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Grain Analysis Strategies

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Abstract - Agricultural product grading is helpful in assessing the quality of a product and classifying it into categories. Presently, the grade analysis procedures involve the manual analysis of grains which is highly subjective and is influenced by human factors and working environment. Thus, determining the quality of grains is a big challenge. In this paper, we have proposed a system that determines the quality of grains using image processing techniques. A variety of approaches were utilized to automate the screening process through machine vision approaches. Initially, the grain samples run on the conveyor belt and then random images of grains are captured by the camera. The image processing algorithm is applied on the grain samples through MATLAB. Quality analysis of rice grain is determined by morphological features of rice grains. Various standards and procedures are then used to determine grades for the sample under test. The process of grading helps farmers to get the value for their produce, particularly rice, depending upon the results of quality inspections. Deep learning and machine learning models involving image processing has been tried in this paper to observe the computational accuracy.

Keywords: Image processing, Machine learning, KNN, Deep learning, RNN

I. INTRODUCTION

Grains are the prime crop for our country to increase the agricultural income. Also, yield is the most noticeable characteristic to farmers while the crop is in the ground, but when the milled rice reaches the market, quality becomes the key determinant of its sale-ability. These grains consist of several impurities like stones, weed seeds, chaff, and damaged seeds etc. The automation level of testing quality of grain is low and most work is done by manpower. The workload is so mass that it will lead to worker's fatigue and need them to have sample testing experience. And it also makes the testing more costly and long to be made. With the development of import and export trade this contradiction is more and more outstanding. During grain handling operations, types of grain and their quality is required at several stages before the next operation can be determined and performed. In the present grain handling system, grain type and quality are rapidly assessed by visual inspection. This analysis process is, however, tedious and time consuming. There is no convenient method to identify these inferior quality grains in the market. Therefore, this has become a serious issue for the consumer. The farmers are affected by this manual activity. Therefore, it is required to explore the possibility of using technology for a suitable solution. The accuracy of quality checking by using manual method is varied from person to person and it also depends on working stress, persuasion and loyalty for traders and also the knowledge and experience of inspectors are required to accurately perform this evaluation process. The purpose of the image processing techniques is testing the quality of the rice grain. The quality of the rice grain is based on the several parameters. Such as grain color, shape, and the size. Recent developments in the field of image processing have opened up a wide scope of its use for sample analysis tool. Various applications in image processing are recorded in the field of agriculture, biomedical engineering, food and drug industry and many others. Food application mainly caters the qualitative aspect of various food and dairy producers. Image processing techniques were developed to classify plants and background pixels in images of rice plants acquired in a field experiment. Conventional standalone image processing techniques are precise in accuracy and demands for latest technologies. Machine learning and deep learning models enhances the classification process and results in improved accuracy. In this paper, automation of the system is done and classification accuracy is compared.

II. SYSTEM MODEL

In this paper, automated grain analysis models are build using image processing, machine learning and deep learning models. Selfsame dataset processing is used for training with machine learning and deep learning models.

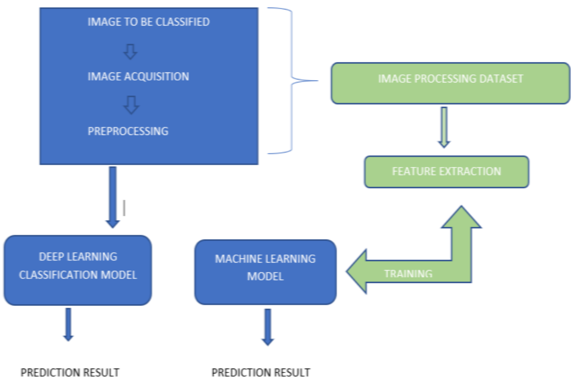

Fig. 2.1 System Model

Grain dimensions and parameter analysis can be accomplished using image processing techniques. Dataset created can be utilized for predicting a machine learning based model. The raw dataset is fed to deep neural networks for improved processing. Dataset classification is done and classification accuracy is compared.

III. PREVIOUS WORK

1.Quality Analysis of grains using ANN and SVM.

The paper presents an automated rice quality assessment system based on ANN and SVM. The system includes image acquisition, pre-processing, segmentation, morphological feature extraction viz. geometrical structure & shape and classification process. In order to classify the rice grains ANN and SVM based algorithms have been used in this research work. A comparative analysis has been made between ANN and SVM Classifier algorithms on the samples of rice grains.

2. Analysis of rice granules using image processing.

This paper presents the method of processing images and extracting features from grains which considerably reduced the complexity of the grading problem. Images are acquired using camera. They converted the acquired images into grey scale, applied median filter and edge detection techniques. The extracted features like perimeter, length, minor axis length, major axis and area are given as input to a neural network for training. The samples grains were collected and a CCD camera is used to acquire and record the images for rice granules of different sizes. The camera is mounted on a stand which provides vertical movement. Image samples were analysed which includes the process of differentiating granules from background and extraction of quantitative information.

3.Grading of rice kernels for embedding image applications.

This paper presents an idea for grading of cereals based on Background subtraction, binary conversion, and successive erosion and dilation. Background subtraction removes the effect of poor illumination. In the case of converting binary output images having pixel value less than threshold value is represented by 0 and others by 1. Consecutive erosion and dilation remove the grains with touching kernels. This process is carried out until all the touching grains are separated. Foreign particles and broken kernels are removed for grading the grain. The number of broken kernels Y1 & Y2 in the two output images can then calculated using a formula.

$$Y1 = Z - X1,\ Y2 = Z - X2$$

X1 represents number of connected components after removing short broken grains and X2 represents the number after removing long broken grains. Z represents the total number of grains. Images are acquired using CMOS based image sensors in an embedded imaging system. Sensors are then connected to necessary support electronics to continuously send pixel data to FPGA. In this paper, images are acquired using a digital camera (includes image sensors) having high pixel resolution. The camera shall be located at a position normal to the object. Illumination or background characteristics varies while acquiring images during real time analysis. Accuracy of the system shall be high under these circumstances. Hence, this algorithm is tested on images placed under different illumination & background color characteristics.

4.Color and texture for seed classification by machine vision

In this paper, a method to classify the quality of seeds according to types of defect output is being presented. Seed quality identification technique that supports more than ten categories of defect is discussed. The technique used is based on color and texture features and support vector machine (SVM) type classifier. A set-top box for capturing the image under closed environment with consideration of the illumination conditions is created. The objective of this box is to control constant illumination condition, to reduce effect from object shadow, and to provide sufficient distinction between foreground and background for the sake of segmentation. Blue color is used in the background plate to maximize distinction between the background and the yellow tone seed samples. With the blue color background, we can easily separate foreground objects (seeds/grains) from the background by using HSV color space. Local binary pattern (LBP), which is a non-parametric kernel which summarizes the local spatial structure of an image and is invariant to monotonic gray-scale transformations. In order to calculate LBP, window size 3x3 is applied to an image. Noise reduction algorithm is applied to the results to refine binary images. The resulted binary images eliminate the interference by using techniques such as median filter or connected component labeling. Any objects which are smaller or larger than defined threshold is being discarded. In preprocessing, useful information is being extracted for representing an image data. In the proposed design, color histograms in the RGB and HSV color space together with texture based on gray level co-occurrence matrix (GLCM) and Local binary pattern (LBP) is adopted to be feature for image classification. The proposed technique is implemented by Microsoft Visual Studio C++ programming language together with OpenCV image processing library and SVM library. Support Vector Machine (SVM) is used for seed classification.

5. A machine learning approach for grain crop's classification in purifying separation.

The paper presents a study of the machine learning ability to classify seeds of a grain crop in order to improve purification processing. The main seed features that are hard to separate with mechanical methods are resolved with the use of a machine learning approach. A special training image set was retrieved in order to check if the stated approach is reasonable to use. A set of tests is provided to show the effectiveness of the machine learning for the stated task. The ability to improve the approach with deep learning in further research is described.

6.Color calibration of proximal sensing RGB images via deep learning

This paper proposes an efficient, robust, and cutting-edge approach for automatic color calibration of three-band RGB images. A dataset of 3150 RGB images for oilseed rape was collected by a proximal sensing technique under varying illumination conditions and used to train, validate, and test this proposed framework. One of the image processing steps used in this method for extracting the traits is image segmentation, which is considerably dependent on the image color feature. Firstly, a CCM (color calibration matrix) is manually derived by mapping RGB color values of each patch of a color chart obtained in an image to standard RGB (sRGB) color values of that chart. Image clustering is considered as one of the vital steps that improves the performance of the CNN model to estimate the CCMs. Next, images are grouped into clusters according to the CCM assigned to each image using the unsupervised k-means algorithm. The images with the new cluster labels are trained and the deep learning convolutional neural network (CNN) algorithm for an automatic CCM estimation is validated. Finally, the estimated CCM was applied to the input image to obtain an image with a calibrated color. The output of the proposed method is being compared with previously reported color calibration algorithms, including gray world (GW), principal component analysis (PCA), and white patch (WP). The comparison was performed using the test dataset (i.e., 150 images). The performance of these algorithms are evaluated by implementing different metrics to describe the error distribution, including mean (μ), median, trimean, best-25% (μ), and worst-25% (μ).

IV. PROPOSED METHODOLOGY

In this project work, Grain analysis strategies, the main objective is to develop an automated system for analyzing grains and compare the classification accuracy of methods implemented. The system includes image acquisition, pre-processing, segmentation, morphological feature extraction. and classification based on the properties. Raw dataset provided is filtered and converted to a suitable scale for extracting features. From the features extracted, properties are tabulated and labelled grains are obtained depending on classification. A supervised learning algorithm such as KNN is required for an enhanced training and is implemented in the same dataset. It doesn't learn any model but can make predictions by calculating similarity. A prediction probability model is obtained based on which classification accuracy of the model is evaluated.

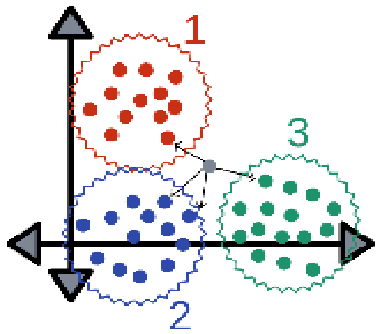

Fig 4.1: K-Nearest Neighbor

The raw dataset is then made to classify by inserting to a deep neural network having connected layers. For getting accurate outputs, RNN model is made use of, that works based on taking the previous outputs and then propagating the error. To be more precise, a sequence classification method needs to be implemented that can train and test the dataset efficiently. LSTM model is employed for collecting the past data accurately and to make the system more accurate.

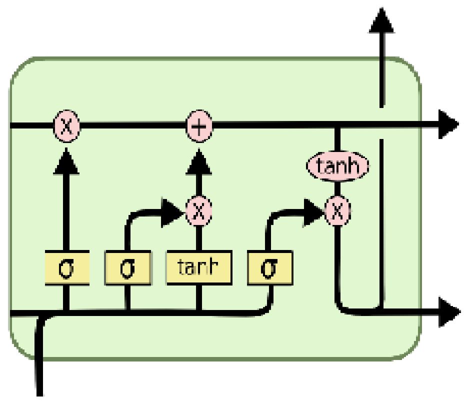

Fig 4.2: LSTM Architecture

V. SIMULATION/EXPERIMENTAL RESULTS

Improvement in classification accuracy is visible on using deep leaning and machine learning models. Following is the observation.

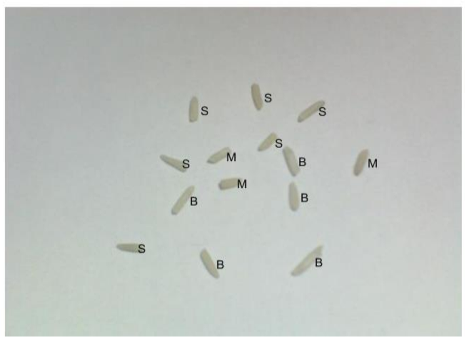

Fig 5.1: Labelling after PCA

Area	Centroid		MajorAxisLength	MinorAxisLength	Solidity	ratio
430	176.83	350.56	40.553	14.006	0.94714	27.279
452	238.05	227.78	44.035	13.647	0.94167	28.841
534	249.1	281.84	54.169	12.78	0.94513	33.474
408	264.67	150.03	39.101	13.534	0.93364	26.318
560	286.3	373.72	48.776	14.955	0.95238	31.866
433	300.89	217.11	39.869	14.137	0.94541	27.003
448	315.16	256.98	36.782	15.756	0.95931	26.269
443	353.2	131.14	41.406	13.781	0.94658	27.594
364	368.62	197.47	36.423	13.032	0.94545	24.728
605	401.07	224.78	47.574	16.538	0.94237	32.056
505	404.61	276.96	43.844	14.797	0.96558	29.321
697	424.38	370.85	61.376	14.805	0.94317	38.09
490	429	151.63	50.132	12.689	0.94412	31.41
479	498.7	226.7	42.505	14.517	0.94851	28.511

Fig 5.2: Various properties of rice obtained

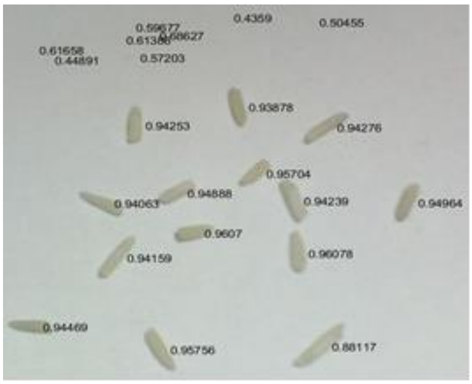

Fig 5.3: Prediction probability of rice

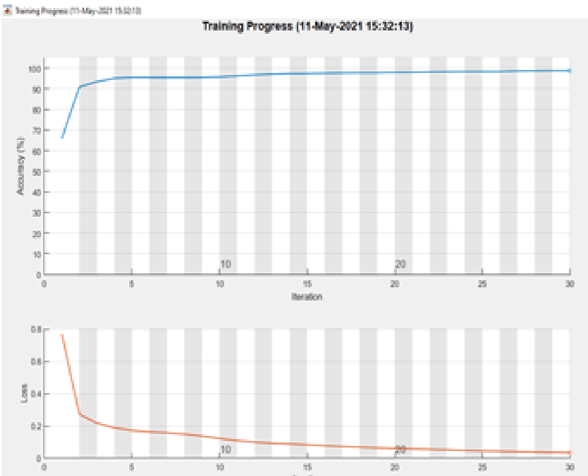

Fig 5.4: LSTM Training

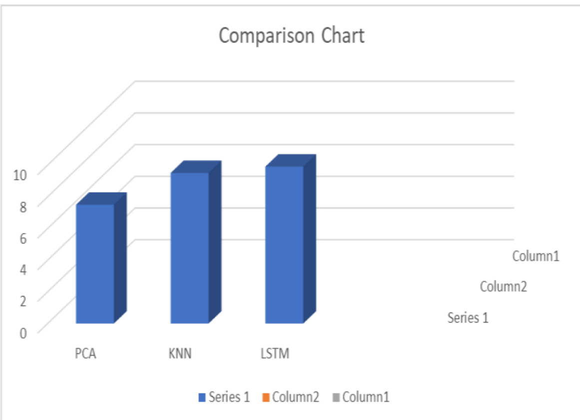

Fig 5.5: Comparison of models

VI. CONCLUSION

In this paper, an exhaustive study of different research works is carried out. Different techniques such as machine learning, deep learning and image processing for automation of quality analysis and classification of rice in field of agriculture. It is found that morphological features of rice were the main focus of researchers to attain high accuracy in determining quality or grading of rice. Most of the researchers used other features of rice like color, texture and shape features in conjunction with morphological features to achieve higher rate of accuracy. It is evident from this study that classification accuracies are further improved to a great extent with expansion of technologies in the world. When different features were tested for classification purpose, accuracies of each process get increased. Thus, there arises the need of updated technologies. It is evident that these research studies have contributed immensely in achieving the goal of optimizing food production at world level by proposing new methods for the rice quality analysis process.

VII. FUTURE SCOPES

As enhanced methods provides with accurate results, an efficient grain analyzer can be developed. On implementing the basic idea as a mobile or web application can benefit the common section of society for analyzing the quality of their crops. An easy interface can help the people with less technical background to familiarize with the system. Efforts can be made to standardize the assessment process. Expansion of idea can lead to new innovations that can help the world in a much better way.

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