Quality Analysis and Grading Of Soybean Using Image Processing

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***Abstract*— The use of good quality seed is important for the satisfactory production of a good quality crop and is essential for export in markets. Quality control is very important in food industry because based on quality of food products are classified and graded into different grades. Soybean is primarily graded based on its grain shape, colour, size and texture. This paper attempts to automate the grading process by using image processing and machine vision techniques. Soybean's grade is affected by damaging, decolourization, infection by insects, immaturity and shrivels, splitting, breaking, cracks, inorganic and organic foreign matter present in the sample. One of the objectives of this paper is to study the effect of these parameters on shape, colour, size and texture of the soybean image. In the present soybean-handling scenario, type and quality are identified manually by visual inspection which is tedious and not accurate. There is need for the growth of fast, accurate and objective system for quality determination of food grains. This paper proposes a model that uses colour and geometrical features as attributes for classification using image processing techniques and artificial neural network. This method requires minimum time and it is low in cost.**

***Keywords*—ANN, Grading, Image Processing and Analysis, Soybean,**

I. INTRODUCTION

Soybean has an important place in world's oilseed cultivation scenario, due to its high productivity, profitability and vital contribution towards maintaining soil fertility. The crop also has a prominent place as the world's most important seed legume, which contributes 25% to the global vegetable oil production, about two thirds of the world's protein concentrate for livestock feeding and is a valuable ingredient in formulated feeds for poultry and fish. Soybean contributes significantly to the Indian edible oil pool. Presently soybean contributes 43 % to the total oilseeds and 25% to the total oil production in the country. Currently, India ranks fourth in respect to production of soybean in the world. The crop helps earn valuable foreign exchange (Rs. 62000 millions in 2012-13) by way of soya meal exports. Soybean has largely been responsible in uplifting farmer's economic status in many pockets of the country. It usually fetches higher income to the farmers owing to the huge export market for soybean de-oiled cake. While on one hand production of Soybean in India has increased at a CAGR of 9.60 per cent from 6.87 million tonnes in 2004-05 to 15.68 million tonnes in 2012-13. On the other hand Soybean meal consumption has also increased at a CAGR of 10.82 per cent over the last eleven years from 1365 thousand million tonnes in 2004-05 to 4225 thousand million tonnes in 2014-

15. Therefore to keep pace with the increasing demand it is imperative to increase the productivity level of Soybean in the country. Production of soybean in India is dominated by Maharashtra and Madhya Pradesh which contribute 89 per cent of the total production. Rajasthan, Andhra Pradesh, Karnataka, Chhattisgarh and Gujarat contribute the remaining 11 per cent production. Because of this global demand of soybean market increasing day by day we need to improved quality of soybean by using image processing for better result than that of the manual inspection. In the present soybean-handling scenario, type and quality are identified manually by visual inspection which is tedious and not accurate. There is need for the growth of fast, accurate and objective system for quality determination of food grains. This paper proposes a model that uses colour and geometrical features as attributes for classification using image processing techniques and artificial neural network. This method requires minimum time and it is low in cost.

II. LITERATURE REVIEW

Timothy J. Herrman, Extension State Leader Grain Science and Industry Carl Reed,[1] Extension Specialist, Grain Storage Grain Science and Industry from Kansas State University Agricultural Experiment Station and Cooperative Extension Service have proposed soybean grading procedure on the basis of 1. Classes as yellow soybeans and mixed soybeans. 2. Damaged kernels 3. Foreign material 4. Heat-damaged kernels 5. Soybeans of other colours they Examine the sample for heating, odour, animal filth, castor beans, crotalaria seeds, garlic, glass, insect infestation, purple mottled and stained, smut, stones, unknown foreign substances, and other unusual conditions. Divide out a representative portion from the sample and determine its moisture content. Determine the test weight per bushel of the sample. When deemed necessary, divide out representative portions and determine the percentage of class, damaged kernels, heat-damaged kernels, foreign material, oil, protein, soybeans of other colours, and splits. All these procedure is done by manual inspection.

In india According Agmark specifications[2] The Agmark grade standards for Soybean notified under the Agricultural Produce (Grading and Marking) Act 1937 by the Central Government (Directorate of Marketing and Inspection) are given on the basis of Oil content on dry basis percent by weight, Acid value of oil, Moisture content percent by weight, Damaged, discoloured, insect infested beans percent by weight, Immature, shrivelled beans percent by weight, Splits, broken, cracked beans percent by weight Inorganic foreign matter percent by weight, Organic foreign matter percent by weight they proposed maximum limits of tolerance(percentage by weight per quintal).Also this procedure is all done by manual inspection.

Salome Hema Chitra,S.Suguna and S.Naganandini Sujatha[3] have proposed A Survey on Image Analysis Techniques in Agricultural Product In this work, they implemented a five processing module for seed identification. Seed image has taken for the basis of image acquisition and then a seed image is pre-processed by noise removal and image enhancement. Enhanced image goes through the processes of edge detection and segmentation. From the segmented image extract features like colour, shape and texture for normal and defected seed which may help to identify the seed by image analysis techniques.

D. Wang, M. S. Ram, F. E. Dowell [4] have proposed Classification of damaged soybean seeds using near infrared spectroscopy. They were classify sound and damaged soybean seeds and discriminate among various types of damage using NIR spectroscopy.

III. MPORTANTENCE OF QUALITY OF SEED

In the past few years, the soy crop has become very important for farmers due to its comparatively better market value and its short duration, which ensures farmers quick cash returns. A recent report by the government Seed Testing Laboratory at Nagpur says that the germination rate of seed is about 75%. with some samples showing a germination rate as low as 40 % It is being very important to use quality of seed for farming. Using quality seed can increase your yield between 5 and 20 percent. Using quality of seed we will save money as inputs to the crops and will get higher production.

IV. IMAGE PROCESSING ECHNIQUES FOR SEED EXTRACTION

Soybean is one of the most important oil crops in India. The quality of Soybean seeds has major effect on the yield. So the proper inspection of Soybean seed quality is very much important now days. The purity of seed is one of the factors whose inspection is more difficult and more complicated than that of other factors. Presently, the identification of Soybean seed variety mainly depends on chemical method and manual inspection method but they have many limitations. These methods are only used to find out general grading of quality of seeds but using image processing and artificial neural network we can uses colour and geometrical features as attributes for classification and grading the soybean seed. This method requires minimum time and it is low in cost.

V.PROPOSED METHODOLOGY

In the proposed method we have considered soybean grain samples. Each of these grains are further classified and graded into grade 1, grade 2 and grade 3. In the Manual process grading is done manually. Based on the features like colour, shape, mature, dried, clean, uniform size, odour, experts grade the grains. The same features are used in automated method for grading of the grains. Fig.1 shows Grading of Soybean.

Grade 1

Grade 2

Grade 3

Fig. 1 Grading of Soybean manually classified

VI. BLOCK DIAGRAM

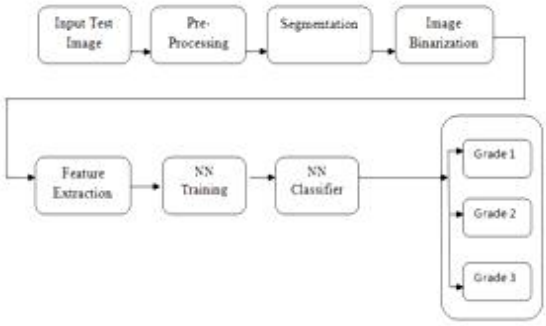

Fig 2: Proposed Block Diagram of the Grading

Figure 2 shows the actual block diagram of the grading system.

VII. ALGORITHM AND FLOW CHART

- Pre-process the images of grain to remove background noise.
- Convert the pre-processed image to binary image using Otsu method.
- Region label the binary image.
- Segment/crop the individual grains present in the

image.

- ❖ Extract the geometric features of soybean seed.
- ❖ Train Artificial Neural Network
- ❖ Use ANN Classifier to Divide image into different quality Levels
- ❖ Stop

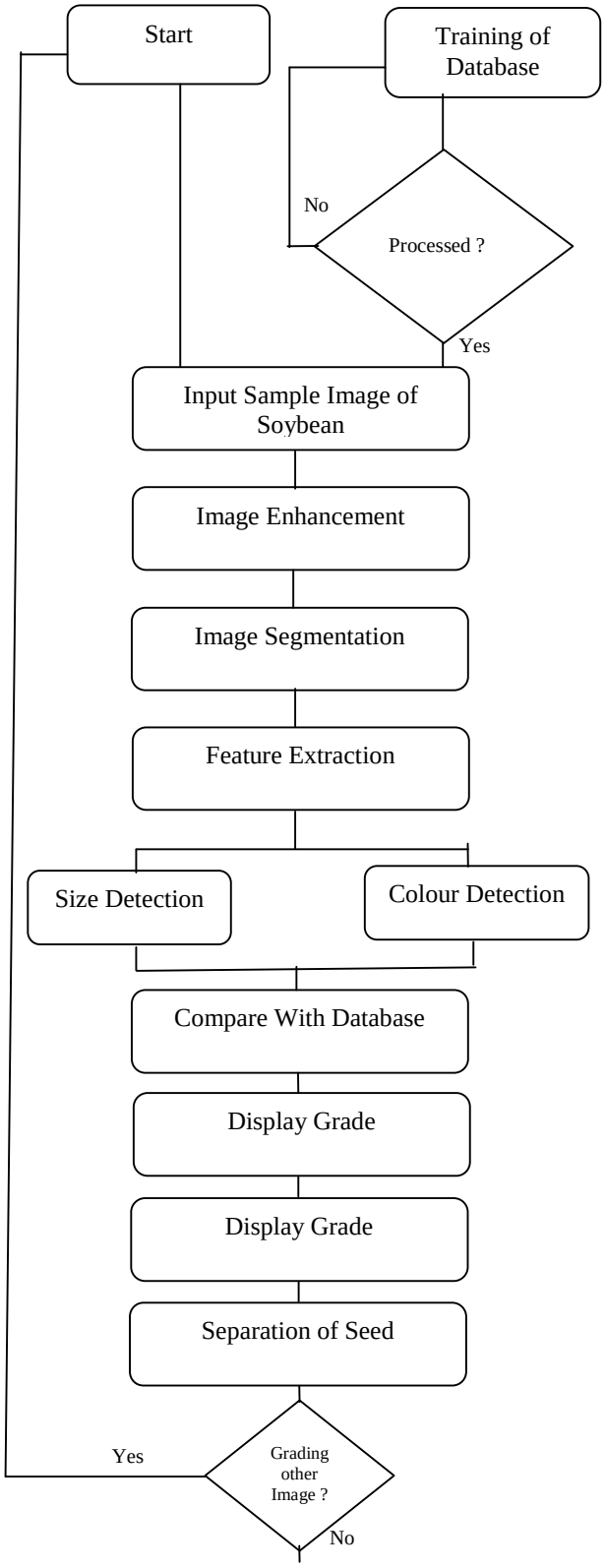

Fig: 3 Proposed Flow Chart

VIII.CRITERIA USED FOR GRADING

Images are acquired using high resolution camera. The soybean samples are placed on the sheet of the paper and the images were captured. The camera was placed at a position normal to the soybean samples. The images were stored in JPG format. A data set of different set of images was created manually, the steps involved here are input image, pre processing, grain extraction, counting, analysis and results. The work focused quality analysis on the basis of the measurement of physical parameter i.e. grain size,colour and shape using image processing techniques.

The work focused quality analysis on the basis of the Morphometry (from Greek "morphé," meaning "shape" or "form," and "metría," meaning "measurement") is the quantitative measurement of shape. Technically, the data for shape analysis may be obtained in two ways: manual and computational. The simplest way is to measure seed length and width with calipers. However, manual methods have limits to the number of data, the quality of measurements, and the variety of shape data that can be generated and processed. By contrast, computational methods using digital imaging technology enable to measure automatically a variety of shape parameters at very small sizes in high-resolution images of large populations. In general, seed shape can be scored as a combination of magnitudes, or by a single magnitude that indicates the percentage of similarity to a given geometric object. Seed shape can be determined by the length/width ratio called Eccentricity Index

$$\mathrm{EI} = \frac{L}{W}.$$

Eccentricity Index is related with the aspect ratio (Image), the aspect ratio of the particle's fitted ellipse is given by

$$\mathrm{AR} = \frac{\text{Major Axis}}{\text{Minor Axis}}.$$

Flatness Index (FI) is based upon the relationship between the particle dimensions along the three principal axes to characterize seed shape. The index is given by

$$\mathrm{FI} = \frac{(L+W)}{2H},$$

Where L, W and H are the length, width, and height of the seeds, respectively. It ranged from a value of 1 for spheres to values greater than 2 for spindly seeds. The following shape descriptors are useful.

1. Circularity index or form factor is as follows

$$I = \frac{4\pi \times \text{area}}{\text{perimeter}^2}.$$

This index (I) is a measure of the similarity of a plane figure to a circle. It ranges from 0 to 1 giving the value of 1 for circles and it is a useful magnitude as a first approximation to seed shape. In figures having many small protuberances through the

surface, the perimeter increases and circularity index has lower values. In these instances it is advisable to use roundness, because this magnitude is independent of such perimeter irregularities.

2. Roundness is given by as follows

$$R = \frac{4 \times \text{area}}{\pi \ [\text{Major axis}]^2}.$$

3. Rugosity or roughness is defined as the ratio of the perimeter to the convex perimeter

$$I = \frac{P_s}{P_c},$$

Where Ps is the perimeter of the seed and Pc is the convex perimeter of the seed, also known as convex hull, that is, the smallest convex figure that contains all the points of an image.

IX. CONCLUSION

This paper will uses colour and geometrical features as attributes for classification using image processing techniques and artificial neural network. This method requires minimum time and it is low in cost. As per the literature survey many authors grades the soybean by physical separation by the human and image processing tools. It has been proposed in this paper not only grading of soybean but also separate the good quality of soybean depends upon morphological features by using image processing and neural network. Various samples are considered of soybeans, Morphological and color features are extracted from the images and are stored in the knowledgebase. A probabilistic neural network (PNN) is predominantly a classifier that maps any input pattern to a number of classifications with samples. The expected output is much better than the previous methods.

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