M. Mohanedova *et al*, International Journal of Advances in Agricultural Science & Technology,
Vol.11 Issue.4, April 2024, pg. 45-50

ISSN: 2348-1358

Impact Factor: 6.901

NAAS Rating: 3.77

Deep Learning-Based Rice Quality Evaluation using Image Processing for Physical Attribute Analysis

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Abstract:

The quality check of rice grain was done manually by experienced inspectors, but their analysis was incorrect. This paper proposes an automated strategy for collecting data on various rice types and analysing them based on their physical properties. We used methods such as computer vision and digital image processing, which included pre-processing, morphological analysis, edge and object detection, and object measurement. The system is trained using both manual and machine learning techniques. The findings of image processing are saved to a file, and hypotheses for manual and machine learning training are generated using SVM and manual approaches. The quality is then examined to establish whether the two ways result in higher or lower marks, and the best methodology is chosen through observation.

Keywords: Image processing, quality analysis, Machine learning, physical attributes, Support Vector Machine, Confidence Interval.

I. Introduction

Image processing manipulates images by applying required operations on a specific image in order to extract vital information from it in a more comprehensible and effective manner. Every entering image must go through three stages of image processing: pretreatment, augmentation and display, and information extraction. Pre-processing an image file, such as grey scaling and binary image conversion, can reduce noise and make further processing easier. To improve the image file, morphological techniques such as erosion and dilation are employed to remove undesired parts such as overlapping objects. Edge detection is used to extract important details from an image. To extract useful parameters from each object in the image, information extraction begins with object identification, or recognition, and then progresses to object measurement [1].

Even though machine learning is a subset of software engineering, it is not synonymous with traditional computational methodologies. Machine learning tasks are often divided into broad categories based on how the system being developed receives feedback. The two most popular machine learning strategies are supervised learning and unsupervised learning. Supervised learning uses human-labelled data to train algorithms, whereas unsupervised learning uses unlabelled data.

Support vector machines, or SVMs, are supervised learning models that use appropriate learning techniques to assess and perform regression and classification on the studied data. An SVM method builds a model and assigns each training example to one of two classification categories for a given set of training instances, each of which is labelled with one of the two. This produces a non-probabilistic binary linear classification. SVM Representation The model or points in space of a single training example are mapped to create a distinct gap between each category. The classification improves as the gap increases. SVM generates hyperplanes, which are used for regression, outlier detection, and classification applications. A linear model might be transformed into non-linear by applying suitable Kernel tricks [2]. In statistics, a confidence interval (CI) is a type of interval estimate (of a population parameter) derived from observed data. The confidence level refers to the frequency, or proportion, of potential confidence intervals containing the true value of the linked parameter. Computer vision research has focused on the analysis of rice grain quality. According to some research, the shape of the rice grain is more important than its texture or other external qualities. Grain colour varies more than form, although it does not

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yield accurate results [3]. The proposed method's major purpose is to give a novel way to quality control and analysis that takes less time, money, and effort.

II. LITERATURE SURVEY

"Analysis and Categorization of Rice Quality Through Image Processing Methods" Rice provides the daily calorie requirements of around 21% of the worldwide population and is consumed by more than half of the world's population. It is recognized as a whole grain that is strong in fiber and contains 80% protein, phosphorus, and potassium. Rice comes in hundreds of different variations, each with its own flavour, texture, and shape that makes it excellent for a specific dish. Different types of rice are appraised using different quality standards. As a result, you must select the best rice available, as it is both helpful to your health and safe to consume. Manual grain sample analysis is difficult and time-consuming. This study describes an image processing-based system for analysing and grading rice grains. To evaluate rice samples, several approaches such as image reduction, enhancement, and increment are utilized to identify spatial objects. These procedures are used on individual rice grains to determine their size, colour, and overall quality. We measure the length and width of each rice grain after we have determined its endpoints.

"Rice Grain Quality Analysis and Grading" The quality of the food grains we consume is more important since people are expecting higher-quality grains as they become more educated. Dealers could meddle with food grains. Typically, visual inspection—a manual process—is utilized to ensure quality. In this work, an image processing technique is used to overcome the limitations of a manual operation through automation. This essay provides a size-based quality assessment of rice grains. Grain grades (grades 1, 2, and 3) are based on size. We tested a range of rice grain varieties, including egg rice, boiling rice, sona masuri, and basmati. The 105 photo sets utilized in the system's development were classified using a decision tree-based classification technique. The findings appear to be promising.

"Analysis of Rice Grading Quality for Agmark Standards" AGMARK employs a manual inspection approach for its rice grain quality assessment, which has been demonstrated to be ineffective and yields incorrect results when carried out by designated inspectors. AGMARK Standards require the use of a computerized inspection method to determine rice quality. In light of this, this study proposes a digital technique for measuring rice quality in compliance with current AGMARK standards. The suggested solution is based on MATLAB's digital image processing methodology. This work proposes the digital translation of three parameters—broken grain, foreign particle, and Agmark Standard mixture—for digital rice quality inspection.

"Intelligent Plant Crack Identification through Image Processing Methods" This study proposes a method for locating fractures in paddies. A single paddy's X-ray image is captured, and image processing techniques are used to assess the paddy's quality without dehusking. thus, eliminating the time-consuming, difficult, and wasteful process of grading rice particles. Crack identification is accomplished by using pre-processing techniques such as de-noising, edge detection, dilatation, and region of interest (ROI) extraction to the produced X-ray image of the paddy, hence assessing the paddy's quality. Paddy's condition determines both its price and quality.

"Analysis of Rice Quality Using Image Processing Technique Based on Physical Attributes" This review paper applies computer vision and image processing techniques to the quality management of rice, the most important crop for humans and the food industry. A major difficulty confronting the Indian food industry is the arduous, costly, and time-consuming quality control process carried out by human inspectors.

III. SYSTEM ANALYSIS

A. EXISTING SYSTEM

Rice quality inspection systems often use image processing techniques such as texture analysis, colour analysis, and shape identification to assess the size, shape, colour, and defects of rice grains.

Smart Grading Machines:

These machines use image processing algorithms and hardware components such as cameras and sensors to automatically analyse rice grains based on quality requirements. These machines can detect faults in grains, such as broken or discoloured grains, and arrange them accordingly.

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A few smartphone applications have been developed to assess the quality of rice. These tools allow users to take photos of rice samples with their smartphones' cameras and do rudimentary studies, such as colour and texture analysis, to assess quality features.

DISADVANTAGES OF THE EXISTING SYSTEM

1.Cost: Many of today's systems, particularly commercial and cutting-edge research prototypes, can be expensive to buy, maintain, and operate. As a result, small-scale farmers and agricultural cooperatives with limited resources may find it more challenging to implement these methods.
2.Complexity: Certain systems may be difficult to calibrate, set up, and run, demanding specialized knowledge and training.
3. Limited Adaptability: Some systems may be less adaptable than others when it comes to different rice types, growing environments, and processing conditions.
4. Data Requirements: Deep learning or machine learning algorithms require large amounts of labelled data for training, which can be difficult and time-consuming to collect, process, and annotate
5. Accuracy and Reliability: While many systems claim high accuracy in rice quality assessment, there may be variability in performance depending on factors such as lighting conditions, camera quality, and sample preparation methods. Ensuring consistent and reliable results across different settings can be a challenge.

B. PROPOSED SYSTEM

The recommended method aims to change rice quality analysis by automating the current manual inspection-based assessment procedure. Using image processing and machine learning, the system focuses on key physical parameters of rice grains such as area, perimeter, width, height, aspect ratio, and main and minor axes. Images are acquired using task-appropriate hardware and then pre-processed to increase their quality. Segmentation separates rice grains from backgrounds, whereas feature extraction captures relevant information. The system employs a machine learning model (SVM) built on a dataset consisting of both manual and processed image data. Testing and assessment determine the effectiveness of the proposed approach by comparing the system's classification performance The recommended method aims to change rice quality analysis by automating the current manual inspection-based assessment procedure. Using image processing and machine learning, the system focuses on key physical parameters of rice grains such as area, perimeter, width, height, aspect ratio, and main and minor axes. Images are acquired using task-appropriate hardware and then pre-processed to increase their quality. Segmentation separates rice grains from backgrounds, whereas feature extraction captures relevant information. The system employs a machine learning model (SVM) built on a dataset consisting of both manual and processed image data. Testing and assessment determine the effectiveness of the proposed approach by comparing the system's classification performance.

IV.SYSTEM DESIGN

SYSTEM ARCHITECTURE

Below diagram depicts the whole system architecture.

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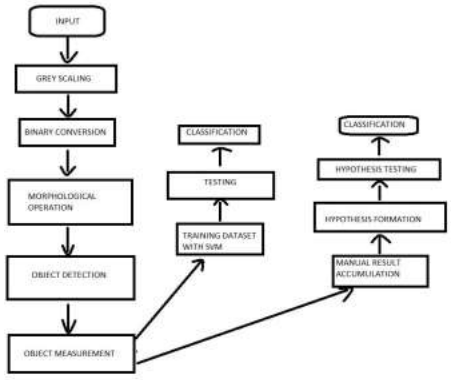

Fig 1. Methodology followed for proposed model

V. SYSTEM IMPLEMENTATION

MODULES

To properly manage and carry out the multiple operations, the project "Rice Quality Analysis Based on Physical Attributes Using Image Processing and Machine Learning" can be divided into several modules. The following modules may be incorporated in your project:

Image Acquisition Module: Utilizes appropriate hardware to capture sharp, consistent images of rice grains.

Pre-processing Module: In charge of using normalization and other pre-processing techniques to improve the quality of acquired images.

Image Segmentation Module: This module employs segmentation techniques to separate the rice grains from the background, ensuring accurate analysis.

The feature extraction module extracts relevant physical features from the segmented rice grains, such as area, perimeter, width, height, aspect ratio, major axis, and minor axis.

Machine Learning Training Module: Using the extracted features and a collection of manually classified data, this module trains a machine learning model, such as a Support Vector Machine.

The manual classification module: allows qualified inspectors to manually classify rice grains, creating a baseline against which the automated system can be compared.

The Results Analysis Module: evaluates the system's performance by comparing and analyzing the results of the manual classification procedure and the machine learning model.

The optimization module: improves classification accuracy by modifying the machine learning model's parameters.

The User Interface Module: provides an easy-to-use interface via which users may communicate with the system, input new data, and view results.

The reporting module: generates detailed reports that include comparisons of automatic and manual classifications, as well as a summary of the analysis' conclusions.

The integration module: brings all of the modules together to create a single system that allows for the seamless operation and automation of the rice quality analysis procedure.

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VI . RESULTS AND DISCUSSION

Through this we aim to automate rice quality analysis and we have developed a software solution primarily to reduce inconsistency with the manual quality analysis, time consuming and customer driven. Through this automation, not only increases efficiency but also reduces the labour cost provided for the quality inspectors, which will be a beneficiary, if implemented in a real world. We are hoping that this work could be utilized to extract its usefulness in real world scenario, not only rice industries, but also in retail shops and many other places. This could also be extended to different food item.

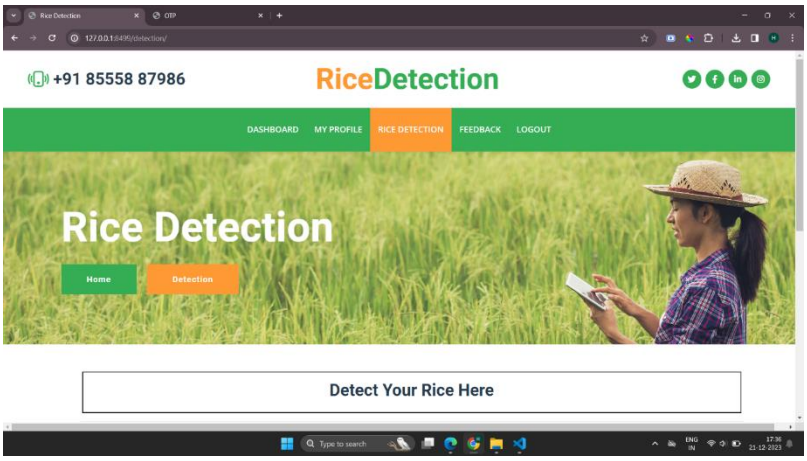

Fig 2.Providing Rice Image For Predection Of Quality

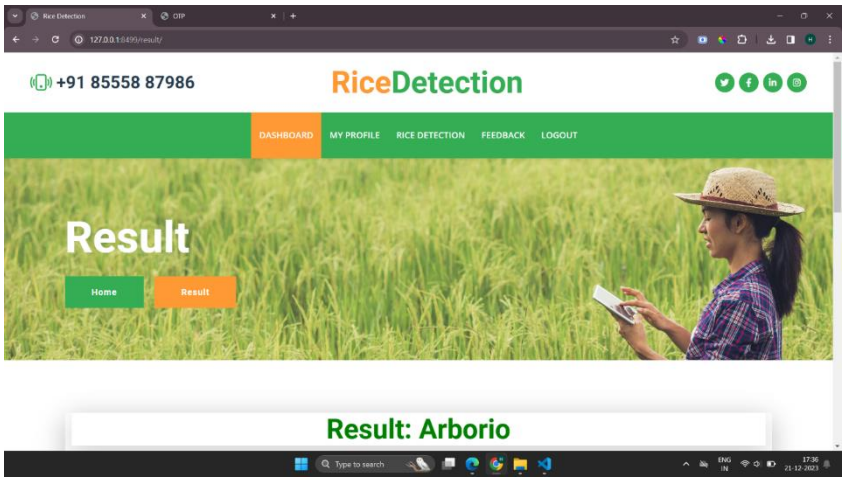

Fig 4. Identifying Rice Quality

VI I.CONCLUSION AD FUTURE WORK

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