iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** V **Month of publication:** May 2019

DOI: https://doi.org/10.22214/ijraset.2019.5110

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 7 Issue V, May 2019- Available at www.ijraset.com

Rice Grains Categorization using Neural Network

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Abstract: Rice is one of the most important food crop consumed by all the human beings. In this paper, an algorithm is used to classify three different varieties of rice based on their features. The proposed algorithm is a supervised learning algorithm which consists of five steps. The steps include image acquisition, image segmentation, feature extraction, neural network classifier and decision making. Fifty four color features and six texture features are extracted from each rice kernel. After passing these features to feed forward neural network, it identifies and counts the different types of rice kernels and displays the result. The overall classification accuracy rate is 98%.
Keywords: Acquisition, segmentation, neural network

I. INTRODUCTION

In the current grain-handling systems, grain type is assessed by visual inspection. The evaluation process for this is tedious and time consuming. The decision making capability of a person can be affected by different parameters like fatigue, eyesight and mental state caused by biases and work pressure and also working conditions such as improper lighting condition, etc. Hence, this needs to the automation of process by developing an imaging system that should acquire the rice grain images, rectify, and analyze it. In this project, we propose a simple, effective and high accuracy vision-based approach using pattern recognition techniques to identify rice varieties. The specific goal was to generate the optimal color and texture features for classifying the rice varieties with increased accuracy rate.

A. Software Components

1) Operating system: Windows XP/7
2) Coding Language: MATLAB
3) Tool: MATLAB R2015b

B. Proposed Method

In the proposed method, a new approach for classification of rice kernels variety using Feed-Forward Neural network is presented. Here three varieties of rice grains are taken namely Basmati, Masoori and Raw rice grains and the features of each type are calculated and trained to neural network.

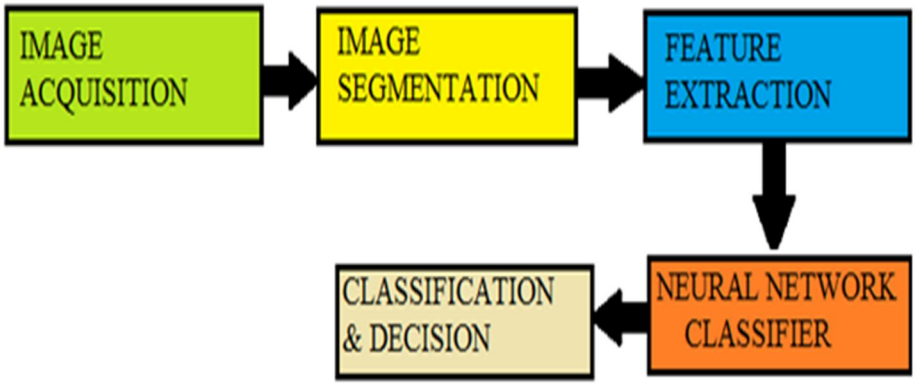

Fig 1: Block Diagram

The block diagram shown in figure-1 illustrates the procedure for recognition and classification of rice grains. It consists of following steps: Image Acquisition, Image Segmentation, Feature Extraction, Neural Network Classifier and Classification & Decision.

C. Working

The input image is first converted in to gray image and then to binary image as shown in figure 2.

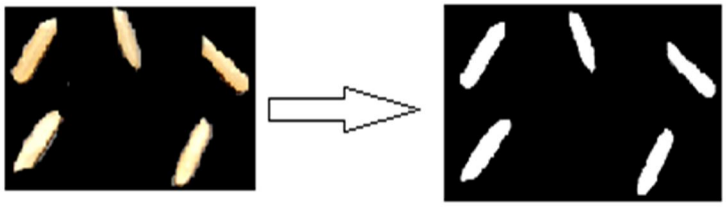

Fig 2: Image Acquisition & Conversion

During image segmentation, all the rice kernels in the image are segmented by thresholding as shown in figure 3.

Fig 3: Image Segmentation

The features are then extracted for each rice kernel and passed to neural network. The neural network then identifies and counts the number of different rice varieties as shown in figure 4. Based on the highest count, it displays the result in command window.

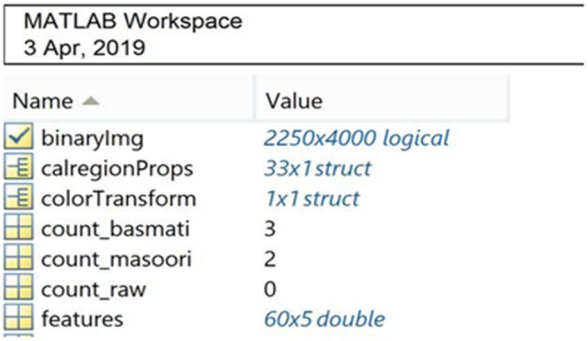

Fig 4: Workspace Window showing count variables

D. Feature Extraction

About fifty four color and six texture features are calculated for each rice kernel.

1) *Color Featues:* Currently the common color models are RGB, HSV, and L*a*b* models. The color features that are extracted from images of individual rice kernels are: Mean, Square of Mean, Standard Deviation, Kurtosis, Variance and Skewness as shown in figure 5. All these features were extracted on R, G and B in RGB color space. Also H, S, and V in HSV color space and luminance, a, and b in L*a*b* color space.

KURTOSIS $\mathrm{Kurt}[X] = \mathrm{E}\left[\left(\frac{X-\mu}{\sigma}\right)^4\right]$ .... (1)

STANDARD DEVIATION $\sigma = \sqrt{\frac{\sum (X - \overline{X})^2}{n-1}}$ ....(2)

VARIANCE $\sigma^2 = \sum \frac{(X-\mu)^2}{N}$ ....(3)

SKEWNESS $\gamma_1 = \mathrm{E}\left[\left(\frac{X-\mu}{\sigma}\right)^3\right]$ ....(4)

Fig 5: Color Features Extracted

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
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2) Texture Features: The texture features that are extracted from images of individual rice kernels are shown in figure 6.

- Mean (m): $\sum_{i=1}^{L-1} z_i p(z_i)$ --(5)
- Standard deviation (σ) : $\sqrt{\mu_2(z)}$ --(6)
- Entropy (e): $-\sum_{i=0}^{L-1} p(z_i)\log_2 p(z_i)$ --(7)
- Uniformity (U): $\sum_{i=0}^{L-1} p^2(z_i)$ --(8)
- Third moments: $\sum_{i=1}^{L-1} (z_i - m)^3 p(z_i)$ --(9)
- Smoothness (μ_3): $1-1/(1+\delta^2)$ --(10)

Fig 6: Texture Features Extracted

E. Neural Network Classifier

A neural network is a computing model whose layered structure represent the networked structure of neurons in the brain, with layers of connected nodes. A neural network can learn from data so that it can be trained to classify data. A neural network breaks down the input into layers of abstraction. It can be trained over many examples to recognize patterns in speech or images. Its behaviour is defined by the way its individual elements are connected and by the strength or weights of those connections. These weights are automatically adjusted during training with respect to a specified learning rule until the neural network performs the desired task correctly.

Here Feed-forward artificial neural network is used to classify different varieties of rice grains. It allows signals to travel in one way only that is from input to output. There is no feedback (loops). Feed-forward ANNs are straight forward networks that associate inputs with outputs. They are extensively used in pattern recognition. This type of organisation uses bottom-up or top-down approach.

II. CONCLUSION

An algorithm was developed to identify varieties of rice grains based on their color and texture features. Sixty features were extracted which include fifty four color and six texture features. These features are then passed as inputs to the neural network to classify the rice kernels. In the test dataset, the total classification accuracy rate is 98%. If there is large amount of dataset then accuracy rate increases.

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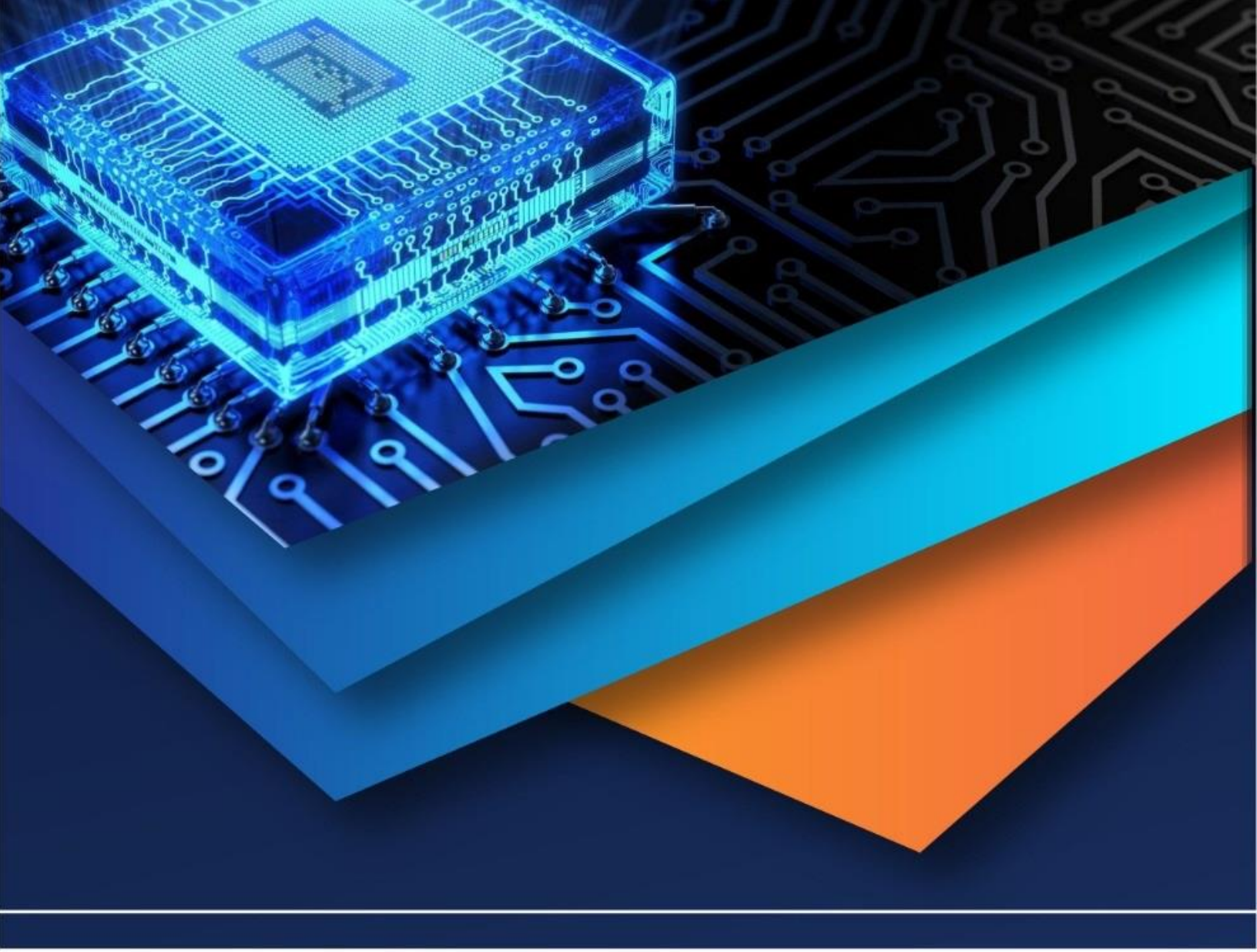
[8] MATLAB can be downloaded by following the steps in this video https://youtu.be/WOpjQouVlFg
[9] MATLAB can be installed by following the steps in this video https://youtu.be/xSXW9SkETB4



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