IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 6, May 2023

Rice Grain Quality Analysis using Deep Learning

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Abstract: *The paper presents an automated system for classifying rice grains based on digital image processing techniques. Currently, rice quality is assessed through visual inspection, which is tedious, time-consuming, and requires human expertise. To overcome these issues, the proposed system captures images of rice grains using a non-contact image processing technique. The images are pre-processed, segmented, and analyzed using MATLAB to extract features for quality assessment. The system utilizes two different classifier algorithms, Neural Networks (NN) and Support Vector Machine (SVM), to classify the rice based on the extracted features. A comparative study was conducted to evaluate the effectiveness of the two methods, and the results indicate that the SVM-based classification outperforms the NN-based classification. Overall, the proposed system offers a more efficient and accurate method for assessing rice quality, reducing the need for human expertise and physical fitness of inspectors. This could have significant implications for the rice industry, leading to increased efficiency and accuracy in rice quality assessment and improved market outcomes.*

Keywords: Automated System, Rice Quality Assessment, Digital Image Processing, Non-Contact Technique, Neural Networks, Support Vector Machine, SVM-based Classification, Efficiency, Accuracy.

I. INTRODUCTION

Grains are a crucial crop for agricultural income in many countries, and their quality is a significant factor in determining their marketability. Unfortunately, grains can contain impurities such as stones, weed seeds, chaff, and damaged seeds, which can negatively impact their quality. The current method of quality testing is mostly done manually, which can lead to worker fatigue, increased costs, and lengthy testing processes. As the import and export trade continues to grow, rapid assessment of grain type and quality at various stages during handling operations is essential.

Visual inspection is the standard method of assessing grain type and quality, but it is a time-consuming and tedious process. The lack of an efficient method for identifying inferior quality grains in the market has become a severe issue for consumers, particularly farmers who are most affected by this manual activity. Manual methods of quality checking are subject to variability and can beinfluenced by stress, persuasion, loyalty to traders, and theknowledge and experience of inspectors.

To address these issues, an automated system has been proposed to improve the efficiency and accuracy of grain quality assessment. This system utilizes digital image processing techniques to capture and analyze images of grains, reducing the need for manual inspection and the expertise of inspectors. This approach can lead to reduced labor costs and increased profitability for farmers. Moreover, the system can help identify and remove impurities from the grains, ensuring that only high-quality grains reach the market and increasing consumer satisfaction. Overall, the proposed system offers significant benefits to the agricultural industry and can play a pivotal role in the future of grain quality assessment and management.

II.PROBLEM DEFINITION

Quality analysis is essential in many industries, and traditional methods of visually evaluating the quality of a product can be time-consuming and subjective, leading to varying results. To overcome these challenges, image processing techniques have been developed as an alternative approach for quality analysis. By analyzing digital images ofproducts, image processing techniques can provide more consistent and accurate results, reducing the impact of subjective factors

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such as human error or biases. This approach has been applied successfully in various industries and has become an innovative and valuable tool for quality analysis.

A.Grain Quality Inspection and Sorting

Grain quality assessment is an important aspect in the food industry. After harvest, food is sorted and categorized based on several quality factors. However, the traditional manual grain quality testing method is subjective, time-consuming and expensive. To overcome these drawbacks, image processing techniques can be used for classifying and grading grains based on their size and shape. In particular, the edge detection method can be employed to determine the boundaries of each grain. This allows for measurement of the length and width of rice using vernier calipers, which is a quick and cost-effective process.

By using image processing techniques, the number of rice grains can be counted and classified based on their length, breadth, and length-breadth ratio. The length-width ratio is calculated as

L/B = [(average rice length) / (average rice breadth)]*100

B.Capturing and Analyzing Images

A camera is utilized to capture an image of the rice grains. The captured image is then saved in a digital format on a computer or other storage device. Image processing techniques are then applied to the saved image to analyze and classify the grains based on various features, such as their size, shape, and color. The application of image processing techniques helps to automate the quality assessment and classification process, making it more efficient, accurate, and cost-effective.

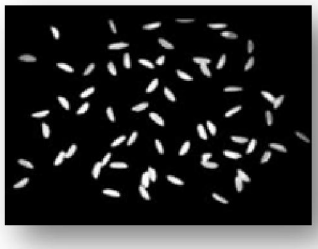

Fig.1 Original Image

"The block diagram of this research method can be seen in Figure 2. There are 6 stages in running the rice quality detection system, namely the image acquisition stage, image pre-processing, segmentation, edge detection, feature extraction, and object classification."

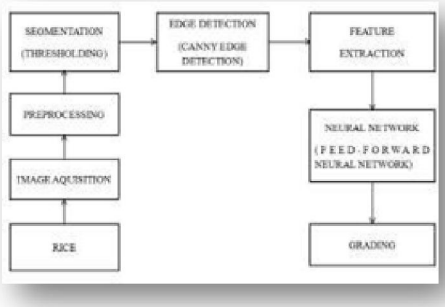

Fig .2 Block Diagram

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III.METHOD

3.1.Image Acquisition

The first step in any image processing technique for identifying different varieties of rice is to capture high- quality images of the rice kernels using a uniform and adequate lighting system. Proper placement of the rice grains is crucial to determine the rice kernel size, which is an important factor in determining the class of rice. Therefore, ensuring proper placement of rice grains is a key consideration during the image acquisition process.

3.2.Pre – processing

The pre-processing stage of image processing involves applying filters to the image to remove any noise and improve its quality. This is followed by digital image sharpening. The threshold algorithm is then used to distinguish and separate the rice grain objects from the background in the image, which is known as segmentation. The purpose of pre-processing is to enhance the quality of the image, making it easier to identify and analyze the rice grains.

i)Resize
ii)RGB to Grey
iii)Noise Removal
iv)Image Enhancement

3.3.Segmentation

This involves dividing the image into distinct regions or segments based on their characteristics, such as color, texture, and shape. By segmenting the image, it becomes easier to distinguish the impurities from the good quality grains, which can facilitate rapid assessment of grain type and quality.

3.4.Edge Detection

Edge detection is a widely-used technique in image processing that helps to detect the boundaries of objects within an image. The method involves analyzing the changes in pixel intensity between adjacent pixels to locate areas of rapid change, which typically indicate the edges of objects. This technique is commonly employed in computer vision applications such as object recognition, image segmentation, and feature extraction. The output of edge detection is typically a binary image where edges are highlighted as either white or black pixels.

By detecting edges, the technique can be used to identify and analyze specific objects within an image. For instance, in object recognition applications, edge detection can be used to locate and recognize the shapes of objects within an image. Similarly, in image segmentation, it can be used to separate objects from their backgrounds by identifying their boundaries. In feature extraction, the technique can be used to identify key features of objects, such as corners or edges, that are useful in distinguishing between different objects.

Overall, edge detection is a crucial tool in image processing and computer vision, enabling the efficient and accurate analysis of complex visual data.

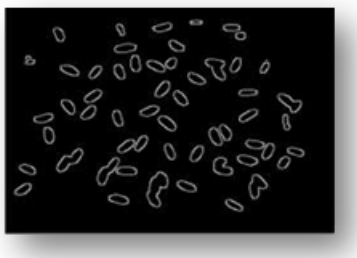

Fig.3 Edge Detection

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3.4.Feature Extraction

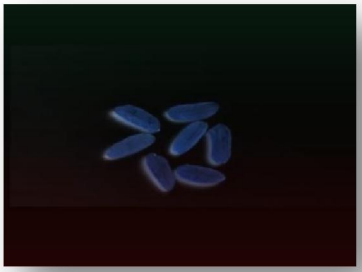
Feature extraction is a method of identifying important characteristics or attributes from a given pattern or input data. In this particular case, we are using a model to match and compare the shape, size, and color of rice grains with pre-defined patterns to extract relevant information. This helps us in identifying and categorizing rice grains based on their features.

3.5.Object Classification

To classify rice grains based on their size and shape, we need to measure and calculate these attributes using standardized methods. The laboratory manual on rice grain quality, provided by the Board of Rice Analysis in Hyderabad, provides the standard information on how to measure the size and shape of rice grains. Based on these measurements, we can classify rice grains into different categories, as shown in the table, based on their length and length-to-breadth ratio. This helps us in identifying and categorizing rice grains based on their physical characteristics.

i) Input Image

ii)Greyscale Image



iii)Invert Image

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SLENDER	Aspect ratio>=3 and aspect ratio<3.5
MEDIUM	Aspect ratio>=2.1 and aspect ratio<3
BOLD	Aspect ratio>=1.1 and aspect ratio<2.1
ROUND	Aspect ratio>=0.9 and aspect ratio<1
DUST	Aspect ratio>3.5

iv)Analysis Table

IV.RESULTS AND DISUSSIONS

The analysis of images of rice grains arranged randomly in a layer can be performed using various image processing techniques. These techniques can help identify defects such as touching kernels, which can be separated by applying the shrinking process. Once the kernels are separated, edge detection can be used to determine the boundaries and endpoints of each grain. The length and width of each grain can be measured using a caliper, and from these measurements, the length-breadth ratio can be calculated, which is an important parameter for determining the grain's quality.

To visualize the results of the analysis, a Dash application can be created that displays an Average Aspect Ratio vs Classification chart and a pie chart for quality analysis of the input image. The Average Aspect Ratio vs Classification chart can be used to classify the grains based on their quality, and the pie chart can show the percentage of good quality, average quality, and poor-quality grains in the input image.

Overall, image analysis techniques can be a useful tool in analyzing the quality of rice grains. These techniques can help identify defects and measure key parameters that determine the quality of the grains. By improving the accuracy and efficiency of this process, it is possible to ensure that only high-quality grains are selected for sale and consumption, thus improving the overall quality of rice

IV. CONCLUSION

Digital image processing using the Canny edge detection algorithm is a useful way to analyze the quality of rice grains by identifying their shape in images. This can help count the number of grains and measure their size ratio. However, there are limitations to this technique, such as the quality of the images, the ability to distinguish between different types of rice grains, and the computational power needed for analysis. It is important to consider these limitations when interpreting the results.

One of the main drawbacks of using digital imageprocessing for rice grain analysis is that adjacent objects in the image can hinder the accuracy of the results. This occurs when rice grains are positioned too closely to each other or to other objects, which can cause the algorithm to have difficulty distinguishing them from each other. Consequently, this can lead to errors in the rice quality analysis. For instance, if the algorithm identifies multiple rice grains as a single object, it can generate misleading information about the size and shape of the grains.

To address this limitation, it is important to ensure that the rice grains are placed in a way that minimizes the presence of adjacent objects in the image. This can be done by placing the grains in a single layer on a black background, which will make it easier for the algorithm to identify and analyze each grain. Additionally, more advanced image processing techniques can be used to accurately separate the grains from adjacent objects in complex or cluttered images.

In conclusion, the canny edge detection algorithm is a valuable tool for analyzing the quality of rice grains in digital images. However, it is important to be aware of its limitations when analyzing images with adjacent objects. By minimizing the presence of adjacent objects and using more advanced image processing techniques when necessary, we can improve the accuracy of this method and obtain more reliable information about the quality of rice grains.

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