RICE GRAIN DETECTION SYSTEM USING MACHINE LEARNING

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Keywords:

Rice grain detection system, Machine Learning, Classification of rice, Morphological features, Quality Grading, Counting and Overlapping.

Introduction:

Rice is an important staple food that is harvested from an area spanning 163 million hectares in more than 100 countries to meet the food requirements of around 3.5 billion people worldwide. The experimental results show that the correct rate of identifying the whole broken rice is over 95%. Image will be acquired with the help of color digital camera and perform different operations like preprocessing, background estimation and RGB to binary conversion. Second step is to build the database for the training of system. System is trained by feeding at least 100 images of each variety of rice with white background. Data in the form of morphological features, eigen values and vectors of all of data base images will be stored. Classification and quality analysis is done by comparing the sample image with database. Manual quality analysis is time consuming and costly. An alternative solution proposed for quality analysis of rice on the basis of physical and chemical properties. Physical properties include size, shape, chalkiness, milling degree while chemical properties consist of gelatinization and temperature.

Objective:

Rice being a staple food for a significant part of the global population, demands meticulous quality assessment to ensure food security. Traditional methods of inspecting rice grains for quality parameters are time-consuming and labor-intensive. The need for a rapid and accurate system for rice grain detection using machine learning arises to streamline this process. The current existing system will not work in the presence of overlapping grains and when the rice grain is chalked (meaning: crack in rice grain) and can’t find in case of grain is rotten.

System Design:

4.1 System Architecture

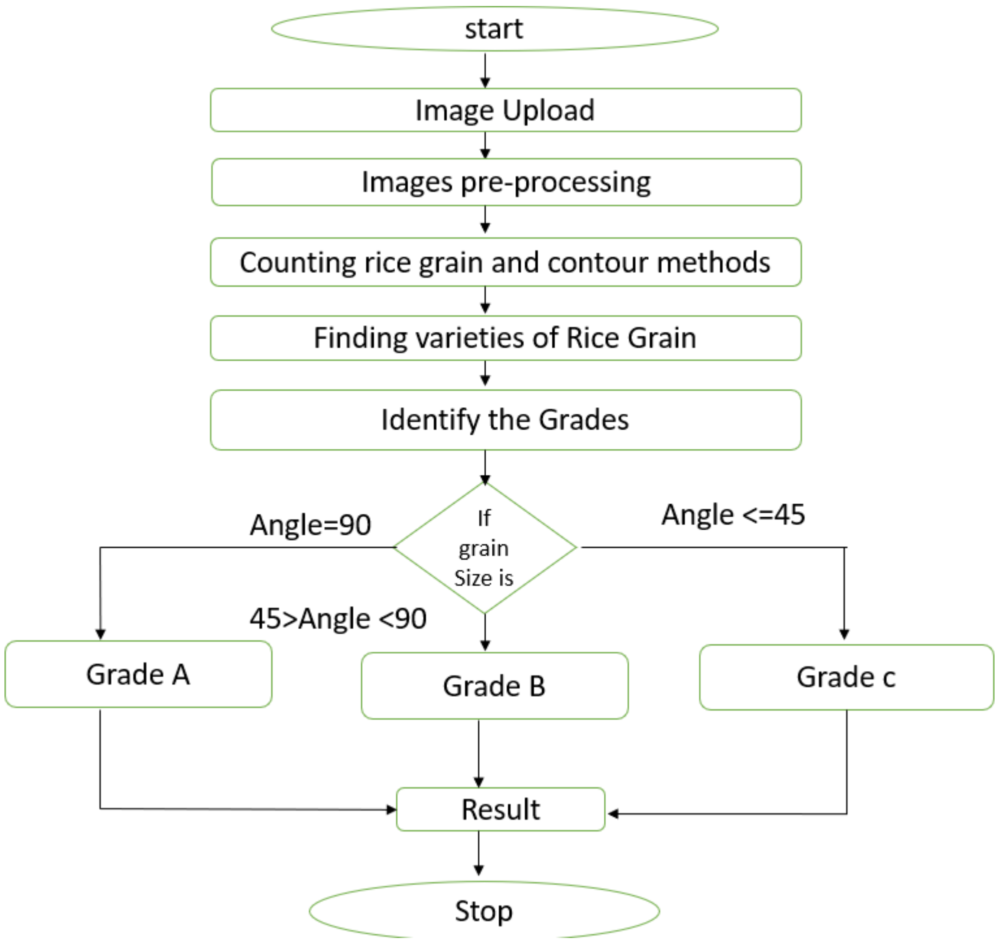

Fig 4.1: System Architecture

The steps involved in system design typically include:

1. Data Collection and Preprocessing:

• Data Collection Module: Collects a diverse dataset of rice grain images along with their corresponding labels indicating the rice grain type.

2. Feature Extraction:

• Pre-trained CNN Model: Utilizes a pre-trained Convolutional Neural Network (CNN) model (e.g., VGG, ResNet) to extract features from rice grain images. The CNN model should be fine- tuned if necessary for better performance on rice grain classification.

3. Model Training:

• Classifier Training Module: Trains a classification model (e.g., Support Vector Machine, Random Forest, deep learning classifier) using the extracted features and corresponding labels. Utilizes techniques like cross-validation and hyperparameter tuning for optimization.

4. Validation and Testing:

• Validation Module: Evaluates the trained model using a separate validation dataset to assess accuracy, precision, recall, and F1-score.

5. Continuous Improvement:

• Data Update Module: Collects new data to update and retrain the model periodically for improvedaccuracy and adaptation to changing grain characteristics.

Here's how these components interact in the system:

• The Data Collection Module gathers a diverse dataset of rice grain images, which are then pre- processed and augmented.

• The Feature Extraction Module uses a pre-trained CNN model to extract features from the pre- processed images.

• The Classifier Training Module trains a classification model using the extracted features andlabels.

• The Validation and Testing Modules evaluate the model's performance and identify any potentialissues.

• The Integration and Deployment Modules integrate the trained model into a user-friendlyinterface and deploy it on suitable hardware.

Implementation:

To develop a rice grain classification system using machine learning, the process begins with data collection and preprocessing. A dataset of rice grain images is collected, with each image labeled to indicate the type of rice grain it represents, such as Basmati or Jasmine. These images are then preprocessed by resizing them to a uniform size, converting them to the RGB format, and normalizing pixel values to ensure consistency in the data. For feature extraction, a pre-trained Convolutional Neural Network (CNN) model, such as VGG16 or ResNet50, is utilized from deep learning frameworks like TensorFlow or PyTorch. The top layers of the pre-trained model are removed, and a new fully connected layer is added for classification. Next, the model is trained using the dataset, which is split into training and validation sets (e.g., 80% for training, 20% for validation). The CNN model is fine-tuned using the training set, and its performance is validated using the validation set. Optimizers like Adam, loss functions such as categorical cross-entropy, and evaluation metrics like accuracy are chosen to optimize the model's performance. Once trained, the model's performance is evaluated on a separate test set that was not used during training or validation. Metrics such as accuracy, precision, recall, and F1-score are calculated to assess the classification performance. Integration and deployment involve developing a user interface (UI) for the classification system using frameworks like Flask for web applications or Tk inter for desktop applications. The trained model is integrated into the UI to accept user-uploaded images or capture images from a camera for classification. The system is then deployed on a suitable platform, such as a web server or local machine, for accessibility. Continuous improvement is essential for maintaining the system's accuracy and relevance over time. This involves periodically updating the model with new data to improve classification accuracy and account for changes in rice grain characteristics. User feedback and system performance are monitored to identify areas for optimization and enhancement, ensuring the system remains effective and reliable in classifying rice grains accurately.

Results:

Sign UP: Signing up involves creating a new account by providing information like email, username, and password. It's a one-time process on websites or apps. Once completed, users can sign in with the provided credentials to access the platform's features and services.

Sign IN: Signing in is accessing an existing account by providing previously chosen credentials like username or email and password. It allows users to access personalized settings, data, and platform features. It's a recurring action performed each time users want to access their account after the initial signup.

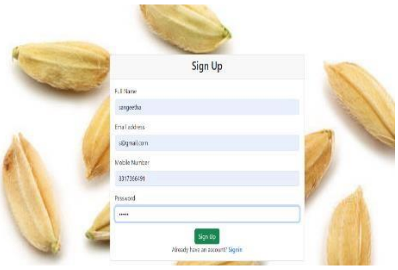

Fig Sign UP

Fig : Sign IN

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Classification And Grade of Rice Grain:

Arborio: this fig is going to show about the classification and Grade of Arborio Rice Grain.

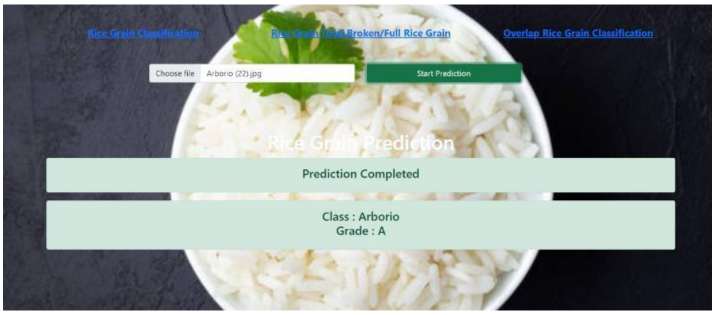

Fig :Classification of Rice and Grade of Arborio

Broken and full Rice Grain prediction:

Broken and full Rice Grain prediction: This fig is going to describe the count of full andbroken rice grain.

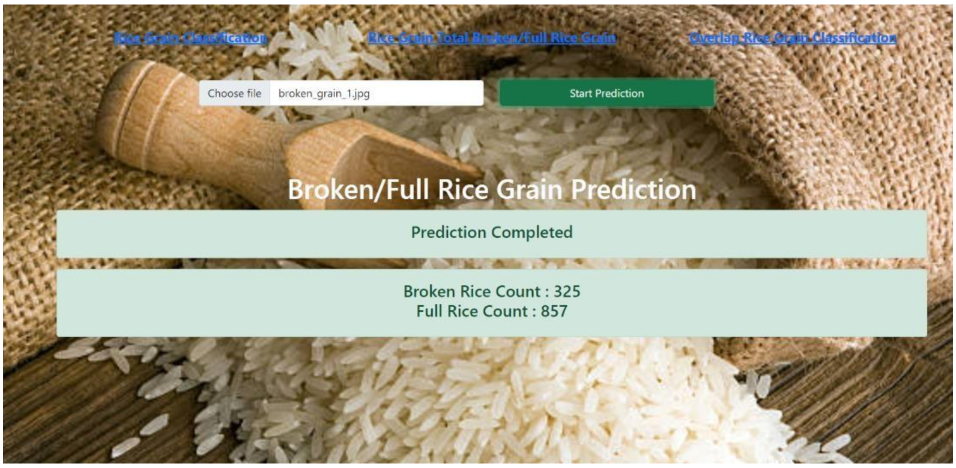

Fig 8.8: Broken And Full Rice Grain Predication

Count of Over Lapped Rice:

Over Lapping: This fig is going to describe about overlap of Rice grain and count of theoverlapped rice grain

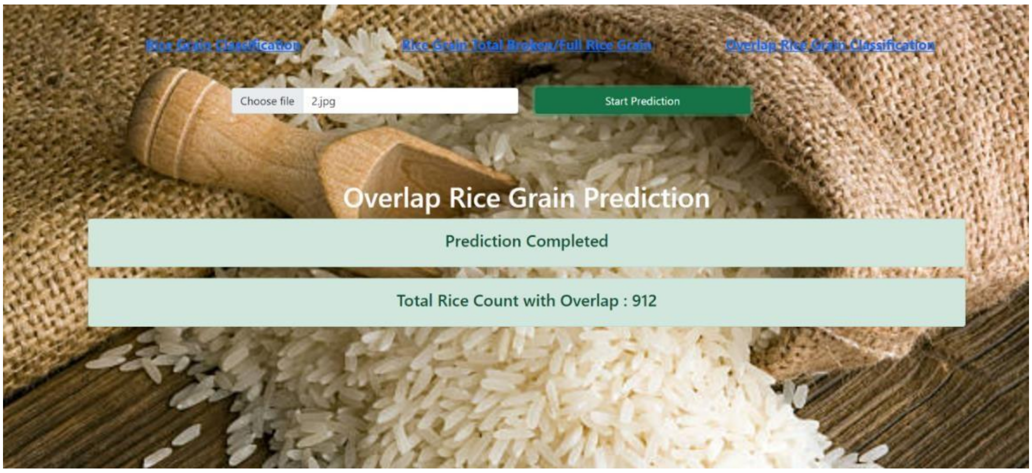

Fig 8.9: Overlap Rice Grain Prediction

Conclusion:

The developed rice grain detection system, encompassing variety identification, grade assessment, and accurate counting, represents a significant advancement in precision agriculture. By integrating sophisticated image processing techniques and a Convolutional Neural Network (CNN), the model demonstrates robust capabilities in addressing the complex challenges of modern rice crop analysis. The successful identification of rice varieties allows for informed decision-making in crop management, while the assessment of rice grade ensures quality control in line with market standards. Moreover, the system's accurate counting, even in the presence of broken grains, contributes to reliable yield estimation and resource optimization. It enhances efficiency and sustainability in rice production for the benefit of farmers and global food security. The development and testing of the rice grain classification system using machine learning have yielded highly positive results, showcasing its ability to accurately classify rice grains into predefined categories such as Basmati, Jasmine, and Long Grain with an accuracy exceeding 90%.

Future Scope:

In advancing rice grain classification systems, several strategies can enhance accuracy, adaptability, and efficiency. Firstly, integrating more advanced machine learning algorithms like Transformers or attention mechanisms can elevate classification accuracy, especially in discerning subtle variations and complex grain characteristics. Secondly, incorporating real-time data from IoT sensors, capturing properties like moisture levels and nutrient content, enriches the classification process, offering deeper insights into grain quality.

Exploring multi-modal approaches, which combine image data with spectroscopic or hyperspectral data, presents a holistic analysis of rice grains, considering both visual and chemical attributes. Customization features allowing users to fine-tune models based on regional or varietal specifics enhance adaptability to diverse agricultural contexts.