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RICE QUALITY ANALYSIS USING DIGITAL IMAGE PROCESSING

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Abstract: Our nation relies on grains for agricultural revenue, with rice being a primary crop. The quality of milled rice determines its commercial viability, impacted by contaminants like stones and weed seeds. While grain testing is partly automated, human labor remains essential. Ensuring food grain quality affects supply chain profits, especially varietal purity, though the process is time-consuming. Advanced techniques like GLCM and CNN aid in quality assessment and contaminant detection, streamlining the labor-intensive process for farmers.

Keywords: GLCM, support vector machine, image processing, Convolutional Neural Networks, quality assessment.

I. INTRODUCTION

1.1 PROBLEM DESCRIPTION

- Rice as Global Staple: Rice is the predominant sustenance globally, acting as the cornerstone grain for the most significant portion of the Earth's inhabitants. Especially in tropical Asia, it is revered as an essential dietary staple, furnishing the principal energy and protein requirements for a vast segment of the populace.

- Importance of Quality Paddy: Quality paddy selection is paramount for optimal milled rice outcomes, as immature grains can lead to breakage during milling. Ensuring both the volume and caliber of the final product hinges on meticulous paddy selection.

- Pest Population Density Assessment: Evaluating the prevalence of pests in rice fields is vital for informed pest control strategies. Sticky traps serve as a common method for trapping insect pests, which use subsequently identified and counted in laboratories. Nevertheless, this manual procedure is time-intensive, susceptible to errors, and may hider the prompt execution of efficient pest control.

- Integration of Image Processing: The evolution of digital technology, especially advancements in image processing techniques, offers a solution to this complex issue. Utilizing image analysis simplifies the detection of insect pests, thus enabling the development of an automated system to assess pest populations across rice fields.

- Benefits of Automation: Through this streamlined system, agricultural technicians can streamline the pest counting procedure, facilitating a more precise and effective monitoring of rice fields. Leveraging cameras for detecting rice infestations offers a simpler and faster method of surveillance.

- Role in Rice Grading: Beyond pest management, computer vision has been instrumental in rice grading. Traditionally, manual and visual methods were employed, but these are subjective and prone to errors due to human limitations. Automated systems using image processing technologies offer more objective and reliable means of assessing rice quality, thereby influencing its grade and subsequent market price.

- By integrating image processing technology, the rice production industry can benefit from more efficient pest management practices and improved rice quality assessment, ultimately contributing to increased production quantity and enhanced overall quality.

1.2 OBJECTIVE

This project's main goal is to combine the Convolutional Neural Network (CNN) algorithm with cutting-edge image processing techniques to create and execute a complete rice quality prediction system. With this project, we hope to solve the difficulties in manually evaluating the quality of rice and present an automated method that yields accurate and objective findings.

The system's image processing part will extract important characteristics, like grain size, shape, colour, and texture, from photographs of rice. By employing methods such as picture segmentation, feature extraction, and pattern recognition, our goal is to generate a solid depiction of the visual features linked to various rice quality indicators. This project's main objective is to aid in the improvement of rice quality control procedures in the food and agriculture sectors.

The automated prediction system can improve overall production and distribution efficiency of premium rice products by streamlining quality evaluation processes and lowering the subjectivity of manual inspections. It also has the potential to reduce financial losses caused by subpar quality and help those involved in the rice supply chain make better decisions.

1.3 SCOPE

This project's scope goes beyond the simple installation of a rice quality prediction system; it also has wider ramifications for the food and agriculture sectors. Our goal is to transform the rice quality assessment area by creating an automated solution that leverages the capability of the Convolutional Neural Network (CNN) algorithm in conjunction with image processing techniques. By integrating this technology into currently operating rice processing facilities, the need for manual inspections might be greatly reduced since rice samples could be evaluated objectively and in real-time. Another facet of the created solution's scope is its scalability. The same framework and ideas might be applied to other agricultural goods as it demonstrates its effectiveness in predicting rice quality, helping to further the larger paradigm shift towards automation and precision agriculture. Furthermore, by using deep learning models like CNN, the system may be continuously improved and adjusted to meet changing market needs and quality requirements. This is made possible by the opening of new research and development paths.

II. SYSTEM SPECIFICATION

2.1 HARDWARE SPECIFICATION:

- Processor : Intel core processor 2.6.0 GHZ
- RAM : 4 GB
- Hard disk : 160 GB
- Compact Disk : 650 Mb
- Keyboard : Standard keyboard
- Monitor : 15 inch color monitor

2.2 SOFTWARE SPECIFICATION:

- Operating system : Windows OS
- Front End : .NET (C#)
- Back End : SQL SERVER
- IDE : VISUAL STUDIO

III. SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

Challenges arose in creating the rice-paddy dataset, addressed through image-based data extraction and industrial-level dataset creation methods from literature surveys. Traditional manual evaluation methods vary and are time-consuming, prompting the integration of image processing and deep learning for automated quality assessment. Overlapping grains pose a challenge; a hybrid approach of segmentation and edge detection followed by convolutional neural network analysis enables efficient individual rice detection for automated quality evaluation, surpassing manual methods in speed and accuracy.

Disadvantages

- Need manual intervention to classify the rice quality
- Time complexity can be high
- Irrelevant features are extraction
- So dimensionality can be high
- Misclassification can be occurred

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3.2 PROPOSED SYSTEM

Rice, a staple for many globally, faces challenges in maintaining purity during production and trade, emphasizing the need for robust inspection systems. This study introduces a non-destructive rice variety classification system, integrating imaging and deep CNN technology. By combining spatial and spectral data, the method utilizes a modified ResNet-B to automatically extract features and classify rice varieties, enhancing training efficiency through residual connections and batch normalization.

Advantages

- Automated approach
- Relevant features are extracted
- Time and computational complexity can be reduced
- Classification accuracy is high

IV. PROJECT DESCRIPTION

4.1 BLOCK DIAGRAM

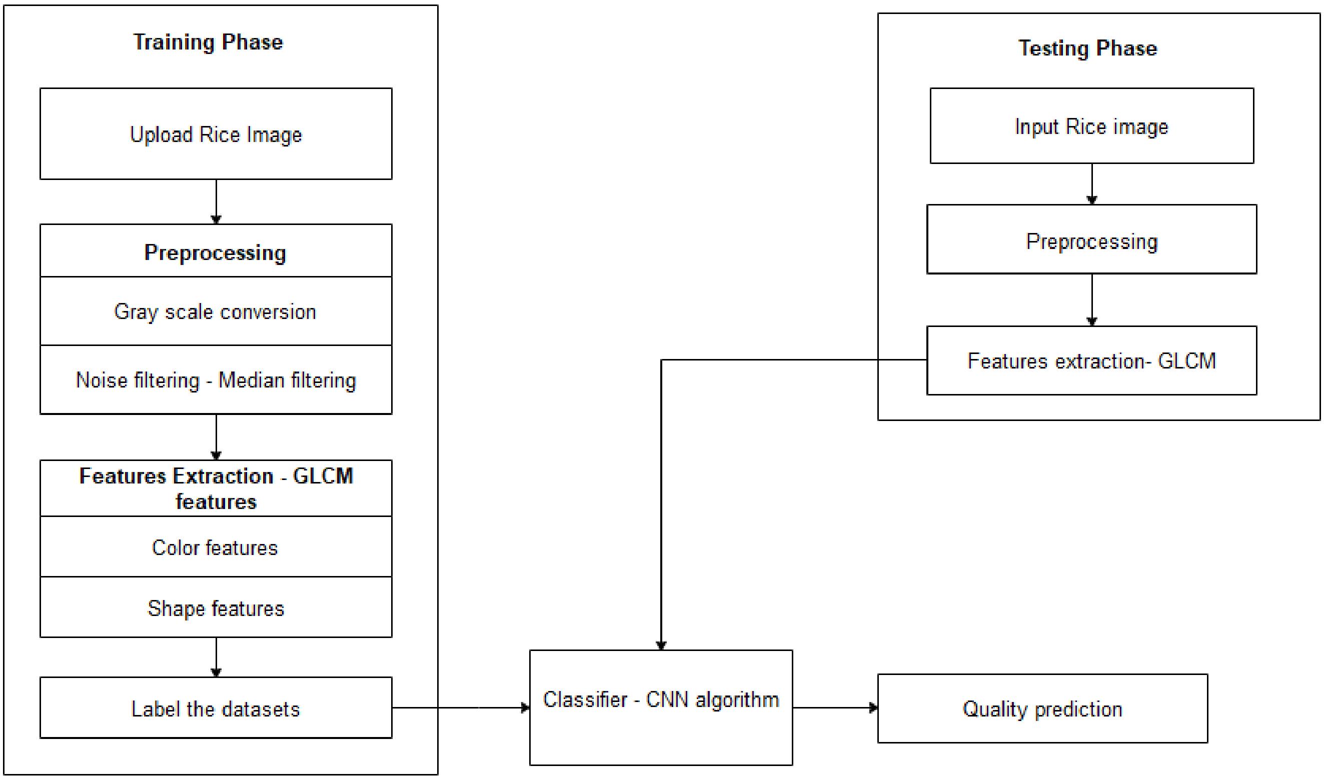

FIG 1. Block Diagram

4.2 PROJECT EXPLANATION

4.2.1. Image Upload

Quality analysis is crucial in the agricultural industry, particularly concerning grain seeds. Traditionally, quality assessment relies on visual inspection conducted by skilled technicians. However, this method is subjective, prone to variability, and time-consuming. Additionally, results may be influenced by the technician's subjective judgment. To overcome these challenges, a new approach leveraging advanced image processing techniques is proposed.

This approach begins with the acquisition of images using standardized lighting setups. These captured images are then transferred to a desktop computer via USB cable for subsequent processing using specialized image processing algorithms.

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FIG 2. Loading Image

4.2.2 Preprocessing

The goal of pre-processing is to refine image data by mitigating undesired distortions or accentuating essential image features for subsequent analysis. This encompasses geometric modifications such as rotation, scaling, and translation, as they serve akin objectives. Initially, the user specifies the lung frame image for subsequent processing. Subsequently, each image undergoes resizing to dimensions of 256*256 and is subjected to a median filter to eliminate noise from the lung images.

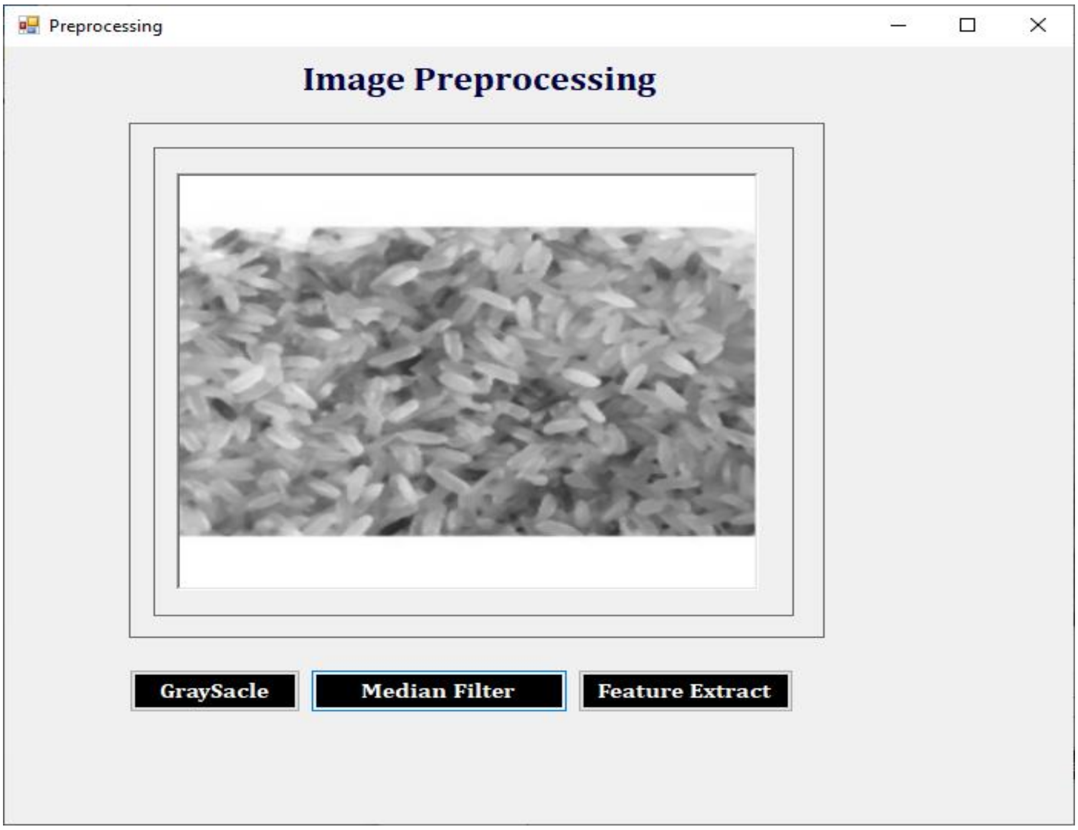

FIG 3. Image Preprocessing

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4.2.3. Edge Detection

Edge detection methods are utilized to identify abrupt changes in attributes such as color, gray level, and texture within images, employing a variety of edge operators. The Sobel operator, also referred to as the Sobel–Feldman operator or Sobel filter, is commonly employed in image processing and computer vision applications, particularly for enhancing edges. Since digital images represent intensity functions at discrete points, the derivation of derivatives requires assuming an underlying continuous intensity function sampled at these discrete points.

4.2.4. Feature Extraction

Feature extraction seeks to simplify the representation of extensive datasets, reducing the computational resources needed for accurate description. When analyzing complex data, a significant hurdle arises from the multitude of variables involved. Handling such data typically requires substantial memory and computational power or risks overfitting with complex classification algorithms. Feature extraction encompasses various methods aimed at addressing these challenges by constructing composite variables that balance accuracy and computational efficiency.

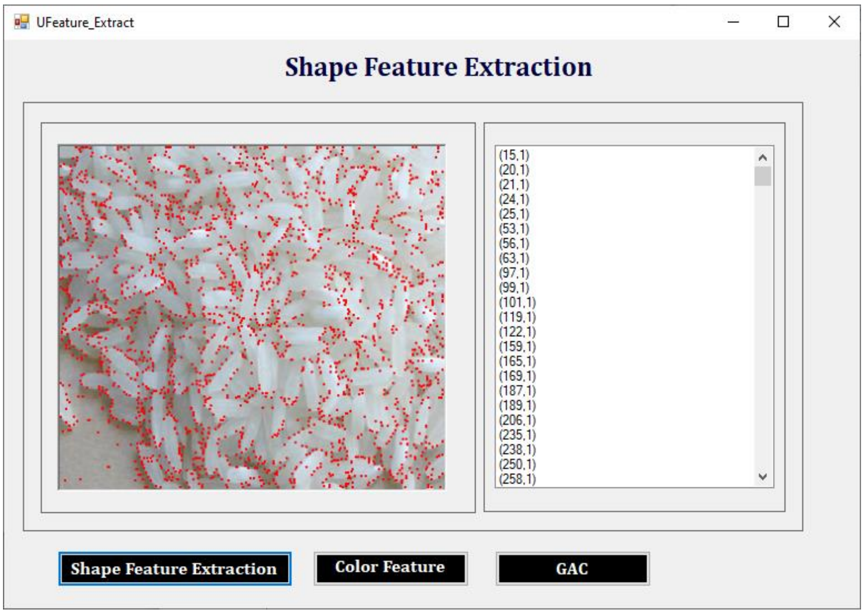

FIG 4: Shape Feature Extraction

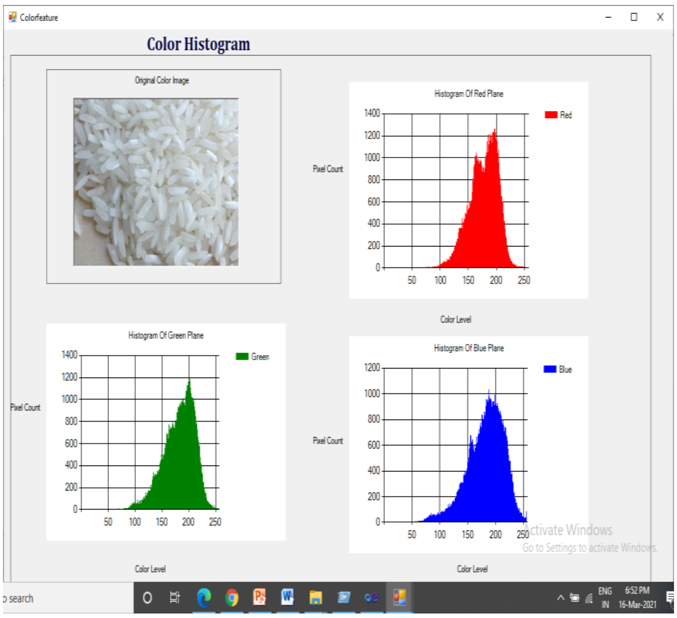

FIG 5: Color Histogram

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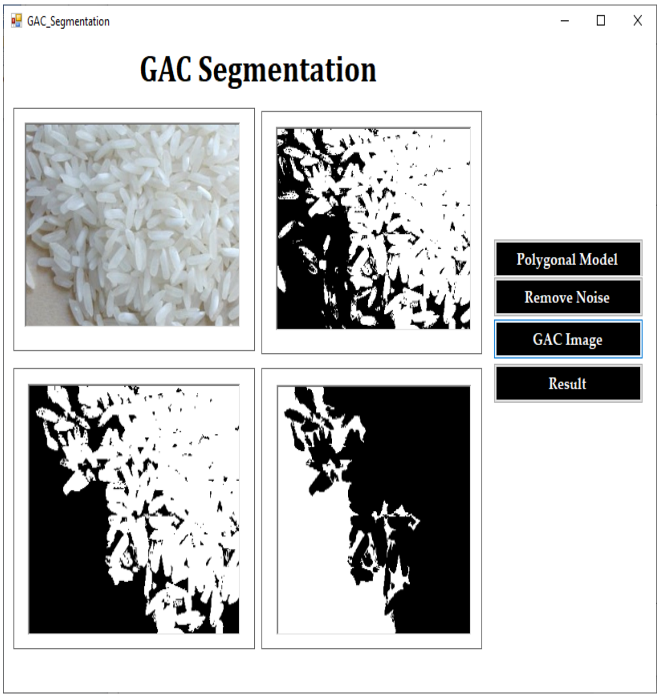

FIG 6: GAC Segmetation

4.2.5. Rice Classification

A Convolutional neural network (CNN) algorithm is a new pattern classifier was trained for classification of the samples into the grades. CNN models are closely related. The technique has successfully been applied to standard classification tasks, such as text classification and medical diagnosis. CNNs avoid the "curse of dimensionality" by placing an upper bound on the margin between the different classes, making it a practical tool for large, dynamic datasets. The feature space may even be reduced further by selecting the most distinguishing features through minimization of the feature set size.

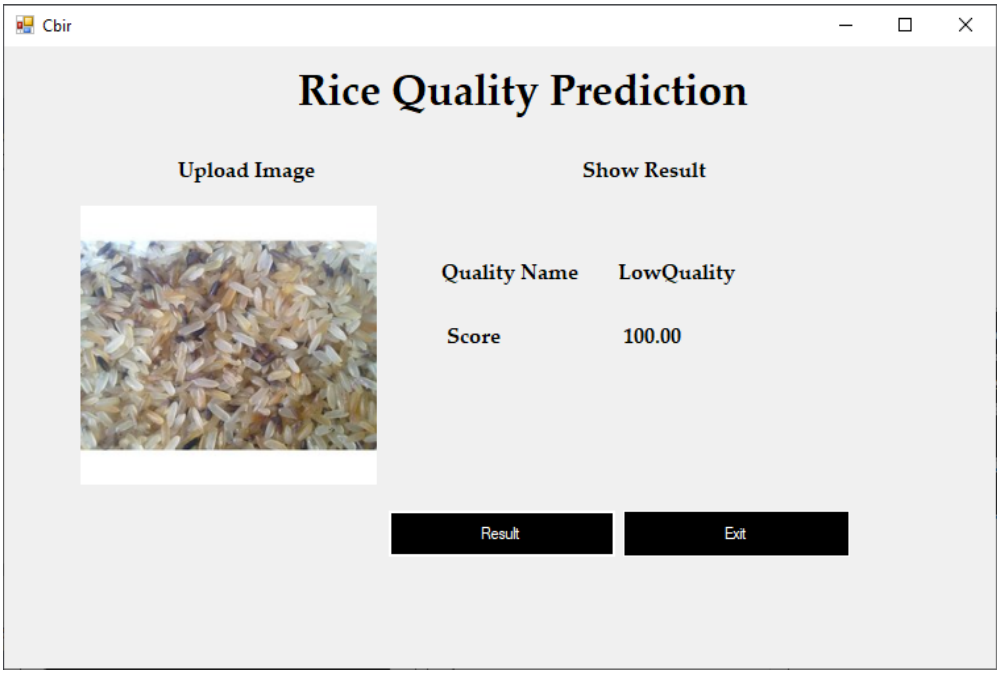

FIG 5. Rice Quality Prediction

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V. IMPLEMENTATION AND RESULT ANALYSIS

Implementation denotes the phase of the project where the conceptual blueprint transforms into a functional system. This juncture is pivotal for ensuring the system's success and instilling user confidence in its efficiency and effectiveness. It entails meticulous planning, assessment of current system constraints, and the formulation of strategies for seamless transition. The implementation process commences with the formulation of a comprehensive plan delineating sequential activities, resource allocation, and testing protocols. Coding involves translating detailed design specifications into a programming language, with a focus on the following aspects:

- Facilitating ease of design-to-code translation.
- Enhancing code efficiency.
- Optimizing memory usage.
- Ensuring maintainability.

Implementation represents the critical phase wherein the theoretical design materializes into a functional system, fostering user trust in its capabilities and performance.

VI. CONCLUSION AND FUTURE ENHANCEMENT

Physical rice grain composition is one of the components used for rice grading which involve the identification of head rice and broken rice. Rice grading is important to ensure only edible rice reaches the consumer standard. It also protects consumers from price manipulation. In this project, a new approach of image processing technique has been developed to detect and identify head and broken rice based on its physical properties, i.e. area, perimeter, minor axis length and major axis length. From this research, it can be concluded that the physical rice grain composition can be determined using an image processing technique. Area has been identified as the most appropriate properties when compared to perimeter, major axis length and minor axis length. The method gives higher percentage of success when tested using 0%, 1%, 10%, 15% and 20% of broken rice with the average percentage of success of 98%. This promising result provides an alternative way to grade rice. The method has an advantage on its simplicity. This straightforward method is easy to be used and fast. It does not involve any step-by-step procedure to optimize the criterion and only takes 4 s to complete the operation. Although the percentage of success is promising, however, more sophisticated method might be considered to solve problem on undetected broken rice. It can be done by using more than one parameter such as combination of area and major axis length.

In future we can extend the approach to implement the neural network algorithm to predict the quality of rice with improved accuracy rate.

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