.33688369	0.30318144
24	0.27690959	0.35607741	0.3375459	0.36657214	**65**	0.57458857	0.29162357	0.32519402	0.39371472
25	0.07217796	0.32670169	0.34287582	0.31678563	**66**	0.47343977	0.32055511	0.33114409	0.353274
26	0.02912825	0.30423332	0.30171947	0.28580907	**67**	0.17871427	0.41119295	0.36292608	0.28774922
27	0.01708145	0.32516864	0.32673728	0.32671648	**68**	0.21570215	0.32353771	0.30512139	0.29859513
28	0.40688219	0.35567427	0.35092737	0.32766331	**69**	0.41644335	0.24161928	0.28634328	0.27216306
29	0.41846195	0.32597004	0.34505259	0.42779043	**70**	0.36471307	0.40002427	0.42712815	0.49467485
30	0.21109306	0.32713831	0.3331929	0.27124134	**71**	0.16640627	0.30802548	0.30535318	0.26654502
31	0.17994452	0.30443597	0.28417781	0.25095704	**72**	0.10155449	0.321105	0.29767185	0.2578323
32	0.55345501	0.44404924	0.43298701	0.45520531	**73**	0.09907577	0.31427919	0.31492252	0.34278889
33	0.31411694	0.24410584	0.27472837	0.29233066	**74**	0.36126093	0.24442244	0.28564347	0.28956006
34	0.25032729	0.29648347	0.31853718	0.35299523	**75**	0.51102783	0.30621345	0.32575293	0.33933164
35	0.17738817	0.33045543	0.31683213	0.30710765	**76**	0.33784827	0.45307611	0.39375894	0.31989766
36	0.28854006	0.33713539	0.31812613	0.24795881	**77**	0.17445096	0.33067057	0.31015321	0.30693867
37	0.12619407	0.34213778	0.34892447	0.34646796	**78**	0.45001123	0.23753114	0.27943604	0.2682005
38	0.50513114	0.32478849	0.35182649	0.39538342	**79**	0.46228993	0.41232392	0.43764714	0.48463864
39	0.22106485	0.34903795	0.36121325	0.33327116	**80**	0.17257064	0.28798442	0.28910222	0.26888301
40	0.18685834	0.36915317	0.34363231	0.29134903	**81**	0.08885746	0.35174538	0.32964871	0.3283989
41	0.3503746	0.34019145	0.31143505	0.32865985					

Step 6: The extracted gradient value of diseased betel leaf is given as input to the classifier. The experimental result for healthy betel leaf is shown in fig. 4.3

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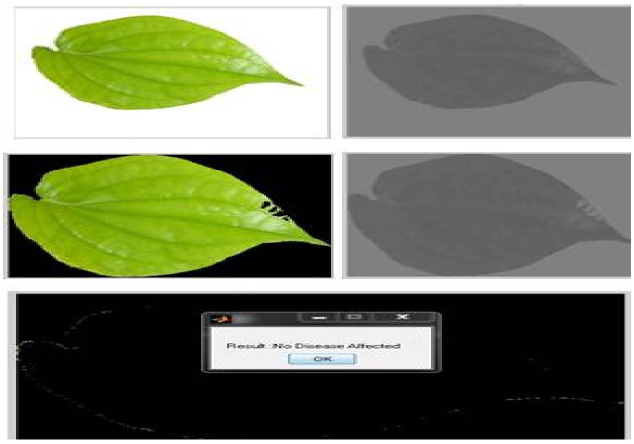

Fig. 4.3 Experimental result for healthy betel leaf

The experimental result for diseased betel leaf is shown in fig. 4.4

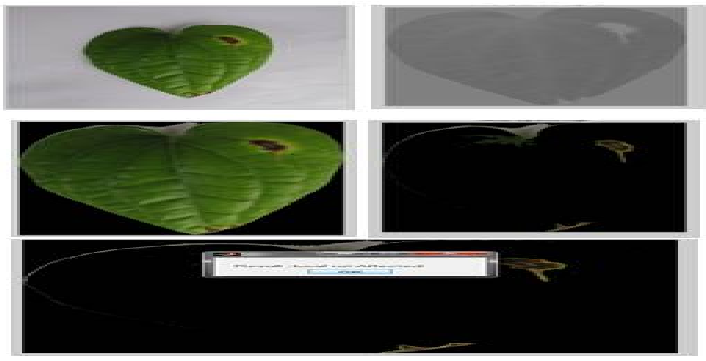

Fig. 4.4 Experimental result for diseased betel leaf

Step 7: Finally betel leaves were classified whether healthy or diseased.

B. Performance Evaluation

The various assessment metrics have been used to calculate and analyse our proposed Watershed transformation algorithm based on gradient features. The metric values like Sensitivity (SE), Specificity (SP) and Average accuracy (AC) are used to evaluate the performance of the Multiclass SVM classifier. The formulas are given in the Table 4.2. **Sensitivity** is the ability of a test to correctly identify those with the disease (true positive rate), whereas **Specificity** is the ability of the test to correctly identify those without the disease (true negative rate).Classification accuracy depends on the number of samples correctly classified.

Table 4.2 Evaluation Measures

Measures	Formula
Sensitivity	SE=TP/(TP+FN)
Specificity	SP=TN/(TN+FP)
Average Accuracy	(SE+SP)/2

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Confusion matrix is evaluated to make decision that can be made by classifier. We consider a confusion matrix illustrated in Table 4.3 where

- TP (True Positive) represents the number of healthy leaves correctly classified,
- FN (False Negative) refers to the number of diseased leaves misclassified as healthy leaves,
- FP (False Positive) expresses the number of healthy leaves misclassified as diseased leaves,
- TN (True Negative) refers the number of diseased leaves correctly classified.

Table 4.3 Confusion matrix

		Predicted	
		Healthy	Diseased
Actual	Healthy	TP	FP
	Diseased	FN	TN

C. Result Analysis

Table 4.4 describes the comparison of detecting betel leaf disease detection in existing and proposed system. The table contains Sensitivity, Specificity and Accuracy of the existing and proposed system.

Table 4.4 Performance Evaluation Metrics

Classification	Methods	Sensitivity (%)	Specificity (%)	Accuracy (%)
Multiclass Svm	Watershed Transformation Algorithm	100	91.67	95.85
	Colour Space Model	100	64.70	82.35

In the Figure 4.5 the sensitivity, specificity and accuracy values for the existing and proposed work are plotted based on Table 4.4. In the X- axis the existing algorithm (Colour Space Model) and the proposed (Watershed Transformation) algorithm are plotted and in the Y- axis values are plotted.

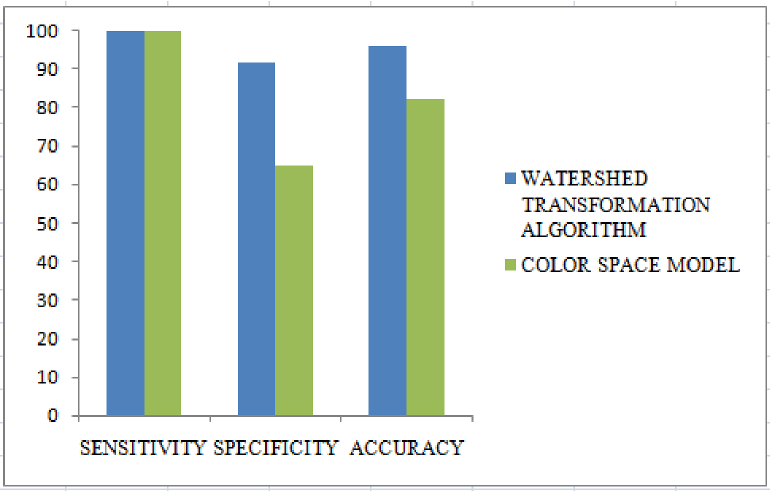

Fig 4.5 Graphical results of sensitivity, specificity and accuracy

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V. CONCLUSION AND FUTURE WORK

The proposed method is to classify the leaf rot, foot rot and powdery mildew diseases affected in the betel vine plantation. The watershed segmentation, Histogram of Oriented Gradients and Multiclass SVM classifier are the recent techniques involved in this research. From the performance evaluation of the accuracy values, it is concluded that the watershed transformation algorithm could detect betel leaf diseases efficiently at the accuracy rate of about 95.85 %. Through performance and evaluation, it is concluded that the proposed solution is feasible and is capable to reach much better classification result than the existing. This research work can be enhanced in the future with the following scopes:

- Minimum distance classification methods can be implemented to enhance the prediction accuracy.
- Threshold based segmentation methods can be implemented to enhance the segmentation accuracy.

REFERENCES

1. BarbedoEmbrapa J. G. A., [2016], "A Novel Algorithm for Semi-Automatic Segmentation of Plant Leaf Disease Symptoms using Digital Image processing", Agricultural Informatics, Springer.
2. Harmeet Kaur kelda, [2014], "A Review: Color Models in Image Processing", International Journal of Computer Technology & Applications, Volume 5 (2), 319-322.
3. Piyush Chaudhary Anand K. Chaudhari, Dr. A. N. CheeranandShardaGodara, [2012], "Color Transform Based Approach for Disease Spot Detection on Plant Leaf", International Journal of Computer Science and Telecommunications, Volume 3, Issue 6.
4. KaneshVenugoban and AmirthalingamRamanan, [2014], "Image Classification of Paddy Field Insect Pests Using Gradient-Based Features", International Journal of Machine Learning and Computing, Vol. 4, No. 1.
5. Shiv Ram Dubey, Anand Singh Jalal, [2012], "Detection and Classification of Apple Fruit Diseases using Complete Local Binary Patterns", Department of Computer Engineering and Applications GLA University Mathura.
6. Minggang Du , Xianfeng Wang ,[2011],"Linear Discriminant Analysis and Its Application in Plant Classification", School of Urban and Environment Science, Shanxi Normal University, Linfen, Shanxi 041004, P. R. China dumg966@163.com Xijing University Xi'an 710123, P. R. China.
7. Antonio Cezar de Castro Lima, Camila Baccili, [2014], "Segmentation of somatic cells in goat milk using color Space CIELAB", Journal of Agricultural Science and Technology.
8. NawarFdhal, Matthew Kyan, [2009], "Color Space Transformation from RGB to CIELAB Using Neural Networks", Springer Verlag Berlin Heidelberg.
9. Nassir Salman, [2006]," Image Segmentation Based on Watershed and Edge Detection Techniques", The International Arab Journal of Information Technology, Vol. 3, No. 2.
10. ManishaBhagwat, Krishna R K, [2010], "Image Segmentation by Improved Watershed Transformation in Programming Environment MATLAB", International Journal of Computer Science & Communication Volume 1, No. 2, pp. 171-174.
11. Dalal N, Triggs B, [2005], "Histograms of oriented gradients for human detection", IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'05), pp. 886-893.
12. Rafael C.Gonzalez& Richard E Woods [2000], "Digital Image Processing", Pearson Education Asia, Addison Wesley Publishing Company Inc.
13. Anil K Jain [2002], "Fundamentals of Digital Image Processing", Eastern Economy Edition, Prentice Hall of India Private ltd., New Delhi.
14. Histogram of oriented gradienthttp://en.wikipedia.org/wiki/Histogram_of_oriented_gradients.