Research on Germination Prediction and Varietal Classification for Rice Seed Quality

S. Durai, C. Mahesh

Abstract*: In agriculture most of the task done manually by experienced persons. They made decision on the basis of what they feel and see. The prediction result also not giving expected results. For getting the best yield the selection of quality seed is mandatory. But the manual analysis cannot assure the best quality seed. Rice Seed quality estimation can be done by considering the textural features of rice seed image. For this we are going to propose Digital Image processing Techniques to classify and grade the quality of the seed. There are number of digital image processing techniques proposed for classifying the variety of seed and predicting the germination rate of seed. In this paper we are going to summarize the hardware setup, varieties, features extracted, methods or algorithms used and result they obtained. In future we are going to propose a simple grading system for the rice seed quality system can be used by formers.

***Keywords* : Image processing, Rice seed Quality, Agriculture, seed germination, seed classification.**

I. INTRODUCTION

Rice is the important food in India, above 75% of people having food as rice. In south India more than 97% of people major food source is rice. Normally formers harvest their rice IN fields and stored some amount for future cultivating. After two to three months the seed must be used or otherwise the seed will be affected by diseases, loss of moisture content, damaged by insects. Apart from the above said some seeds may be damaged, contains crack in the texture, foreign seeds mixed, and other varieties mixed, red rice seeds that won't be germinated. This seeds must be separated from the batch of seeds that selected as seeds.

Seed is an important living product and must be grown, processed correctly and harvested to get the maximum yield, good productivity in the agricultural market. Seed quality depends on three major factors: 1. Varietal Purity 2.Seed viability 3.Moisture content. The evaluation of seed quality with respect to other features like disease, fungal attacks, and cracks in the seed, damaged seeds, chemical composition, and insect infestation is a time consuming process. Simply saying if we want to check the germination rate of seeds, at least we have to wait more than 15 days. Therefore simple, efficient, less cost, accurate and automated method must be developed to enhance the technology used in the agro-industry to ensure the quality of the rice seed in terms of harvest, storage, process and germination.

Revised Manuscript Received on October 15, 2019

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For selecting good quality seed the formers are following specific gravity method. All the seeds are put into the water contained salt or ethanol. The seeds which floating on the surface of water won't be germinated , so that will be removed from the selected seeds and only the seeds which sink on water will be selected for cultivation. This method will be fine for immediate sowing on the field. But for later use it will not be recommended because the sunken seeds must be washed by fresh, clean water to dilute Ethanol or Salt. This Gravity method is very time consuming and the seeds selected may be wasted because of the post processing. Moreover own seed production not a big problem with this method, but when we are going to buy the seeds from third party will be a complex task. In India most of the farmers depend on the third parties, they cannot by themselves, because of alternate crop cultivate method in agriculture (storing of rice seed for longer period is a big task).

In automated rice seed evaluation system the physical properties of seed must be tested. In recent years the computer technology enhanced with lot of machine vision system. We can use those features for extracting the physical properties of rice seed is best option. In most of the fields they already proved the accuracy of machine vision system like medical, food processing, soil testing, satellite image processing etc..

For any machine vision system hardware setup depends upon the field and application, it is going to implement. We can customize the setup depends upon the purpose. The important factors are Camera that is going to capture the images, Illumination setup, computer hardware and software .In the upcoming chapters we detail summarize the type of vision systems, varietal classification methods and germination prediction systems.

A. Vision Systems

[2016 seed science research] Machine vision system commonly known as "computer image processing system", which is an artificial intelligence technique which simulates the human vision. It consists of four basic components which we already discussed:1. Illumination system 2. Camera or Sensor 3. Lens 4. Computer with frame grabber or digitizer. It will identify and grading the seed based on image physical or external features like shape, size, color and texture features. This system already been implemented and succeed in various crop and non-crop species.

B. Spectroscopy

This system investigates the electromagnetic radiation emitted by spectrum. This system may use range of spectroscopic techniques such as near-infrared, Mid –infrared, fluorescence, Fourier transform-infrared and Raman spectroscopy.

This system used to detect seed quality attributes like viability, damage by insects, chemical composition and other causes.

C. Hyperspectral Imaging

This imaging system consists wavelength dispersion devices, detectors and light sources. Using this imaging system large number of sample can be analyzed. This system integrates both machine vision and spectroscopy advantages. We can obtain spectral and spatial features by using only one system.

D. Thermal Imaging

It is a technique which transforms the hidden radiation pattern of an object into visible images to extract the features and further analysis of the same without future contact with object. By using this, the surface temperature of object can be transformed into high resolution 2D values. This system does not require illumination devices which other machine vision systems need. By using this we can detect the variety of diseases, insects, viability, crop water stress, determining disease estimating yield. This systems performance based on weather and environment conditions.

E. Others

Soft X-ray imaging system which used electromagnetic waves, which used to detect defects, internal voids, insect damage in the seed, insect infestation. Electronic nose system contains consecutive number of electronic and chemical sensors which recognize simple and complex odours. This system used for pathogen detection and kernel classification.

II. VARIETAL CLASSIFICATION

To ensure the purity of rice seed, we need to identify the unwanted seeds and other varieties mixed from the batch of seeds which we have selected. There are number of methods already proposed and produce the good results with variety of seeds. In agriculture for classification machine vision system applied and succeeded in automatic assessing, harvesting and grading of products like fruits, food, vegetables and plant classification. For classification they extracted physical features of seed which cannot be seen by human. The comparison of various techniques, features extracted and the results they produced is listed in Table 1, for table of results

III. GERMINATION PREDICTION

To assess the seed viability still its time consuming and difficult task because of germination time of the seeds. The germination of seed test will be usually done by seed producers, in the buyer side they blindly depend on the producers. Even if they want to test, there is no non destructive method and minimum ten days it will take. Usually the seed germination will be evaluated by .

Germination Rate (GR) (%) = (Number of Germinated Seeds / Number of seeds used for testing) *100

Estimation of germination also tedious because of the huge number of seeds must be verified, after germination the germination seeds are overlapped, separation also complex one because before evaluation separation done by manually. In this chapter we aim to summarize the method which follows automated non-destructive methods, varieties, Features extracted for analyzing and result obtained.

A. Machine vision inspection of rice seed based on Hough transform

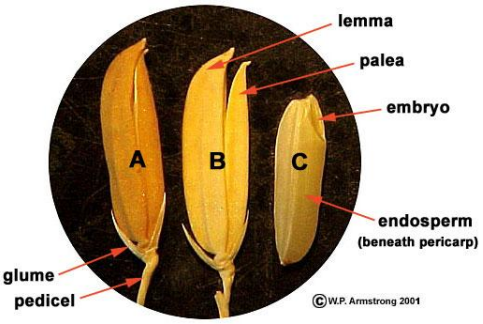

Fig.1 Individual parts of a rice seed

In figure 1 shows the individual parts of the rice seed. [7] They developed machine vision inspection system to inspect the rice seeds with incompletely closed glumes. Moisture content in incompletely closed glumes is lower than normal seeds. Sometimes incompletely closed glumes are deformed. Normal seeds are always having well closed glumes. This method used to classify:

1. Normal Seed
2. Fine fissure seed- tiny incompletely closed glumes; treated separately from normal seeds with special care.
3. Unclosed seed-seed quality is relatively low and tested.

They used five varieties for estimating germination rate of Jinyou402, Zhongyou207, IIyou, Jiayou and Shanyou10. They applied hough transform algorithm with Digital Image processing algorithm and achieved accuracy of

Normal seed - 96 %
Fine fissure - 92 %
Unclosed glumes - 87%

B. Automatic Evaluation of Germination Rate of Rice Seeds

Fig. 2. Germinated Rice seed

Figure 2 shows the image of germinated rice seed which contains all germinated parts in the seed.[8] They developed automatic tool in real application for estimating germination rate of rice seed. They used computer vision and deep learning mechanisms to assess the seed germination. This is done by taking photos of the germinated seeds in the germinated paper and applies image processing techniques.

Data set of different varieties germinated seed is available as public for research community. Commonly for evaluating the seeds must be separated from germination sheet and place it on dark ceramic. It's very tedious and time consuming task because the seeds are overlapped with one another.

Methodology:

1. Seeds detection---a) Seed segmentation b) seed localization

[Fully convolutional networks—U-Net]-→segmented map , value of each pixel represents the probability of pixel belongs to a seed.

2. Seed classification

Res-Net-101 [deep residual networks with 101 layers]

They applied this method for the varieties Bac_thom, Nep_97, TBR_1, Khang_dan, Q5, TBR_225 and BC_15. They successfully achieved the F1- scores of 93.38 % and 95.66 % respectively for segmentation and classification tasks. Proposed method closely related to manual analysis.

C. Non-destructive Quality Analysis

[9] They proposed method for evaluating the quality of rice seed using Digital Image processing system and multi-layer feed forward neural network technique to achieve high accurate quality result than human manual inspection. They extracted the features Minor axis Length, major axis Length, eccentricity and area of a individual rice seed image for Kamod rice. For kamod rice usually it must be lengthy, for producing good grade of rice all the selected seeds must be lengthy. For selection of good seed the small size seeds must be separated. The number of small seeds and other varieties mixed in the samples that have taken decides the quality and grade of the seed. For that purpose they implemented this approach and get 100 % classification accuracy.

D. Non-destructive identification of pure breeding

[10]They proposed method to find the Breeder seed. In the agricultural market we have four types of seeds:

1.Breeder seed
2.Foundation seed
3. Registered Seed
4. Commercial seed

All the seeds are classified using the following parameters: percent of good seed, percent contamination, germination, moisture, no of other species seed and number of red rice seed. For achieving the proposed objective they used Khao Dawk Mali 105 seed variety. They extracted the features Area, Diameter, Average histogram R,G and B are calculated and applied Degree of connecting superficial pattern. Finally they got 98% accuracy result.

E. Image analysis based on color, shape and texture for germination evaluation

[11]To predict the germination rate of rice seed they extracted the following 3 color features,7 Morphological and 8 textural features of the seed. Figure 3 shows the structural chart of the proposed method they have used.

- 3 color features

Average Red,Green,Blue

- 7 morphological features

Major axis
Minor axis
Orientation
Eccentricity
Area
Roundness
Aspect ratio

- 8 textural features

Contrast horizontal, vertical
Correlation horizontal, vertical
Entropy horizontal, vertical
Homogeneity horizontal, vertical

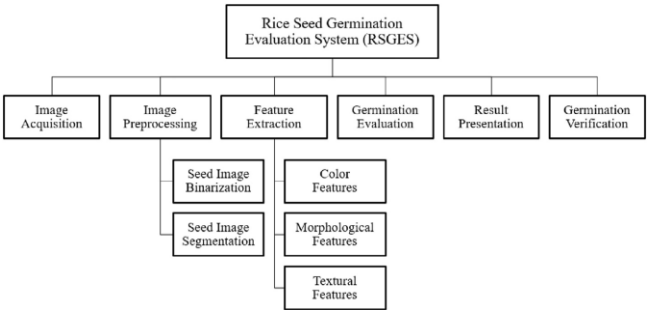

Fig.3. Simple Rice Seed Germination Evaluation System

They applied Artificial neural network- 18-13-2 for Evaluating the proposed system module. They used the Variety called CP-111 and the result obtained 7.66 % false accepted,5.42 % false rejected respectively

IV. CONCLUSION

In agriculture most of the task done manually by experienced persons. They made decision on the basis of what they feel and see. The prediction result also not giving expected results. For getting the best yield the selection of quality seed is mandatory. In this paper we summarize the methods that already applied with number of varieties and features need to extract for analyzing the quality of seed with automated system. In feature we are going to develop a system for automated evaluation and varietal classifications of rice seed with low cost hardware's and ease of access to the farmers. Like for capturing and acquiring image they can use mobile camera or digital camera so that they can have the immediate access and evaluation system in their hands.

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Table 1: Techniques and Features Extracted

References	Hardware setup	Seed Variety	Feature Extraction	Accuracy %
[1]	(CCD) camera with TMC7DSP display of 640X480 pixels	ey7954, syz3, xs11, xy5968, xy9308, z903	R, G, B color bands of an image and Hue (H), Saturation (S) and Intensity ,Areal length, Width, major axis length, minor axis length, Thinness ratio and Aspect ratio.	90.00%, 88.00%, 95.00%, 82.00%, 74.00%, 80.00%
[2]	CCD cameras with container, conveyer belt attached with PC	Xiannong',Jinyougui',You166, No. 3 'Xiannong', 'Medium you'	embryo area ,fine area ,pixel area	99.99%, 99.93%, 98.89%, 82.82%, 86.65%
[3]	CMOS image (NIKON D300S) camera with determination of 640 x 480 pixels	BC-15, Huong thom 1,Nep-87, Q-5, Thien uu-8, Xi-23	morphological highlights, shading, surface, GIST	90.54%
[4]	Sony make 18.9 megapixels computerized camera	Karjat-6(K6) , Ratnagiri-2(R2), Ratnagiri-4(R4), Ratnagiri-24 (R24)	texture feature, Shape Features,(contrast, energy, and homogeneity)	82.61%, 88.00%, 87.27%
[5]	canon MP287 with 1200X2400 dpi scanner	Khao Dawk Mali 105	area, Perimeter, diameter and Histogram average, Red, Blue and Green	98 percentage of accuracy of test

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S.Durai having 8 years of experience in teaching,area of interest are data structures,algorithm analysis,operating systems. Research area is Image processing in agriculture .Published more than 19 papers in various scopus indexed journals.

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