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Characteristic Recognition of copra using Image processing.

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***Abstract*: Agriculture is a largest economic sector in India. Coconut is one of the fruit which have more demand. The dried coconut is copra which is the source of a coconut oil. It contains 70% of moisture content and it is dried to 7% for production of coconut oil. The sulphur is added as preservative because it acts as anti-microbial preventing bacteria, fungus etc….It is toxic food preservative it restricts lung performance and direct allergen. The survey of world health organisation (WHO, 1999) says 65% of asthmatic children sensitive to sulphur and affects 75% of children in their behavioural. The sulphur fumigation over coconut provides a toxic effect. In order to prevent this copra is examined under image processing using MATLAB. In this paper image processing techniques such as segmentation, feature extraction and classification is carried out to differentiate the sulphur and normal copra images. The result shows 70% accuracy in classifier in detection of sulphur and normal copra images.**

***Keywords*: copra; WHO; moisture; fumigation; sulphur.**

I. INTRODUCTION

India is third largest country of producing coconut. Copra is the source of coconut oil. It is dried under open sunlight on the drying yard which made by granite or cement. The pre-processing of drying includes cracking and shelling. The post-processing includes the fumigation of copra under sulphur. The sulphur fumigated copra forms a sulphur patch which looks similar to normal copra. The sulphur patch is differentiated by basic segmentation process such as active contour and threshold based segmentation.

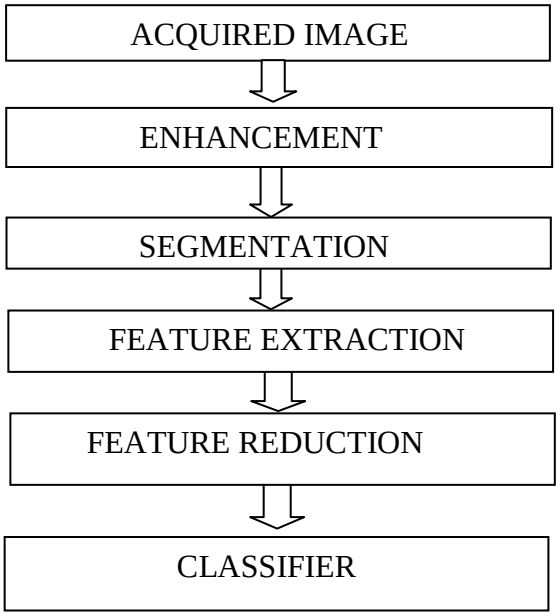
The feature is extracted from both sulphur and normal copra by using various features such as GLCM, intensity, shape. The GLCM features extract the Contrast, Correlation, Energy and Correlation. The intensity feature like Median, Mean, Standard Deviation, Entropy and Maximum Intensity Region is measured. The shape features measures the Area and perimeter of copra. The extracted features is reduced and applied to classifiers. The ANFIS classifies the image with the accuracy of 35% and K-NN classifiers used to classify the sulphur and normal copra by accuracy of 75%. This paper proposes the classification of sulphur and normal copra by classifiers.

II. METHODOLGY

The acquired image is preprocessed and segmentation is carried out to differentiate the copra and feature is extracted to classify the sulphur and normal image.

The methodology follows here to differentiate the copra by normal image segmentation method. The basic segmentation and feature extraction with classifier differentiate the copra. The methodology explained in flow graph which explains the proposed work.

The enhancement removes the noise and segmentation differentiates the sulphur and normal copra. The feature is extracted to classify the sulphur and normal copra by classifiers.



III. ACQUIRED IMAGE

The database of image is collected from a coconut oil industry. It has a resolution of 3200*2400.The both sulphur and normal copra is dried for 2 days. The sulphur copra is maintained in sulphur condition for 1 day and processed to drying. The normal copra is directly undertaken to drying.

IV. ENHANCEMENT

The acquired image is not chosen for process directly. It includes conversion of RGB to grey, background elimination and filtering of image. The filtering involves removing the noise. The filters used are median filter and adaptive local filter.

A. Median filter

The median is calculated by first sorting all the pixel values from the window into numerical order, and then replacing the pixel being considered with the middle (median) pixel value. The median filter gives the PSNR value as 8.7432. The median filter removes the noise efficiently as in the example [1]

B .Adaptive local filter

The Adaptive filter is performed on the degraded image that contains original image and noise. The mean and variance are the two statistical measures that a local adaptive filter depends on. The adaptive local filter gives the PSNR value 13.45.The adaptive local filter removes the noise efficiently shown in [2].

V. SEGMENTATION

The segmentation is process to separate the sulphur patch from its back ground and to differentiate the copra. The active contour is used to separate the patch from white layer of copra. The threshold is basic segmentation used to differentiate the sulphur fumigated and normal copra.

A . Active Contour

Active contour segments the 2-D grey scale image into foreground (object) and background regions. Normally sulphur fumigation over coconut forms a sulphur patch on the white layer of coconut. The active contour separates the sulphur patch (foreground layer) from white layer (background layer). The mask is applied on coconut to separate the patch from its background. The mask separates the region of patch from the background shown in Fig.1.

Fig .1. Active contour of sulphur copra

B. Threshold Based Segmentation

Threshold is the simplest method of image segmentation as shown in [3]. From a grey scale image, threshold can be used to create binary images. Threshold segmentation highlights the low intensity region by threshold. The threshold is set to

100. When T<100 it highlights the region of low intensity. The low intensity region has low content `of sulphur. The region of T>100 is not highlighted which has more sulphur content. The threshold value is tested for 50 to 150.

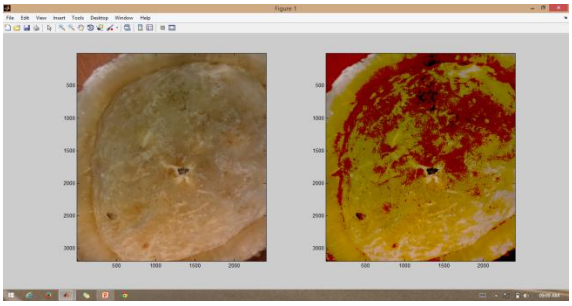


Fig.2 Threshold based segmentation of normal image.

The threshold value is set as 100 and checked for sulphur content copra region is highlighted and sulphur content area is not highlighted and visible as white is shown in Fig 3

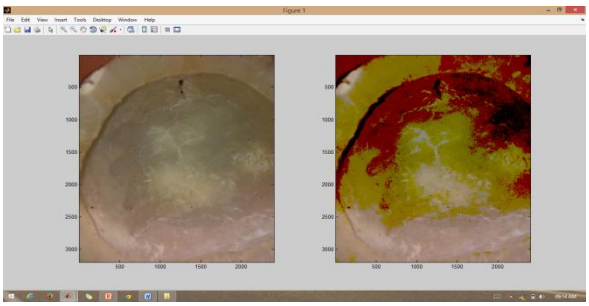


Fig **3** threshold based segmentation of sulphur image

VI. FEATURE EXTRACTION

The feature of normal and sulphur fumigated coconut is measured. The feature measures the different properties of coconut, which helps to classify the normal and sulphur coconut shown in [4]. The different types of feature is extracted such as

1. GLCM feature
2. Intensity feature
3. Shape feature

A. GLCM Features

The GLCM matrix is created by occurrence of matrix (i) with (j) horizontally. The GLCM features measure the contrast, correlation, energy and homogeneity shown in ([4],[6])

$$\text{Contrast}=\sum_{i=0}^{N-1}\sum_{j=0}^{N-1} P(i,j)(i-j)^2$$

$$\text{Energy}=\sum_{i=0}^{N-1}\sum_{j=0}^{N-1} P(ij)^2$$

$$\text{Entropy}=\sum_{i=0}^{N-1}\sum_{j=0}^{N-1} P(i,j)\log p(i,j)$$

Where i, j is a grey level pairs, p is a GLCM element. P,d (i, j) is the joint probability of the grey level pairs i and j in a given direction.

The GLCM features of sulphur & normal image are displayed in TABLE 1&2.

TABLE I GLCM Feature of normal copra

Features	**Image1**	**Image2**	**Image3**
Contrast	0.0124	0.0260	0.0225
Correlation	0.9830	0.9915	0.9733
Energy	0.5149	0.2807	0.4540
Homogeneity	0.9944	0.9910	0.9918

TABLE II GLCM Feature of sulphur copra

Features	Image1	Image2	Image3
Contrast	0.0356	0.0176	0.0422
Correlation	0.9734	0.9972	0.9699
Energy	0.3655	0.2864	0.3797
Homogeneity	0.9869	0.9938	0.9405

Contrast

The contrast of sulphur and normal copra are similar. The value of contrast for sulphur image lies from 0.02 to 0.04. The contrast of normal image is similar to sulphur image which lies from 0.02 to 0.05. The contrast measures the value of illumination of image which is similar for both images.

Correlation

The correlation of image is difference between the each pixel values. The correlation of image for sulphur and normal copra is 0.9. The correlation of image is similar for sulphur and normal copra image.

Energy

The energy of image has slight difference between sulphur and normal copra image. The variation is too small to classify the image.

Homogeneity

The homogeneity of image has the value 0.9 for sulphur and normal copra image. There is no variation between the images. The homogeneity is not applied for classifiers.

B. Intensity Feature

Pixel intensities are simplest available feature which measures entropy, mean standard deviation and median as shown in ([4],[8]). The intensity features has more difference between the normal and sulphur fumigated images. Standard deviation and median has less similarity between sulphur and normal image. Maximum intensity displays the maximum point in the image. Intensity is higher for sulphur fumigated image and less for normal coconut image.

Entropy

The entropy of sulphur image is 5.2 to 6.5 and normal image has value from 5 to 7. The both feature are similar in values and not used for classification process.

Mean

The mean of the image is average of points in image. The mean of the sulphur image is coinciding with normal copra image. The coincide results in worst classification.

Standard deviation

The standard deviation is mean square value. The standard deviation of sulphur image has the value 20 to 80 and the normal image has the value up to 22. The feature has more difference and applied for classification.

Median

The median is a middle value of intensity. The median values lies from 125 to 200 for sulphur copra and 70 to 120 for normal copra images.

Maximum Intensity

The maximum value of intensity lies from 200 to 270 for sulphur copra and for normal copra it lies from 170 to 220. The difference of sulphur and normal copra is high and it is applied to classifiers.

The intensity features are displayed in TABLE 3&4. The intensity of sulphur and normal copra is measured and found that it is suitable for classifiers.

TABLE III Intensity Feature of sulphur copra

Features	Image 1	Image 2	Image3
Mean	117.274	68.1664	116.73
Standard deviation	48.1332	47.76	62.144
Median	143	200	213
Maximum	223	244	253

TABLE IV Intensity Feature of normal copra

Features	Image 1	Image 2	Image3
Mean	119.45	75.859	116.73
Standard deviation	15.530	17.64	19.044
Median	72	98	110
Maximum	203	174	200

C. Shape features

Shape feature measures Area, perimeter as shown in ([5],[7]). In this application only area is measured by converting the image into BW image. The area of sulphur content is differing between sulphur and normal copra. The area is shown in TABLE 5

TABLE V Area of Copra

Features	Image 1	Image 2
sulphur	2.6e+06	6.05e+05
Normal	2..4e+05	1.3e+05

VII. FEATURE REDUCTION

The mean is calculated for 30 sulphur and normal image. The feature is reduced by choosing the feature has high difference as shown in [9]. The feature with high difference is proposed to classifiers. The reduced features are

1. Standard deviation
2. Median
3. Maximum intensity

The reduced features are shown in TABLE 6

TABLE VI Reduced feature

FEATURES	DIFFERENCE
Contrast	0.0002
Correlation	0.00384
Energy	0.08
Homogeneity	0.0022
Entropy	0.1500
Mean	0.33
Standard deviation	**13.598**
Median	**20.12**
Max intensity	**19.4**
Min intensity	1.7
Area	3.18

VIII. CLASSIFICATION

The classification is to classify sulphur and normal coconut by various classifiers. The classifiers are

1. ANFIS
2. K-NN Classifiers

A .ANFIS

An adaptive neuro-fuzzy inference system or adaptive network-based fuzzy inference system (ANFIS) is a kind of artificial neural network that is based on Takagi–Sugeno fuzzy as shown in [10]. The ANFIS classifier is used to classify the testing database. The feature is trained in workspace and testing database is given by image. The test image compared with trained database and result of classification is shown in Fig 5 as GUI. Totally 30 image is trained and 12 image is tested. The image correctly classified is only 4.

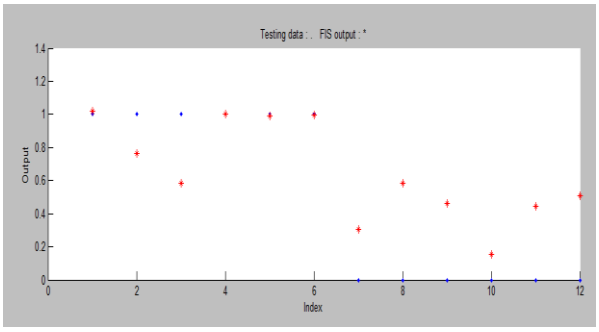


Fig 5 ANFIS classifiers output.

D Error Factor

The ANFIS classifiers, classifies with some error values. The classification is calculated by different membership function. The GBELL membership function has less error and accuracy measurement is taken for GBELL membership function. The error values of different membership function is shown in Table 7

TABLE VII Error Factor for Different Membership Function.

S.no	Membership Function	Error Values
1	TRIMF	0.3657
2	TRAP	0.3569
3	GBELLMF	**0.3345**
4	GUASS MF	0.3574
5	PIMF	0.36274

C Accuracy Measurement

The accuracy measurement is taken from the output of classification. The true positive and true negative values is calculated from classification part and accuracy is shown in TABLE 8

TABLE VIII Accuracy measurement

S.no	Classification parameter	Test images
1	True positive	4
2	True negative	5
3	False positive	3
4	False negative	0
5	Accuracy (%)	30%

The database is trained in work space with different membership function and only 30% of trained database are classified accurately and this

method does not have efficiency for this proposed method.

E K-NN Classifier

An object is classified by a majority vote of its neighbors, with the object being assigned to the class most common among its *k* nearest neighbors as shown in [10]. K-NN classifies the 10 input tested samples by comparing 30 trained features. The image is given as tested samples and it measures the true positive, negative and measures the accuracy of a classifier. The accuracy is 70% in K-NN classifier. The K-NN classifier displays the output as suphur or normal coconut image. Accuracy of classifier is shown in Table 9

TABLE IX Result of K-NN classifier

S.no	Classification Parameter	Test Images
1	Feature Extracted	3
2	Featured Trained	30
3	Samples Tested	10
4	True Positive	7
5	False Positive	3
6	Accuracy (%)	70%

Totally three feature is extracted and trained feature is for 30 images. The 10 sample is tested against trained features. Seven images is correctly classified and the value is stored as true positive. The false positive of classifier is 3. The accuracy is calculated as 70%.

IX Comparison of Classifiers

The two types of classifiers are proposed. The ANFIS and K-NN classifier is used to classify the sulphur and normal copra. The ANFIS gives only 30% efficiency in classification so K-NN classifier is proposed. The K-NN gives 70% efficiency in classification and it is used to differentiate between the sulphur and normal copra images. The comparison of classifier is shown in Fig 4

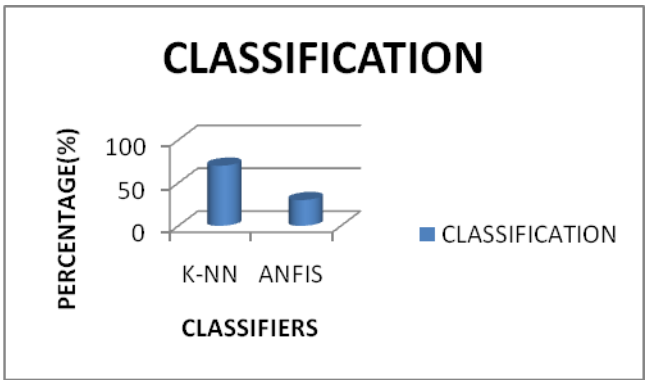


Fig 4 Comparisons of Classifiers

X CONCLUSION

The digital image processing that prepared grading factors which implement different algorithms and methods and the second part is classification that will also enhances the classification system and makes it moves like the human classifiers. The segmentation provides the differentiation of sulphur patch from coconut. Then extract several image features from the resulting segments, and assign the fruits to the corresponding quality categories using statistical and syntactical classifiers. The extraction of feature is based on GLCM, shape and intensities. The highest performances are achieved by statistical classifiers and the results are significantly different. The result proves that intensity feature based k-NN is giving higher classification rate of 73%. The intensity gives a better performance when compared with GLCM and shape features. Thus classification of sulphur content coconut is done and it helps for normal people.

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