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Rice Quality Evaluation Based on Image Processing: A Survey

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ABSTRACT

In rice production industry as per the market demand, the rice quality evaluation is very important in the present time. The factors such as whiteness, shape, milling degree, chalkiness, cracks & polish are the evaluated factors for rice quality. To defend consumers from sub-standard products, the quality of rice is an important necessity. In the world population more than the half people, a primary dietary staple is rice. It is most popular for supplying energy, protein, essential vitamins and minerals, fiber, grain, beneficial antioxidants, and carbohydrates. By using the rice kernel manually for rice quality analysis, it is complicated, time-consuming and having a chance for error with the bias of human perception. To overcome these issues and to achieve the rice quality, the image processing techniques have a wide scope. This paper review different techniques that evaluate the quality of rice on the basis of image processing techniques. Identification and classification of seeds, grading of seeds, quality determination of seeds in seed science and food processing sectors are the essential role of these techniques. This survey provides a review of image analysis techniques and proposes a processing module for seed identification and classification. Mainly this review paper focuses on the quality control of rice which is the most used crop in the world on the basis of image processing methods.

Keywords: *Rice quality, Chalkiness, Crackness, Whiteness, Image Processing*

1. INTRODUCTION

Rice grain plays out a huge commitment to fulfil human needs. They are real source products of Asian populace and numerous different nations [1]. The position of rice is characterized in surroundings of its extent components, for example, Protein, Carbohydrates and so forth. In this paper, we will go in depth to the analysis of quality of rice [2].

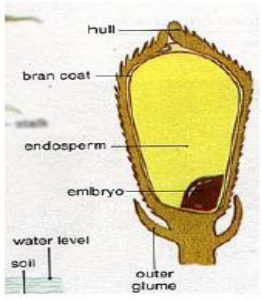

Figure 1 Cross-section of Rice Seed.

In figure1 represents the cross-section of rice seed. The rice kernel is contained bran coat and a hull, both of them which are withdrawn by shining is known as white rice.

- Rice shell, hull or husk: Bounded the bran coat, the embryo, and the endosperm.
- Bran Coat (layer): An extremely thin coat of modified tissues. The coat carries fiber, vitamin B, protein and fat. The nearly all nutritious segment of rice occupies in this layer.
- Embryo: The innermost segment of a rice grain consists mostly of starch known as amylase and amylopectin.

Seed is a livelihood product that should be grown, harvested, and processed precisely in order to realize the yield perspective of any rice variety [3]. Good standard seed can expand yields by 5-20%.

2. RICE STANDARD

Rice seed standard isn't preeminent for eating however it is additionally ramification for the ranch. Development with great standard seeds can supply predominant yield item. For grain standard Measurement it is imperative to research into the quality parameters of seeds [4]. The development of products in horticulture is that thing on which Indian economy profoundly depends. Rice is developing practically everywhere throughout the world. India is the second biggest rice maker and exporter. It is additionally hard to oblige different kinds of grains and distinctive guidelines accessible. Rice is just a single of its sorts among other grains as it is totally cleaned grain are expended while different grains are handled before they achieve the shoppers. Its quality is in this manner a responsive issue. Remote particles must be identified and answered to research will be kept to the accessibility of different sorts of rice variations accessible in the topography [5]. The examination requirement for advancement of programmed rice arranging on its dimensional arrangement is watched and these should be tended to utilizing picture preparing or other pertinent systems. Created grain analyser gives a choice of the diverse gauges for the order of grain test. Length and width of grain are basic parameters for grain tests ordered. The finish of the different gauges spins around estimation of length, width, territory and other physical parameters. Then after, in view of single or joining at least one parameter, sorting and classification

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redeveloped. Many other distinctive rice standards are considered [6].

Rice Standard Organisation (RSO): In view of ARSO (African rice standard association), grain seeds are partitioned into head broken and chip seed. The other recorded occurrence of institutionalization depends on African rice standard association [7]. This African standard indicates the necessities and techniques for inspecting and test for milled rice of the assortments developed from Oryza species. Expected for human utilization ARSO CD-ARS 464-2012 standardised seed like head rice, whole kernel and broken kernel. Also, these guidelines could be founded on processing degree.

Cambodia Milled Rice Standards: These models give the definitions to paddy rice, darker rice, processed rice, and germ. It gives definitions to distinguish entire head, enormous broken, little broken and chalky kernel. Immature, harmed, outside issue and remote smell are additionally characterized by this standard [8]. Head rice parts are having a length in the middle of 8/10 to 9/10. Big broken ought to have the portion length in the middle of 8/10 to 2. It gives definition to shading based categorization, for example, red-streaked and yellow seed [9].

United States Standards for Rice by USDA: It has given rice standards in 2009. It has characterized broken kernels, chalky kernels and diverse classes of rice. "Medium grain unpleasant rice" will comprise of harsh rice which contains in excess of 25 percent of entire pieces and which in the wake of processing to an all-around processed degree, contains not in excess of 10 percent of entire or expansive broken kernels of long grain rice or entire portions of short grain rice [10]. Short grain unpleasant rice will comprise of harsh rice which contains in excess of 25 percent of entire portions and which after processing to a well-milled degree, contains not in excess of 10 percent of entire or vast broken kernels of long grain rice or entire kernels of medium grain rice.

FAO: FAO has given distinctive measures to evaluating rice. Complete paddy with 80 percent of the entire dark colored rice parts extra-long having length 7.5mm or progressively, long having 6.5mm or more yet shorter than 7.5mm, the medium having length 5.5mm to 6.5mm, short having length 5.5mm. It likewise characterizes 1b proportion, harmed kernel, yellow kernel, red rice, contaminations and remote mater [11].

3. METHODOLOGY FOR THE SYSTEMATIC LITERATURE REVIEW (SLR)

In the research methodologies, the main research area is the Systematic Literature Review (SLR). To review the existing information about rice quality evaluation is the main cause for undertaking the SLR methodology. Additionally, it provides detail information about our domain existing techniques, research questions and future challenges for the rice quality based on the image processing technique. The main aim is examining or detect the relevant literature based on image processing technique. In Systematic Literature Review, we followed different steps. The SLR process phases illustrated as follows:

3.1 Research Questionnaire

The first step in the SLR methodology is to framing the research questions and searching appropriate papers in different online databases. Table 1 shows the research questions and solution based on rice quality evaluation.

Table 1: Research Questionnaire and Solution

Research Question	Solution
1. Why quality is important in Rice?	Rice quality evaluation is very essential for rice production. To improve the quality of seed increase the harvest between 5 and 20 percentage. If the seed quality is less it makes many issues in the crop production.
2. What are the methods practised for cleaning, threshing, drying and storing rice?	Field drying Sun drying Large stationary threshers Hold-on threshers Hermetic storage Bulk storage Bag storage
3. What are the characteristic of rice quality?	The characteristic of rice quality on the basis of physical or chemical of genetic or acquired properties.
4. What are the limits of post-harvest handling of rice encountered by the Outgrowers?	Delayed harvesting and sifting. Heavy reliance on customary sifting rehearses. Heavy rainfall during harvesting and dry seasons. Delay of mechanical drying facilities High broken rate in hulling and cleaning. Lack of appropriate specialized information.

3.2 Study and Analysis of References in the Article

An investigation of articles in term of various reference of an article has been done in this survey in between the year 2010 to 2018.

Table 2: Study and Analysis of References in the Article

Sl. NO	Keyword	Time	Content type
1	Rice Grain Quality classification	2010 to 2018	Journal, conference, Symposium, University Thesis
2	Rice quality based on image processing		
3	Application of rice quality		
4	Analysis and Identification of Rice Granules		
5	Image processing steps		

4. METHODS FOR QUALITY ANALYSIS OF RICE

In this section, we review some existing methods of quality analysis of rice.

4.1 Based on Whiteness

Peng Wan *et al.* [12] proposed a detection process for rice process quality utilizing shading and BP neural system. Here a unique gadget called rice process quality location dependent on PC vision was utilized. The material and technique, comprises of preparing of rise test, by Huller, processing and so on and

afterward getting diverse examples of rice, at that point accumulation of image, of rice tests by identification vision framework. At that point, the shading highlights of rice are removed by rice image handling. After that shading estimation of rice, an image is removed. The extraction of shading estimation of rice picture is separated into 5 rises to sub-locales. Than RC, B shading estimation of rice pixel is extricated and changed over to HIS (Hue Saturation Intensity) shading esteems. After that, the nature of rice is being tried by utilizing BP typical system. 4 test of rice is chosen to be utilized to image analysis and to acquire shading highlight volumes. The great picture of rice acquired through rice image process. Than shading extraction territory of rice is recognized and highlight esteem is extricated. Moreover, Liu Guang-rang *et al.* [13] had explained an objective and exact approach to assess rice shading dependent on image processing technique. It presents two techniques, for example, RGB and HIS. Thus, 20 rice grains is filtered on the plane of the scanner and unique image is stored in PC and prepared by an image storage format. The unique image is utilized to dissect shade of rice grain. At that point in choosing a shade of framework, in RGB demonstrate characteristic shading and show shading are made and in HIS, the framework depends on the shade of human inclination. At that point in the subsequent stage, RGB is acquired from the shading by strategy. The shading immersion 'S' of circle focus is 0. It can likewise decide further for example dark or white contingent upon the size of splendor. In this way, in experimentation it became more acquainted with that it is 60 with a donation, it shows the essential tone of rice grains. It is fundamentally unaltered shading changes from dim to light with increment in brilliance. By this examination, it is presumed that rice shading gotten by HIS framework is predictable with one by human physiological visual observation qualities, so this investigation expresses that this technique without emotional unsettling influences is objective and precise and can store, show and process it whenever.

4.2 Based on Chalkiness

S.durai *et al.* [14] proposed a strategy to quantify pale zone dependent on image processing. The examples were gathered from 50 to 100 nos. Of rice kernels set on the scanner and filtered the images in JPG arrange for further process. For showing signs of improvement quality the differentiate alteration and some median filtering technique-median filtering, unsharp mask filtering was connected. The chalky region was recognized by changing over RGB image to greyscale image and then to a binary image. The number is relegated to each rice bits of the examples and calculates a number of associated segment of a binary image, which is the only white territory of rice portions. As indicated by the white territory, a chalky region the rice was reviewed into three classifications.

Andres M.Tuates Jr *et al.* [15] proposed a methodology to analyze the brown rice quality by computer vision based on image processing. The samples were collected by 1000 nos. Of rice,grains placed on the scanner and scanned the images in JPG format for future process. The brown rice samples were classified by a trained classifier into chalky, paddy, yellow fermented, red, immature and sound damaged. Moreover, to extract shape and color features of the brown rice grain image using the analysis software method is known as PhilMech quality analysis. After milling the operation the defective grains of brown rice are different in, especially in red, chalky and sound yellow. To detect the color and predict the weight of the brown rice the computer visions system (CVS) is utilized. When we compared the CVS with the human inspection it is more accurate and efficient.

Yosuke Yoshioka *et al.* [16] proposed a methodology to evaluate the effectiveness of the image scanner to measure and categorize chalkiness and assessed the method's viability as an alternative to human visual assessment.246 perfect and chalky grains were taken as a sample here. It is classified into 8 different categories based on the chalkiness. The images were scanned by a scanner or personal computer in JPG format. These high-quality images of the grains were converted into grayscale then to a binary image by using the threshold method. Here support vector machine (SVM) is used for the algorithm. To quantify the location and degree of chalkiness a principal-components analysis (PCA) in view of the variance-covariance matrix of the 18 mean grayscale esteems gotten by the portioning technique. The accuracy of the classification is 90.2%.

Liu Guangrong *et al.* [17] proposed a methodology on chalk degree of rice based on image processing. 20 samples of rice grains were taken on the plane of the scanner which secured with a dark plastic sheet as foundation, then the scanner quietly those rice grains to acquire a unique picture in JPG format. In this paper differentiate chalky and non-chalky rice more clearly. For getting better quality image median filter is applied. Moreover, the chalky rate and the chalk degree were calculated in this paper.

Y.Lan *et al.* [18] proposed a methodology to identify fissures in rice grain using image processing. The examples were equilibrated to a moisture content of 10.5% in a cooled room. After equilibration of the rice tests, the processed grain rice was fixed in jugs bottles and stored in a cooled room at 58%RH and 20-degree centigrade. Here illumination is used to increase the prominence of stress cracks in the kernel. Each rice grain area and perimeter were mechanically firm by the Auto-area feature of an image-pro plus. Histogram equalization alters the dynamic range and divergence of an image. The spatial filtering tasks decrease or increment the rate of brightness change in a picture.

Wan putrid N.W.M.Tahir *et al.* [19] proposed a methodology for rice grading using image processing.60 to 70 nos.of rice grains images were collected to examine. The rice grader is differentiating based on special features such as shape, length, chalkiness, color and internal damage of rice. Naive baize method is used to classify the length, color, and shape of the rice image. The accuracy of the resulting gain is 46.6%

PK Sethy *et al.* [20] proposed a methodology on the basis of image processing to classify the quality of the rice kernel and develop an automatic assessment technique for chalkiness. Some samples of the rice grains were collected on the plate, which has a black metal background, and then the image captured and scanned it with a scanner in JPG format. To estimate the background elimination here using the technique of morphological operation. After it converts the image into a binary image. To separate the chalky part of the rice kernel

using the k-means clustering. Then the chalky area and binary image are calculated from the cluster technique, which contains white opaque of the rice kernel. This methodology separates the chalky area in the rice and gives good quality of rice.

4.3 Based on Size & Shape

Hua Gao *et al.* [21] proposed an image processing technology i.e., the detection, classification and feature extraction for the shape of plant grain by taking rice grain as prime e.g., So at the first-pixel size of rice, the image is decided for which camera calibration is done before the image acquisition. At first image, size distortion is done based on the supposition i.e., by the black-white grid. Firstly the camera is installing and fixed vertically above object desk. Then the black-white grid image is shooting before the seed image. After that corner point, the coordinate matrix is found out. Then after 4 regions, inner points are searched and finally, it is being calculated. After that pixel size is being calculated along with the width of every pixel. Then mapping relationship between rice image and pixel size coefficient matrix is done. In the 2nd step shape of rice, grain is found out by a new method i.e. by an algorithm whose steps are:-Firstly centroid coordinate 'Dc' is calculated, then 'D max' point in the boundary is being found out. Then the longest distance point 'Do' is being found out. After that starting from 'Do', the boundary point i.e, D1 to D7 is searched. At lastly to standardize image, the image boundary is being rotated. So, all the measurements unit are in the pixel. Therefore, it needs to be converted into length. After the experimentation which is done by 8 feature points is simple & high efficient &also fit to every fixed distance shoot image size calibration.

4.4 Based on break & Crackness

Siti Sarifah *et al.* [22] proposed an image processing technique to extract rice features. This features consists of area, perimeter, minor and major axis length of rice. The overall accuracy found out to be 98%when it's tested using 600 samples of rice images. MR219 rice variety was used for this study. All rice samples randomly separated into training and testing set. 100 samples of broken and head rice were used for training. While 100 samples for same were used for testing part of the different percentage of broken rice (0%, 5%, 10%, 15%, and 20%). Each sample consists of 1gm. Of rice. In image segmentation part Otsu method is used to automatically segment rice image by which it will produce a binary image of rice samples. Then for removing unwanted noise, connected component analysis and morphological operations applied. This method will search for threshold which then minimizes intraclass variance (which is the sum of weighted variance). In feature extraction part, physical rice properties have been used.

Ajay *et al.* [23] proposed an automatic evaluation method for the determination of the quality of milled rice. The quantity of milled rice samples is determined with the help of shape descriptors and geometric features. In morphological image processing, the analysis used to perform various operations (object extraction, image filtering operations, image segmentation etc.). Firstly image is being read from a file than morphological operation is performed to estimate background illumination. The morphological operation is erosion followed by a direction. Than surf, the command is used to create a surface display of background. As surf command requires data of class double. So we need to convert background using a double command. For creating a more uniform background it needs to subtract image background. Then I am adjusting and I am b2w is used to adjust the contrast of an image and then to convene grayscale image to binary image.

Xu Liz hang, Li Yaoming [24] proposed an image processing algorithm to increase the quality of object and decrease noise in the acquired image. A machine vision system was developed to do less dissimilar types of stress cracks in the kernel. This system provided in any accuracy of approximately 96.5%, 9.3% 84% &83.4% (for None, Single, doubles multiple cracks). The processing time was taken as b/w 0.45 and 0.12. Kennel. In system description Part Nikon SMZ 100 Stereomicroscope and Nikon DS-5M-U1 video microscope were used to obtaining an original image of rice Kennels with strong cracks. Mainly 4 variations of rice were used i.e., wugeng 13, wuxiangeng14, Eyou512, You 84 for investigation.

Lakshmi G.R. *et al.* [25] proposed an algorithm to analyze the quality of paddy without de-husking by image processing technique. In this paper, an automated system is developed to came the amount of paddy and detect cracks in the term for this a system is developed by acquiring x-ray images of rice and processing it. The image is acquired by using a digital dental X-ray image machine. So, My Rac RXAC digital x-ray is used. It is designed with non-variable volt and current parameters of 70Kvp and 08mA. Then in the pre-processing part, the acquired image is filtered with a median filter, which is used to smoothen the image. Here each Kernel of rice is separated from other Kernels and individually identifies. After that image is counted by using the concept of contours on segmented image. Then lastly cracks are identified in rice Kernel by though line detection algorithm. So, it is concluded that this automated processes, is more efficient and economical rice milling industries.

Jagdeep Singh Aulakh D.R. V.K. Banga [26] purposed the grading of rice grains by image processing technique. So, here by using this technique we can overcome external influences (fatigue bias etc.) and also identify broken grains. Firstly image is captured by a digital camera of the high pixel. The process used is Flat Bed Scanning (FBS). Images captured were 34190x300 pixels in size. It's stored in JPG format. The methodology consists of 3 steps where the level of background is set and the image is subtracted after that stretch limit of the image is adjusted and the ratio is set b/w 0&1 for background and grains Kernel. So by this experimentation, it's found out that grading of rice can be effectively done by image processing and purity of sample is also calculated.

Dollawat Ngampak and Punpiti Piamsanga [27] proposed a method to evaluate broken rice grains in order to make a higher profit from its higher quality portion by image analysis. The 1st step is done in the pre-processing part where rice image is conversed to grayscale and Gaussian filters applied. Then in the segmentation part, the broken image is separated from the background, by creating a binary image and detecting broken rice by the Sobel operator. After that different features of the image (color feature, texture and morphological features (i.e. major and minor axis length are extracted by MATLAB. Then virtual major axis is calculated by broken grain to the size of

the whole grain. For classifying broken rice grain we used Least Square SVM with Radial Basis Function.

5. EXPERIMENT RESULTS BASED ON IMAGE SEGMENTATION

In this section, we are going to discuss the experimental results based on image segmentation. Here we are going to learn about factors to classify seed by various strategies, besides there are distinctive factors and highlights are there for it.

5.1 Elements to Classify Seed

- Varietal purity
- Seed Viability
- Moisture content

5.1.1 Varietal purity relies on the accompanying conditions Red rice seeds

- Unwanted materials %= (Weight of Undesirable resources) / (Weight of seeds taken for the sample), (Undesirable resources such as soil, dust, stones etc.)
- Extra mixed varieties
- Moisture content
- Weed %= (weight of weed) / (Weight of seeds taken for the sample), (Weed seeds and other crop seeds)
- Propagation measurements of the seed Development %=(Number of Seeds developed)/ (Number of seeds taken for the example)

5.1.2 Seed viability

The factors like moisture level, force and germination potential are appropriate for the seed in the field is dictated. To purchase or produce the good seed was in the form of,

- Select your own great seed are the form of the good seed.
- Get rancher created great seed.
- Purchase affirmed seed that is unadulterated and named.

5.1.3 Moisture content

The quantity of water contained in the rice seed is measured is known as moisture content. The moisture content must be lesser than 14% then the seed is related to good seed. In the time of harvesting seeds, we can measure the moisture content by using the resistance type moisture meter. By using this method gets results speedily but it can use only for lesser samples. A capacitive moisture meter is used for measuring the large set of sample, but it is expensive.

5.2 *Image Segmentation*

In digital image processing, the main important step is image segmentation. For testing the image, the image is subdivided into a set of parts. Thus we can get the images for testing in clear or segmented. From this, the edge value is created and it is agreed to the histogram analysis also stable for similar situation conditions. In this analysis, it was explained that the blue value was a remarkable difference between the foundation and the articles. The limit value from the histogram decided to isolate the rice seed from its background [28]. The consequence of the division of image is in the form of a twofold image. This type of image contains two types of pixels. The pixels either 0 or 1 known as dark level of pixels. The main application of the image segmentation is object recognition or image compression.

5.3 Feature extraction

The feature extraction is mainly used for analysing the rice seed. For analysing the seed they utilized the features of color and morphological. To extract the RGB color band for an image by calculating the Hue (H), Saturation (S) and Intensity of an image. Thinness ratio, aspect ratio, areal, width, length, minor axis length, and major axis length features are then extracted from the morphological feature. The researchers found mainly four components are used to extract the features of the image [29]. They are GIST, shading feature, morphological feature and surface feature. The most common feature to represent the state of the protest in the image is a morphological feature. To identify the objects when the shape remains similar is used surface and shading features. To extract the rice quality using the texture feature, this feature consists of texture natives and texels. The texture can be represented by the power properties of texels and structure spatial connections of texels [30]. The texture feature can be extracted from the measurable arrangement of the features. The image of pixels measurements is arranged in the order of first organize, second organize and higher organize estimations. The RGB color is measured from the image and the physical data are extracted from the seed is an area, diameter, perimeter, and histogram average.

5.4 Classification

After feature extraction the following stage is classification. To arrange the seed there are numerous classifier techniques are used. Here we alluded a portion of the classification techniques that broadly utilized for grouping the fragmented items [31].

5.4.1 K- Nearest neighbor (KNN): KNN classifier is used to classify the class of object. This strategy is used to find a class of new specimen on the basis of k nearest neighbour. This classification method is based on the Euclidean distance. The Euclidean distance is used to detect the nearest distance among the training data and input data. This method is non-parametric, compelling and straightforward and this strategy is mainly used in the issues of characterization [32].

5.4.2 Support Vector Machine (SVM): To detect an ideal hyperplane for different distinct examples in a high dimensional space is the main process of the SVM. To fulfill this model there is more than one hyperplane. This process depends upon the bolster vector which the information that lies nearest on the closed surface and coordinating with the ideal choice surface. It performs classification by planning the input vectors into a high dimensional space and constructing the hyperplane to separate the data. This strategy is mainly used to solve a quadratic programming problem and non-convex, unconstrained minimization problem. The SVM is the most effective method in the classifier process [33].

5.4.3 Random Forest (RF): RF classification method was first proposed by Breiman. This method is classified by creating the sequence of decision trees. RF use a variety of different bootstrap samples for every decision tree and changes how the trees are constructed and how the classification was done. By using the best subset every node is divided and the nodes are chosen randomly. Due to this process, the trees are grown with the highest extension without removing any node. After it collects all the outputs to predict the new data. While comparing the RF with another classifier it gives a more efficient and quickest performance with a huge amount of data [34].

***5.4.4* Deep Learning:** Deep learning neural network is used to solve the issues in machine learning. It also gives a better result in the image classification method. The main advantage of this network is image pixels as the input and it does not require the feature extraction algorithm. Moreover, it automatically extracts and classifies the features from the more images. In a neural network number of layers, these layers are powerful to classify the image and extract the more complex feature in the image. This network has high accuracy and simultaneously extract the feature from the images at a time [35].

Table 3. Performance Comparison of Various Methodologies.

Year and Ref no	Technique	Data set	Extracted features	Colour spaces	Training	Average Accuracy
(2013), [36]	Filter, dilation and erosion	9 rice varieties	Morphological, colour and texture	RGB	Multi-Layer Perceptron	92%
(2013), [37]	Threshold	Mixed rice samples	Morphological, colour and texture	Gray scale	Nil	75%
(2013), [38]	Maximum variance method	4 to 5 samples	Chalky volume, shape, purity	RGB	Multi-Class SVM	86%
(2014), [39]	Image segmentation	4 paddy varieties	Texture, shape, and texture-n- shape	RGB	Levenberg Marquardt	86%
(2014), [40]	Image segmentation	3 rice varieties	Morphological	RGB	Nil	98%
(2014), [41]	Image segmentation	5 rice varieties	Morphological, shape	RGB, HSV and YCbC	Multi-Layer Perceptron	98%
(2015), [42]	Color cooccurrence matrices	15 paddy varieties	Color, Texture	HIS	Multilayer feedforward artificial neural network	92.33%
(2015), [43]	Image segmentation	3 rice varieties	Geometric	RGB	Nil	93%
(2016), [44]	Image Processing	Seville dataset and Ipsala dataset	Mean, Variance, Homogeneity, Contrast, Dissimilarity and Entropy	RGB	SVM	98%
(2016), [45]	Image Processing	115 rice leaf images.	Color, shape	YCbCr	Minimum Distance Classifier and k-Nearest Neighbor classifier.	89.23
(2017), [46]	Internet of things (IOT)	5 crop images.	Crop monitoring easy and efficient to enhance the productivity of the crop	Nil	Wireless sensor networks and micro controller	85.69%
(2017), [47]	Image processing	22 Rice image samples.	Area, Major axis Length, Minor axis Length, Length and width	RGB, HSV	Nil	96%
(2018), [48]	Artificial intelligence techniques	Five most produced grains	Morphological and color shape	RGB	Deep learning network	97.75%

6. PERFORMANCE COMPARISON WITH PREVIOUS TECHNIQUES

This paper presents recent advancements of using computer-vision based systems for classification of rice varieties. A computer-vision application using image processing techniques involves five basic processes such as image acquisition, pre-processing, segmentation, object detection, and classification. This survey highlights these approaches in the context of rice grading practices and summarizes their relevancy to precision farming. Table 3 summarizes research that has been reported on methods developed using image processing techniques and provides an assessment of techniques used in terms of accuracy for practical usability in an agricultural context.

7. FUTURE SCOPE

- Different types of grains and its varieties are used for the details analysis of quality products related to the accuracy and efficiency performance.
- For the experiment purpose instead scanner we can use conveyor belt with vibration mechanism for using the appropriate hardware.
- To avoid the grain shadow in the image and also provides consistency in the intensity of background color we can use a secure system for image acquisition with a high definition camera.
- Conduct research for crop improvement on the basis of resource management and to increase and stabilizing rice productivity in rainfed rice ecosystems.
- Generation of appropriate innovation through connected research for expanding and supporting profitability and revenue from rice and rice-based trimming/cultivating frameworks in every one of the biological communities in perspective of a decrease in per capita accessibility of land.
- The collection, assessment, protection and trade of rice germplasm and circulation of enhanced plant materials to various national and local research focus.
- Development of innovation for incorporated nuisance, illness and supplement the board for different cultivating circumstances.

8. CONCLUSION

This paper presented a survey on using image processing techniques used in an automated rice grading systems in an agricultural context. Most of the work in this field use image processing methods like background subtraction, feature extraction, and training and classification. An image processing based solution is also explored from the published literature for automatic rice recognition, classification, and recognition of foreign particles from images using color and texture features. There is a necessity to select the most appropriate techniques to assist in decision-making. The image processing techniques have been used widely across agricultural contexts. It can be an effective tool in food quality assessment. There is a number of applications and methods to select for implementation to real-time needs. While the existing rice classification methods sustaining the needs of today, there are more and more new methods are evolving to assist and ease the rice classification. It is evident that these approaches will all contribute to the wider goal of optimizing global food production.

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