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Identification and Classification of Rice Varieties using Neural Network by Computer Vision

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Abstract— In this paper, an algorithm for identification and classification of four different varieties of rice, using the color and morphological features is presented. The proposed algorithm consists of several steps:- Image acquisition, Image Segmentation, Feature Extraction, Feature Selection, identification and classification. The identification and classification is done using the Neural Network algorithm. The color features i.e.,(Red Green Blue) and morphological features i.e.,(Area, perimeter, MajorAxislength, MinorAxislength, eccentricity) are used for identification and classification purpose. RGB color modal is used. Neural Network is used as a identifier and also classifier.

Keywords— color features, computer vision, feature extraction, feature selection, image segmentation, morphological features, Neural network.

I. INTRODUCTION

Rice is one of the most important cereal grain crops. The quality of rice seeds has distinct effect on the yield of rice, so the proper inspection of rice seed quality is very important. Quality of rice grains is required for protecting the consumers from sub standards products because the samples of food material are subjected to adulteration. For the identification and classification purpose, four varieties of rice i.e., Basmati, Tural, 6622, 1509 are used.

Manual Identification of object is based upon traditional visual quality inspection performed by human beings, which may be tedious, time-consuming, slow, less efficient and non-consistent. The research of human-computer interaction is no longer the design of devices and psycho-logical experiments of windows layouts, but evaluates to a new stage: intelligent interaction. One aspect is that computers should be able to accept audio and visual sensory inputs, and then make some kind of analysis and interpretation, and then provide intuitive feedbacks by synthesizing speech, video or actions. Fundamentally, besides speech recognition, computers should be able to recognize, interpret and understand human actions and behaviors from visual inputs. Technological advancement is gradually finding applications in identification and classification of objects in industry for quality purpose. It is one of great challenge to meet this requirement. Identification and classification of objects is accomplished based on attributes like appearance, color, shape and sizes.

Rice quality inspection by humans (relying upon the naked eye) is neither objective nor efficient. Error creep in sometimes due to inexperience or the inspection may be deliberately shifted out of sympathy for the producers. In view of this, automated rice quality inspection using computer vision is desirable to perform fast and objective quality measurement.

The color of rice is one of the main factors of the evaluating the quality. While detecting the rice varieties by the color features, people adopt more RGB color space and HSV color space; in addition, L*a*b* color space is also commonly used to extract the color feature value [2,3].

During the last decades several studies have been carried out related to the application of machine vision for quality evolution, Zhao-yan et al., 2005 proposed a method of identification based on neural network to classify rice variety using color and shape features with accuracy of 88.3% [7]. Verma (2010) extracted six morphological features (area, perimeter, maximum length, maximum width, compactness and elongation) to classify three varieties of Indian rice. A neural network was used with an accuracy ranging from 90 to 95% [8]. In another research, Van Dalan (2004) developed a method for determination of the rice size and the amount of broken rice kernels using image analysis [9]. Regarding the quality evaluation of rice, a new method has been developed to estimate the breakage and fissures ratio [10].

In a primary study Zayas et al., 1989 used machine vision to identify different varieties of wheat and to discriminate wheat from non-wheat components [11]. In later research Zayas et al., 1996 found that wheat classification methods could be improved by combining morphometry (computer vision analysis) and hardness analysis. Hard and soft recognition rates of 94% were achieved for the examined seventeen varieties [12]. In 978-1-4577-1535-8/11/$26.00 ©2011 IEEE another report, the discrimination power of size, shape, color and texture for the identification of seeds of fifty seven weed species was assessed. Size and shape characteristics had larger discriminating power than color and texture ones. However, all of these features are required to reach an acceptable identification performance for practical applications [13].

In this paper, we propose a simple, effective and high accuracy vision-based approach using Neural Network techniques to identify and classify rice varieties. The specific goal was to generate the optimal color and morphological features for classifying the rice varieties with high accuracy using comparing the performance of the some feature selection algorithms during the classification process.

II. METHODOLOGY

The block diagram shown in Fig. 1 illustrates the procedure for recognition and classification of rice grains.

Block diagram of Image recognition and classification of rice grains

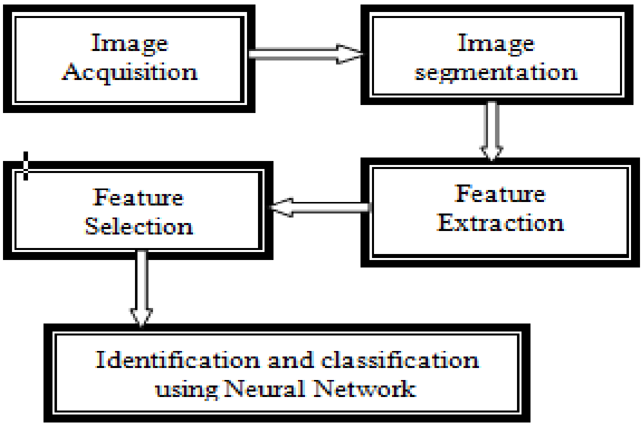


Figure 1

A. Image Acquisition

In this work, RGB is used. RGB color model is used because red, green and blue are three primary colors. These are pure colors, no white light mixed to them Many image segmentation approaches take advantage of this. Segmentation is usually performed in one color feature (hue) instead of three, allowing the use of much faster algorithm. A approach for classification of rice variety using Neural Network will be presented.
A CCD (charge coupled device) color camera (Model Canon EOS 5 D Mark III) with resolution of 1670 pixels×1259 pixels will used to record images. For image acquisition, a lens (Model Canon EF 75-300 f4-5.6 Mk III USM) with 102 mm focal length is fitted to the camera using an extension tube of 35 mm length. The camera is mounted on a stand which provided easy vertical movement and stable support for the camera. The exposure time is 1/125 sec. When the camera is fixed at the place 130 mm between the lens and the sample table, clear images of rice varieties is obtained.

(A) (B) (D) (C)

Figure 2. (A)Basmati (B) Tural (C) 6622 (D) 1509

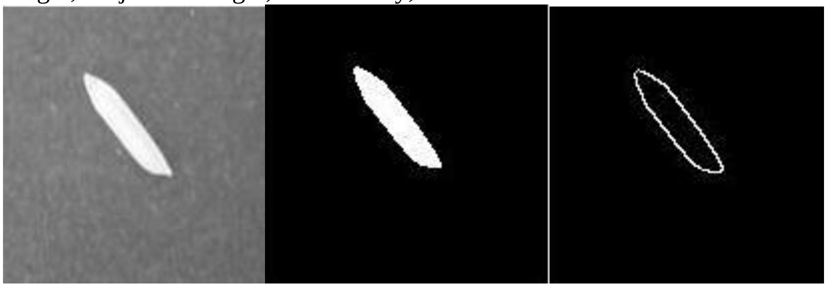
Every object could be situated in any random orientation and at any position inside the field of view. The background is a black paper. The color representation of objects of interest is relatively R (red), G (green), and B (blue) values at every pixel. The distant Gray level separation between background and objects made the image segmentation easier.

B. Image Segmentation

The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyse. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics.[1]
In this work, morphological features and color features (RGB features) are required to be extracted. So the image must retain the color information of the rice varieties when segmentation is processed.

C. Features Extraction and Feature Selection

There are two features extracted by the given flow chart i.e., Morphological feature and color feature. Initially, RGB image is taken as input sample. The input image is form of pixels. First feature was Morphological feature. For extracting the morphological feature, process was stared from reading the image. After reading the sample image, there was a need of conversion of RGB to GRAY image. Gray image is just retaining the luminance of the image (figure 3). Next step of conversion was Binarisation by thresholding(figure 4). In the binary image, it reduced the image into only two values (0, 1). Morphological Parameters were extracted by edge detection from binary image(figure 5). The selected parameters were Area, MinorAxislength, MajorAxislength, Eccentricity, Perimeter.



Figure(3, 4, 5)

Second feature to be extracted was the color feature. There were different color values of RGB pixels within the specified range according to pure image. It includes selection of region of interest from RGB input image (figure 6) and RGB components were extracted (figure 7) .

Figure 6

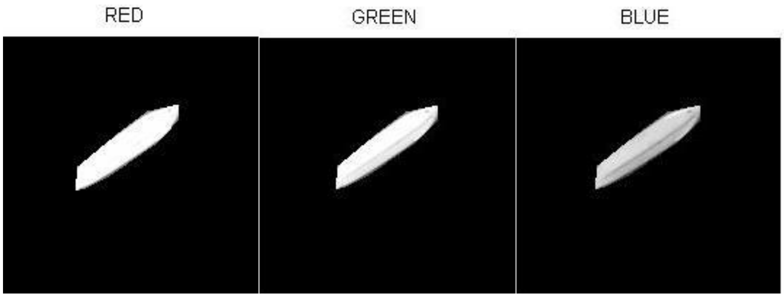


Figure 7

after selecting the selected parameters, Database was prepared. That database(figure 8) was used to train the neural network system for the purpose of identification and classification.

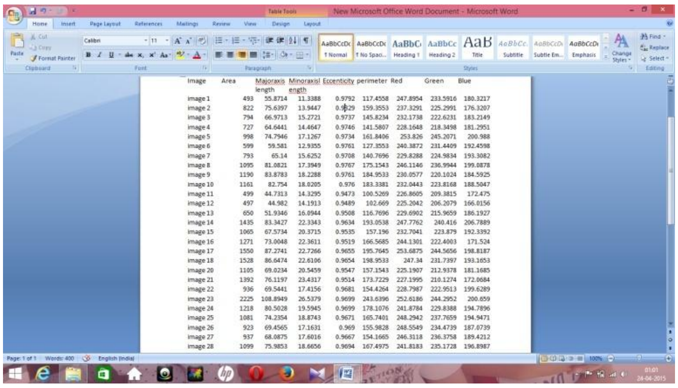


Image	Area	Majoraxis length	Minoraxisl ength	Eccenticity	perimeter	Red	Green	Blue
image 1	493	55.8714	11.3388	0.9792	117.4558	247.8954	233.5916	180.3217
image 2	822	75.6397	13.9447	0.9829	159.3553	237.3291	225.2991	176.3207
image 3	794	66.9713	15.2721	0.9737	145.8234	232.1738	222.6231	183.2149
image 4	727	64.6441	14.4647	0.9746	141.5807	228.1648	218.3498	181.2951
image 5	998	74.7946	17.1267	0.9734	161.8406	253.826	245.2071	200.988
image 6	599	59.581	12.9355	0.9761	127.3553	240.3872	231.4409	192.4598
image 7	793	65.14	15.6252	0.9708	140.7696	229.8288	224.9834	193.3082
image 8	1095	81.0821	17.3949	0.9767	175.1543	246.1146	236.9944	199.0878
image 9	1190	83.8783	18.2288	0.9761	184.9533	230.0577	220.1024	184.5925
image 10	1161	82.754	18.0205	0.976	183.3381	232.0443	223.8168	188.5047
image 11	499	44.7313	14.3295	0.9473	100.5269	226.8605	209.3815	172.475
image 12	497	44.982	14.1913	0.9489	102.669	225.2042	206.2079	166.0156
image 13	650	51.9346	16.0944	0.9508	116.7696	229.6902	215.9659	186.1927
image 14	1435	83.3427	22.3343	0.9634	193.0538	247.7762	240.416	206.7889
image 15	1065	67.5734	20.3715	0.9535	157.196	232.7041	223.879	192.3392
image 16	1271	73.0048	22.3611	0.9519	166.5685	244.1301	222.4003	171.524
image 17	1550	87.2741	22.7266	0.9655	195.7645	253.6875	244.5656	198.8187
image 18	1528	86.6474	22.6106	0.9654	198.9533	247.34	231.7397	193.1653
image 20	1105	69.0234	20.5459	0.9547	157.1543	225.1907	212.9378	181.1685
image 21	1392	76.1197	23.4317	0.9514	173.7229	227.1995	210.1274	172.0684
image 22	936	69.5441	17.4156	0.9681	154.4264	228.7987	222.9513	199.6289
image 23	2225	108.8949	26.5379	0.9699	243.6396	252.6186	244.2952	200.659
image 24	1218	80.5028	19.5945	0.9699	178.1076	241.8784	229.8388	194.7896
image 25	1081	74.2354	18.8743	0.9671	165.7401	248.2942	237.7659	194.9471
image 26	923	69.4565	17.1631	0.969	155.9828	248.5549	234.4739	187.0739
image 27	937	68.0875	17.6016	0.9667	154.1665	246.3118	236.3758	189.4212
image 28	1099	75.9853	18.6656	0.9694	167.4975	241.8183	235.1728	196.8987

Figure 8

D. Object identification and classification

In this work, Neural network was used for object identification and classification. Neural network model was designed and developed using Matlab 7.10 toolbox. Database contain the combined features of morphological and color feature. In this neural network, there is one input layer having number of neuron, hidden layer, and output layer. Neural network is used Back propagation learning process.

In general, the neural network with too few hidden neurons will not have a sufficient capability to represent the input-output relationship accurately. Contrarily, the network with too many hidden neurons many lead to a problem of data over fitting, and affect the system's generalization capability [19].
Hence, determining the optimal number of hidden neurons is very crucial step in designing classifiers. However, such a determination is not an easy task since it depends largely on experience and trial and error method. The validation process of database has been carried out using the mean square error of the classification result of different neural network structures.

III. RESULTS AND DISCUSSION

The computer vision system was designed for identification and classification purpose. With four rice seed of different quality,40 images are taken ,10 for each rice seed from different position of rice at different angle from same distance using computer vision system and Neural Network was implemented for identification and classification of rice seed. In this, training algorithm was based on using Levenberg Marquardt and performance is based on the mean square error. Error should be minimized for best linear relationship. Figure 9 shows the trained network system.The network was trained , validate , test on given parameters ; then regression (relationship between input and output) is approx. 89.7%.

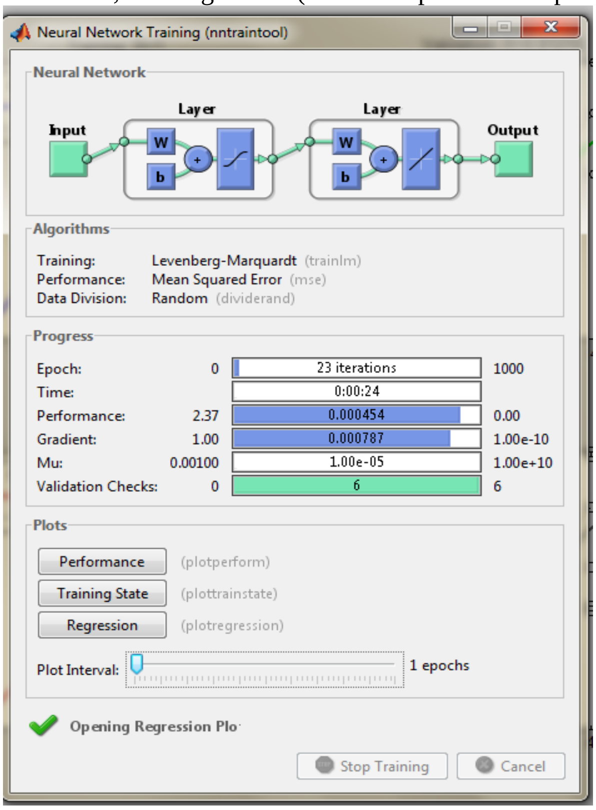


Figure 9

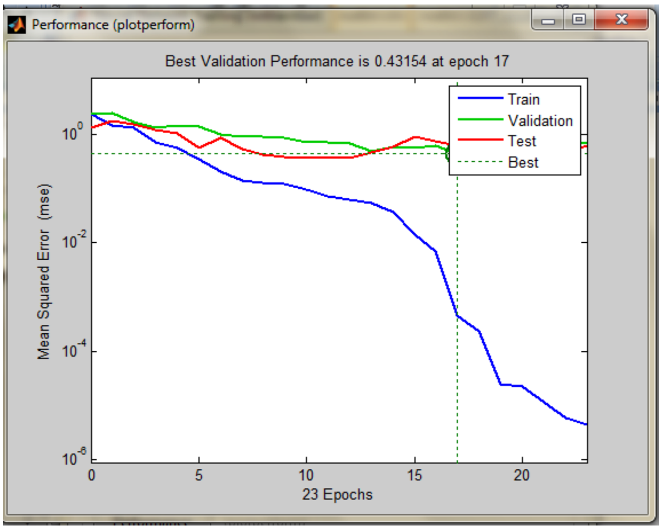


Figure 10

Figure 10 shows the performance of the trained network system. In this, MSE should be minimized.

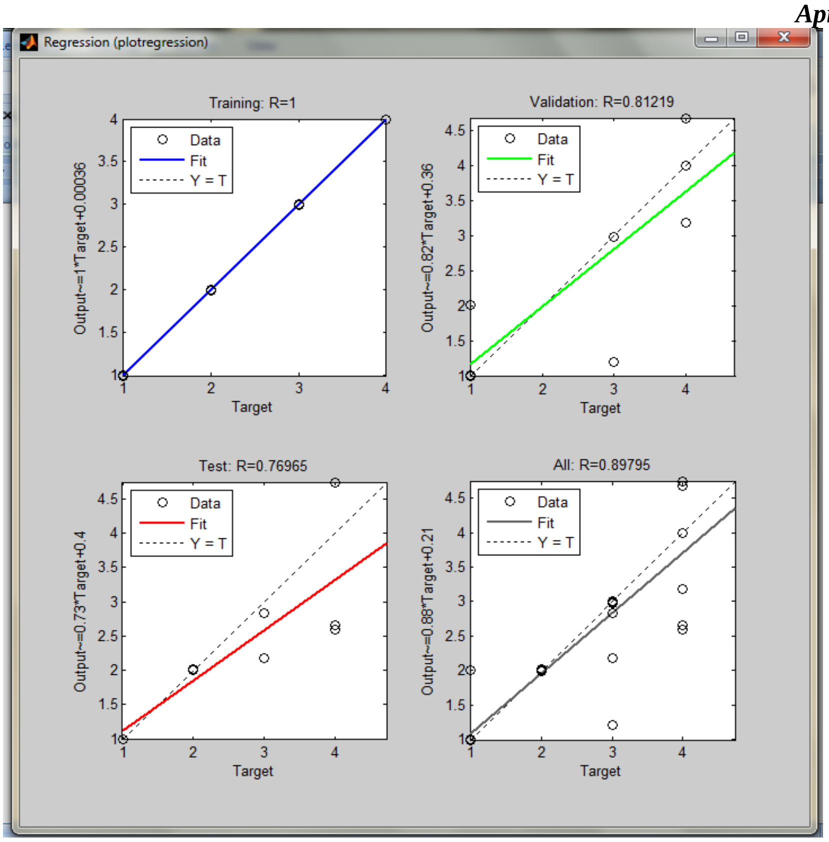


Figure 11

Figure 11 shows the best relationship between target and output. The regression is 89.7%. In this, training is done 100%. testing is done 76.96%. so the overall classification and identification is based on training and testing dataset.

IV. CONCLUSION

The processing of imagery and the vigilant assortment of the variety measured in this effort for extracting features from rice granules significantly abridged the intricacy of the identification and classification problem. Neural Network Pattern Recognition Tool is lucratively applied to classify and identify the varieties of rice seed. The developed Neural Network is based upon back propagation Neural Network. It is able to classify and identify fast and accurate. the overall classification and identification accuracy is 89.7%.

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