

# A Survey on Food Grain Identification Techniques

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**ABSTRACT:** India is an agricultural country where a large number of food products are produced every year namely rice, ragi, jowar, cereals, pulses and other grains. Identification of each type of grain is a challenging task which needs expert knowledge. An efficient automated system, which can identify the grain type, is a topic of research from many years. The process of food grain identification includes image acquisition, pre-processing, data reduction and classification. In this paper, a study of the various techniques adapted till date to identify food grain is done.

**KEYWORDS:** Back Propagation Neural Network, Artificial Neural Network, Euclidian Distance

## I. INTRODUCTION

Grain analysis and identification is needed to obtain information about grain the type, variety and quality of the grains. Expert knowledge is required to identify grains and there are limited aiding tools and references [1]. Consumers are fraud by traders who release low quality grains to the market. They must be protected by consuming such sub-standard grains available in market. There is a need for an automated grain classification and recognition system to help consumers and agriculturalist in selecting good quality grains with less effort.

Digital image processing refers to processing of a 2D picture by a digital computer. Image is an array of complex or real numbers which are represented using a finite number of bits [1]. Digital image processing has various applications such as image transmission, remote sensing using satellites, medical processing, radar, robotics, Video processing, Microscopic Imaging and Agricultural fields. The general image analysis process is given in the figure 1. The process is broken into three primary stages i.e., pre-processing, data Reduction and feature analysis [2].

In pre-processing stage of image processing, noise is removed and irrelevant, visually unnecessary information are eliminated. Noise is generally unwanted information that is resulted from image acquisition process. Other pre-processing steps might include gray-level or spatial quantization or finding regions of interest for further processing.

Data Reduction includes either reducing the data in the spatial domain or transforming it into frequency domain and then extracting features for the analysis process. Feature analysis examines and evaluates the features extracted by the data reduction process for their use in the application. After pre-processing, segmentation of image can be performed in the spatial domain or in the frequency domain via a mathematical transforms. Image segmentation is used to find regions of the image which represent objects of interest and meaning parts of image. To perform any higher level operation on images and to identify real, pseudo objects, and shadow image needs some form of segmentation. The spatial frequency content of an image is given by transforms. In general, the mapping of image data into mathematical space is performed using transform equation.

After either of the processes namely segmentation or transform, the image could be filtered. The filtering process further reduces the data and allows us to extract the features that might be required for analysis.

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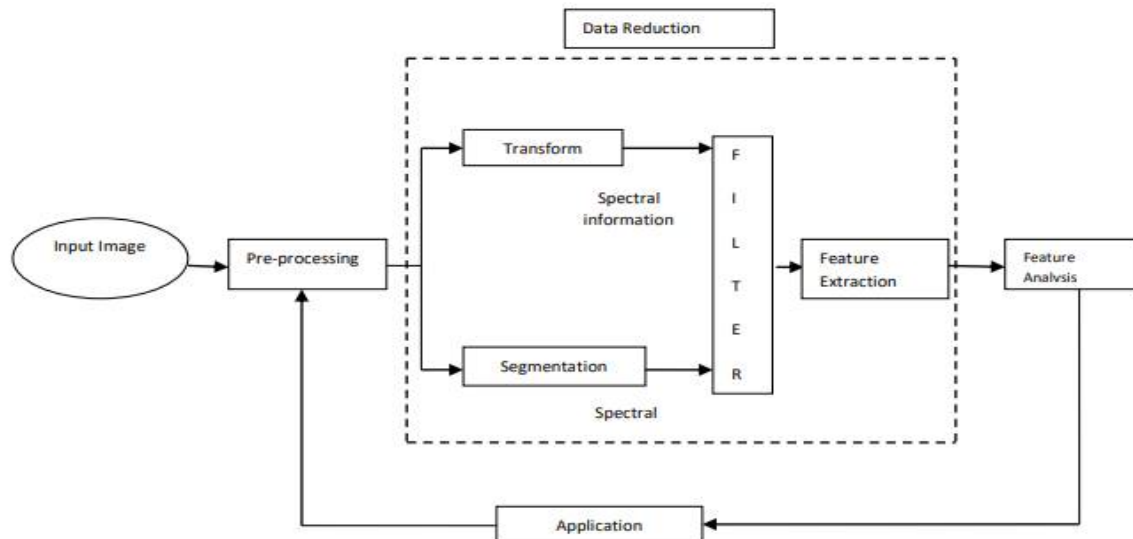


Figure 1: Image Analysis [2]

Image segmentation helps to get object features, and the image transforms provide us the features based on spatial frequency information- spectral features. The object features of interest include the geometric properties of colour features, binary objects and histogram features. After the features of interest are extracted, the image could be analyzed.

## Applications of Digital Image Processing

Digital Image Processing is applied in various fields of Agriculture Field, such as :

- To retrieve earth observation data and to support increased area under agriculture, increased crop intensity and productivity, Remote Sensing (RS) technique is used
- RS data is also applicable in providing the data related to groundwater level which helps in irrigation and flood management.
- To estimate direct and independent crop area in the study region, remote sensing data and pattern recognition technique can be used.
- To identify the quality of vegetables and fruits and for classification of agricultural products, image processing and machine learning is used.
- To identify weed seeds in the crop sample Image processing and Artificial Neural Network (ANN) is used.[3]

## II. CLASSIFICATION TECHNIQUE

The food grain identification technique includes the following process, namely: image acquisition, image pre-processing, image reduction, feature extraction and classification processes.

A literature survey of these processes followed in food grain identification in presented in the work.

### Image Acquisition

A high resolution digital camera is usually used to acquire images. A standard setup with natural light is used to avoid illumination. Megha R. Siddagangappa et al.[4] have used a camera with 8MP resolution to capture images and saved in JPEG format. They maintained a fixed length between the camera and the grain sample by using a stand with

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allowed vertical movement. A uniform background of blue colour was maintained and grains were spread on this blue sheet in a non touching fashion.

Naveen Pandey et al. [5] used a digital camera of 12 MP resolutions and a constant distance of 14 centimetres was maintained between the camera and the grains.

P.K. Mallick et al. [6], used a digital camera which is connected to personal computer by mounting it over the illumination chamber on a copy stand. This provides the vertical movement for the camera.

Ai-Guo et al.[7], used a machine vision hardware for image acquisition. The set up includes CCD camera, light source, conveyor belt, discharging section, machine controller, feeding section, image processing unit and a computer.

Most of the work carried out in this field had followed one of the techniques mentioned above. It is suitable to acquire food grain images with a digital camera with minimum resolution of 8 MP and in a standard set up which maintains a constant/ uniform distance between the camera and grains for all the samples.

## Image Pre-processing

Image pre-processing is a preliminary step where unwanted distortions are removed and some important features are enhanced for further image processing. Image pre-processing includes: noise removal, resizing, binarization, enhancement and cropping.

Noise removal is carried out using filters. Some of the commonly used filters are: median filter, wiener filter and gaussian filter. Filtering also helps in sharpening the contrast and to highlight contours.

## Image reduction and feature extraction

Data reduction involves either reducing the data by transforming image into frequency domain or segmenting it in spatial domain and then extracting features for further analysis.

Pavankumar Naik et al. [8] have extracted four seed features: seed edge, roundness, ripple and shape using canny edge detection.

Phan Thi Thu Hong et al. [9] have used segmentation for separating rice seed images from blue background. They have chosen threshold method for background subtraction. In segmentation, the pixels with blue value less than 90 are assigned the value 255 and the pixels with the blue value more than 90 are assigned 0. This work extracted features which are representatives of two major groups: Global features (Morphological features, colour, texture, GIST) and local feature (SIFT). The morphological features extracted are Area, length, width, length/width, major axis length, minor axis length, area of convex and perimeter of convex. RGB components of all images are analysed and colour features with six dimensions (mean values and square root of mean of RGB) are extracted.

The texture features extracted are uniformity, mean(m), standard deviation and third moment.

Harish S Gujjar et al. [10] have used image segmentation and extracted color and textural features for detection of foreign bodies from the food grains. Total of 18 color features i.e mean, variance and range of RGB and HSI were extracted using standard feature extraction algorithm. Textural features were extracted from Gray-Level Co-occurrence Matrix (GLCM).

Xin Yi et al.[11] have extracted color, shape and texture features. Seed color is described by histogram of pixel values of the a and b channels in the CIE L\*a\*b\*colour space. Shape is described using histogram of curvature (HoC). Three different descriptors are adopted to capture local textural features: Scale-Invariant Feature Transform (SIFT), Speeded

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Up Robust Features (SURF) and RootSIFT. Single kernel Support Vector Machine (SVM) and multi kernel SVM is used for classification.

Megha R. Siddagangappa et al.[4], have used image segmentation to cluster pixels into salient image regions. The color features i.e. the mean values of the RGB colors and geometrical features i.e. area, majoraxislength, minoraxislength, convexarea and eccentricity are extracted and are classified using Probabilistic Neural Network (PNN) classifier.

Most of the work in food grain identification is carried out using segmentation and edge detection. Majority of the works consider shape, color, texture and morphological features for classification. P.K. Mallick et al. [6] have extracted colour features using the algorithm suggested in their paper and 18 colour features were extracted. Multilevel Wavelet decomposition techniques is used for extracting textural features of similar looking grains. The work has extracted 7 features resulting in 21 features at each level which leads to a total of 42 textural features. *Back Propagation Neural Network* (BPNN) algorithm is used for classification.

D.M. Hobson et al. [12] have used unsupervised clustering techniques for feature extraction. This work is carried out using canny edge detection which returned an image in binary form based on local 3x3 neighbourhood homogeneity. The survey indicates that limited work has performed using transforms in identification of food grains.

### III.IDENTIFICATION OF FOOD GRAINS

Human inspection system is used for several centuries to identify and classify food grains. This system involves high labour costs, need for trained workers, fatigue and inconsistency. Image processing provides rapid, economic, consistent and objective assessment. It is applied increasingly in agricultural area for inspection and evaluation purposes. Over the years, considerable work carried out in the area of image analysis of food grains. Few of the significant works are discussed below:

D.M. Hobson et al., conducted two series of experimental tests using a specific imaging setup which could identify eight varieties of rice grains. Grain length, aspect ratio and texture features were extracted. This work has extended the earlier work of rice variety identification by considering surface texture descriptions along with other effective shape descriptive measures. Unsupervised clustering techniques were used to find the dissimilarity between different varieties to a degree that would allow a successful identification. The work has concentrated on short, medium and long, along with brown and white rice varieties. [12].

Sanjivani Shantaiya et al., developed an approach to perform texture and morphological based retrieval on a corpus of food grain images. This work performed image wrapping technique to remove effects of orientation. Image scaling is performed by cropping the rice grain image for enhanced smoothness and apparent sharpness. After image enhancement, the edges of the object in binary image are detected using Canny and Sobel detector and the image is segmented using thresholding. The neural network is used for classification. The work tested six rice varieties and achieved good accuracy. The work is restricted for rice grains [13].

Ai-Guo OuYang et al., designed a system model in which colour space and features in RGB are computed. To identify the rice seed, a back feed forward neural network was used by which 86.5 % accuracy in identifying rice seeds is successfully obtained. Like most of the works, this work is also restricted for rice grains [7].

Benjamaporn Lursthut et al., developed a system named “Plant Seed Image Recognition System (PSIRS)” by considering size, shape, texture and colour feature. The features extracted and are classified using Euclidean distance technique. For the trained dataset, the system recognizes the plant seeds with a rate of 95.1% and for untrained dataset the recognition rate was 64%. The experiment was conducted on 15 species of plant seeds and has used Euclidean distance technique for classification [14].

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Kantip Kiratiratanapruk et al., developed a system to classify corn seeds into defect or not in more than ten categories and extracts texture, colour features. They have used Support Vector Machine (SVM) as type classifier. Success rate of the system in identifying normal corn seeds is 96.5 % and 86.5 % success rate is achieved in identifying defect seed (group) types. This work is restricted to corn seeds [15].

Dayanand Savakar designed an algorithms which extracts 27 texture and 18 color features from food grains. ANN is used for the automatic recognition and classification of similar looking food grain images. The accuracy in recognizing mustard seed is about 87% and for Soya the accuracy is 78%. The accuracy in maximum classification using colour and texture feature is 84%. [16].

Naveen Pandey et al., designed algorithm which uses Machine Vision technology to automatically classify seed by shape and colour features. Image recognition is carried out on three different grains using both Euclidean distance technique and ANN. System gives an accuracy of 95% using ANN and 84.4% accurate by using Euclidean distance method. The experiment is restricted to three different grains namely, wheat, gram and pulse [5].

Narendra V G et al., developed an intelligent system to identify Indian Lentil types (Red, Green and Yellow lentils) using ANN. The aim of this system is to intelligently find a standard and repeatable set of parameters to consistently identify lentil types. Size and colour features are used as the input variables, the ANN classifier identifies all the three Lentils type with an overall accuracy approaching 97.08%. The work is concentrated only on three types of lentils [17].

P. K. Mallick et al., identify and classify similar looking food grains. They describe a comparative study of ANN and SVM classifiers to identify and classify 4 pairs of similar looking food grains namely, Mustard, Finger Millet, Pigeon Pea, Soyabean, Cumin-seeds, Aniseed, Split Blackgram and Split Greengram. The developed algorithm extracts 18 colours- HSV (Hue, Saturation, Value) and 42 wavelet based texture features. Wavelet-texture, colour-HS and a combined model are the three feature sets used to design BPNN-based classifier for this system. SVM model for colour-HSV is designed for the same samples. The classification gives the accuracy ranging 78% to 94% for wavelet texture model, 93% to 96% for colour-HSV model and about 92% to 97% for combined model using ANN. For the SVM classification model the accuracy ranges from 80% to 90%. This work concentrated on four pairs of similar looking grains [6].

Yingrak Auttawaitkul et al., developed a visual classification system to identify the rice seeds varieties by the colour features and its appearance size of the rice seeds. The work considers four classes of rice and the system gives an accurate result which is enough to use for inspection of coloured rice seed based on its appearance characters of the seeds. This work is restricted to identify rice grains [18].

Megha R. Siddagangappa et al., developed an automated system to identify grain type and analyse the rice quality (Delhi, Boiled and Basmati) and grade (grade 1, grade 2 and grade 3) using PNN. Accuracy of the system in identification of rice type is 98%. The quality of the rice is analysed and the system gives the accuracy of 90%. The rice grading accuracy is 92%. The work is concentrated on rice grains and 13 other dissimilar looking grains [4].

Harish S Gujjar et al., proposed a novel method for inspecting food samples using ANN. The work classifies foreign bodies present in the grain samples using segmentation which was difficult to detect using conventional methods. Good accuracy is observed from both classification and foreign body detection models. This work is concentrated on foreign body identification in the food grains [10].

Xin Yi et al., developed a system to identify morphologically similar looking seeds using multi-kernel learning. Three different types of features (colour, shape and texture) from seed images were extracted and a multi-kernel SVM was used for classification. The image features and machine learning algorithms described in their work achieved a high recognition rate i.e., more than 97%. This work is restricted to morphologically similar looking seeds [11].



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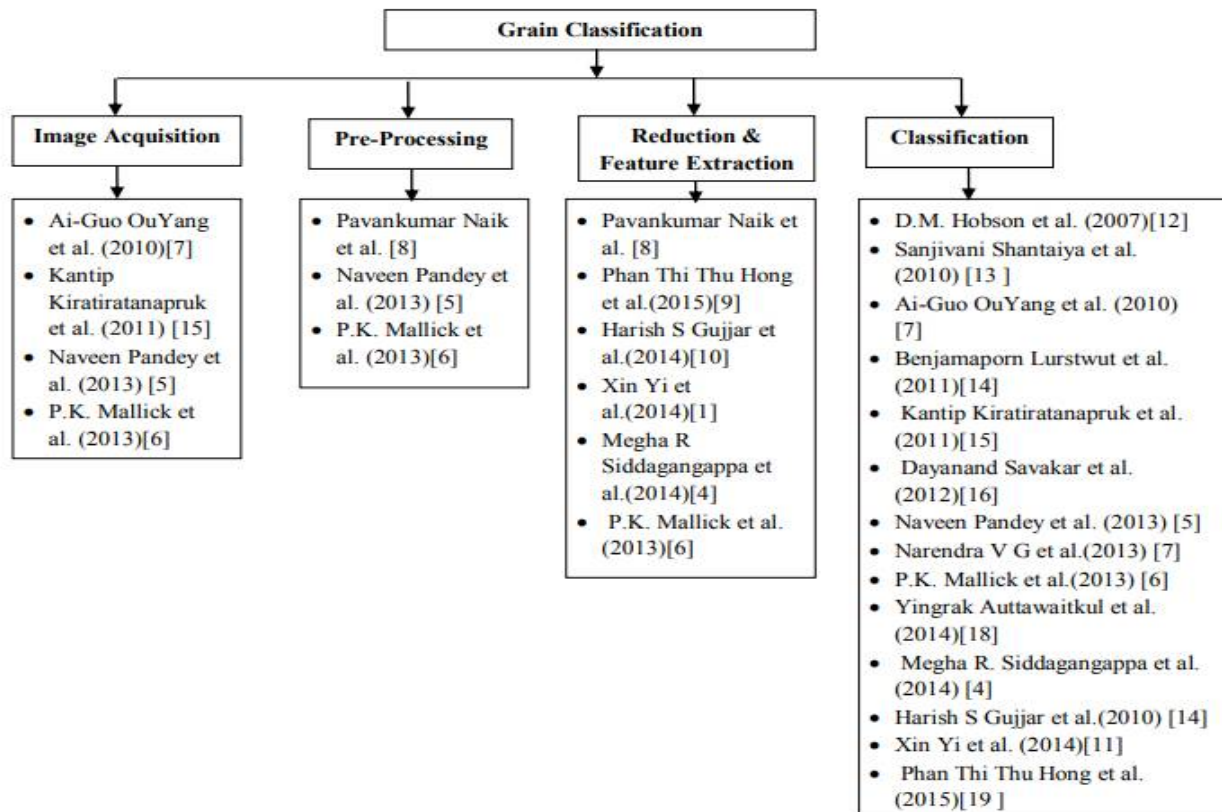


Figure 3.1: Quick reference of papers for food grains analysis

Phan Thi Thu Hong et al., presented a system for automatic identification of rice using image processing and computer vision techniques. Images of 6 different rice seed varieties from northern Vietnam was collected and analyzed. The experiment demonstrates the average accuracy of 90.54% for the classification system using Random Forest method. This experiment is concentrated on rice grain classification [19].

Figure 3.1 gives a fleeting look for the various techniques followed in each processes of the food grain analysis.

Thus a detailed study of the various techniques used in food grain analysis, along with improvements in the processes over the years is detailed in this work.

## IV. CONCLUSION

This survey has clearly shown that analysis of Indian food grains is still a challenging task. Majority of the above work is based on either specific grains or on similar looking grains. There is a lot of scope to improve the efficiency of food grain identification by adapting intelligent models.

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