CHAPTER 2

LITERATURE SURVEY

A lot of research has been done on Grain Quality Detection using Image Processing over the past few years. Different researchers have proposed systems with different accuracies using different methods and algorithms. But these systems are not 100 percent accurate. The numerous papers on which the literature survey was conducted are given below.

2.1   Reference Papers

Harpeet Singh et al.,[1] have surveyed four techniques for food quality analysis. The first technique is a semi-automated machine which deals only with the size and weight of kernels and not with colour, damaged and adulterated kernels. For extending the feature detection capability of machine, image processing techniques are used. Second technique is based on image processing, third and fourth techniques are based on machine learning. Digital Image Analysis Seed Count 324 and Image acquisition system are an off-line grain classification technique which limits itself in a particular number of kernels analysis at a time. Hence it cannot be used in large scale industries which require processing of large number of kernels. The other on-line automatic grain quality inspection technique is useful for analysing huge quantity of kernels and requires less intervention of an operator. Image acquisition system and automatic grain quality inspection technique are based on a machine learning algorithm. Machine learning method requires training in the initial stage with a large number of kernel images to increase the accuracy of the system. Accuracy of system may be changed by applying different hyperparameters values during training. Considering the various issues, a Grain Analyser system should have features of non-destructiveness, automatic sampling which does not require any tray preparation or sample pre-preparation task. It should accommodate various types of grain. The software used in system must support local and remote analysis. The software should be scalable in terms of adding different grain samples and standards at later stage. Foreign particles, chalkiness, insect damaged grains must be detected and reported in the future works.

Muhammad Junaid et al.,[2] presents an image processing-based solution to classify the different varieties of rice and its quality analysis. An approach based on the combination of principal component analysis and canny edge detection is used for the classification. Quality analysis of rice grain is determined by morphological features of rice grains. These morphological features include eccentricity, major axis length, minor axis length, perimeter, area and size of the grains. Six different varieties of rice are classified and analyzed in this paper. A database is trained by feeding the 100 images of each variety of rice grains. Classification and quality analysis is done by comparing the sample image with database image. Canny edge detector is applied to detect the edges of rice grains. Eigen values and Eigen vectors are calculated on the basis of morphological features. Then by applying the PCA, different varieties of rice are classified by comparing the sample image with a database. Results obtained in terms of classification and quality analysis are 92.3% and 89.5% respectively. Proposed system can work well within minimum time and low cost.

Deepika Sharma et al.,[3] proposes a system that determines the quality of food. Initially, the grain samples run on the conveyor belt and then random images of grains are captured by the camera. The image processing algorithm is applied on the grain samples through MATLAB. The classification has been done according to colour, shape and size. It results good, bad and medium quality by using Neural Network (NN) classifier. The final output is displayed on the LCD also the message will be sent to higher authority through GSM module. This system can be implemented in food industries at later stage for grading purpose which will ma the task of classification of grains simpler for the public.

Muhammad Anzar Alam et al.,[4] have worked on the quality of grain and proposed different techniques to characterize the quality of rice. Chalky is whiteness part in the rice grain and it is one of the most important parameter that is used to evaluate the quality of rice grain. The research proposes an image processing technique using extended maxima operator to detect the chalky area in the rice. It has also calculated the dimensions and color to classify rice grains. The experiment was performed on 22 sample images of rice grain to test the proposed method and was validated using visual inspection.

Shraddha Shahane et al.,[5] have proposed a system that assesses the food grain quality using image processing. It is proposed to work at ration shop to avoid the distribution of low-quality grain. In this system, visual inspection for quality assessment is replaced by image processing technique. The quality parameters of grain are size, area, major axis length, minor axis length and perimeter. These features of grain are extracted from the image of grain sample. Based on these features, grain quality is assessed. This system distributes ration (food and non-food items) at subsidized price to poor. There are many challenges in this system like quantity issue, lower quality of food, system transparency etc.

Robert Singh et al.,[6] have described the classification of four varieties of bulk rice grain images using back propagation neural network (BPNN). Eighteen colour features, 27 texture features using grey-level co-occurrence matrix, 24 wavelet features and 45 combined features (combination of colour and texture) were extracted from the colour images of bulk rice grains. Classification was carried out on three different data set of images under different environmental conditions. It is seen that BPNN is able to classify faithfully the four varieties of rice grain even with a poor image quality. It is also found that classification based on reduced wavelet features outperform the classification using all other features (such as colour, texture features taken separately) for two data set of images with minimum resolution. The authors have further compared the proposed BPNN technique with other classifiers such as support vector machine, *k*-nearest neighbour and naive Bayes classifier on all the three data sets. It is found that the average classification accuracy of more than 96% was able to achieve using BPNN consistently on all different features for each data set.

Miroljub et al.,[7] have presented approaches, methods and tools for assessment of main quality features of grain samples that are based on color image and spectra analyses. Visible features like grain color, shape, and dimensions are extracted from the object images. Information about object color and surface texture is obtained from the object spectral characteristics. The categorization of the grain sample elements in three quality groups is accomplished using two data fusion approaches. The first approach is based on the fusion of the results about object color and shape characteristics obtained using image analysis only. The second approach fuses the shape data obtained by image analysis and the color and surface texture data obtained

by spectra analysis. The results obtained by the two data fusion approaches are compared and it is found that the approach which uses the shape data obtained by image analysis and other features give better results.

Neelamma K Patil et al.,[8] have presented the study on identification and classification of food grains using different color models such as L*a*b, HSV, HSI and YCbCr by combining color and texture features without performing pre-processing. The K-NN and minimum distance classifier are used to identify and classify the different types of food grains using local and global features. Texture and color features are the important features used in the classification of different objects. The local features like Haralick features are computed from co-occurrence matrix as texture features and global features from cumulative histogram are computed along with color features. The experiment was carried out on different food grains classes. The non-uniformity of RGB color space is eliminated by L*a*b, HSV, HSI and YCbCr color space. The correct classification result achieved for different color models is quite good.

2.2 Existing System

The existing systems suggest that the manual classification and segregation can be done using the processes of sieving, cleaning, milling among the others. On the other hand, automated process using advanced techniques are done using algorithms like K-Means clustering algorithm, K-Nearest neighbor algorithm, morphological feature extraction and Detection.Not highly secure and hence leads to inconsistency and tampering of food grains for illicit purposes. Immediate disbursal of the food grains does not take place which results in rotting of food grains due to inexplicable weather conditions.

2.3 Proposed System

The process starts before the customer encounters the food grains. It's an initial process in food industries. Henceforth, the cost is decided for each type of grain. In this system, images of wheat and rice samples are taken by a camera and then it's given to the image processing unit. All these food grains are run along a conveyor belt and the images are captured randomly of different samples. The features of the colour, shape and size of the rice grains in order to grade them for quality. A unique bar code will be generated for each commodity and each warehouse. The bar code will be attached to the package

at a place which is easily noticeable. The FPS dealer verifies the ration card of the BPL card holder and if it is successfully verified, the dealer determines how much quantity of ration, the card holder is eligible. The information of the package delivered to the card holder will be stored in cloud. This will help is getting the quantity of ration handed over to the card holder, from which FPS the package was delivered and the type of commodity.

2.4 System Requirements

The components which are employed for the smooth running of the proposed system are elucidated as below in terms of software and hardware requirements.

Hardware Requirements

a) Processor: Intel core i5-7400 clocked @ 2.7Ghz

b) Ram: 8GB DDR3

c) Hard-Disk: 250GB

Software Requirements

a) Programming Language: Python 3.7

b) Operating System: macOS / Windows 8/10 64-bit version

c) MATLAB2018a

d) Inkscape - graphics editor

e) Jupyter notebook

f) OpenCV

2.5   Methodology

In this section, a detailed description about the various modules in the proposed project are elucidated.
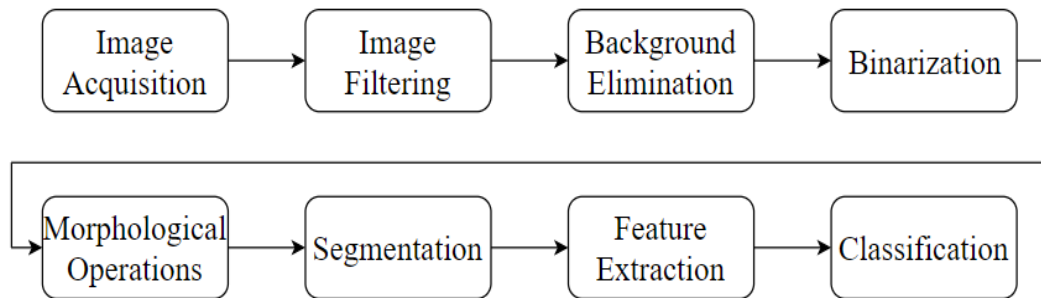

Figure 2.1 Proposed System

2.5.1 Image acquisition

The rice grains taken from the silos are manually examined for the freshness and other impurities. Randomly images of the rice grains are taken, preferably in the same background, so as to eliminate the process of background filtering. The images are taken by using a high definition camera so as to get good quality images for further processes

2.5.2 Image Pre-processing

Preprocessing is one of the important steps for the enhancement of quality of the captured image. The preprocessing methods use a small neighborhood of a pixel in a image, to get a new brightness value in the output image. This Research proposes to apply the Gaussian filter for image smoothening. Also this process involves a threshold method in order to eliminate background. Then the grayscale image is binarized. Once the image is binarized morphological operations are performed, first erosion operation is used to eliminate the shadow of the grains, this is followed by dilation to enhance the image after the erosion and improve the boundary sharpness[2-8].

2.5.2.1 Image filtering

Images are often corrupted due to the variation in illumination, intensity or may have poor contrast and can't be used directly [3,4,6]. Filtering helps to transform pixel intensity values to reveal certain image characteristics

a. Enhancement: helps to improve the contrast of the image
b. Smoothing: Remove the noise from the image.

2.5.2.2 Background Elimination

Background elimination which is also called as Foreground Detection, is a technique in the fields of computer vision and image processing wherein an image's foreground is extracted for further processing, i.e. Object Recognition. Usually the images region of interest are a part of image foreground [5-7]. Here checking the intensity of each pixel of the image with a precalculated value, and the pixel values falling with this range are set to zero.

2.5.2.3 Binarization

Binarization of an image is a process representing an image using only two different pixel values. It is generally performed by classifying a gray scale image into two groups of pixels based on certain threshold value. Those pixel values greater than or equal to the threshold is set to a particular grey value and those below the threshold to another grey value [3,4]. The quality of the binary image is much dependent on how appropriately the threshold for binarization are chosen or how fairly the pixels are classified into two groups of pixels.

2.5.2.3 Morphological Operations

Morphological image processing is a collection of non-linear operations related to the shape or morphology of features in an image. Morphological techniques probe an image with a small shape or template called a structuring element. The structuring element is positioned at all possible locations in the image and it is compared with the corresponding neighborhood of pixels [3,4,6].

2.5.3 Image Segmentation

The aim of image segmentation is to cluster pixels into salient image regions. Image segmentation is an essential preliminary step in most automatic pictorial pattern recognition and scene analysis problem. Here performing the segmentation using Component Labeling plays an important role. Once the image is binarized, perform labeling of connected components. By using labels and the similarity of grey level values, grains are segmented [3-8].

2.5.4 Feature Extraction

In this process some qualitative information is being extracted from the objects to be analyzed in the image. These extracted attributes are called features and a pattern is defined as a vector of such features. The various features that could be extracted are color features, geometrical features and texture features. In this method 3 color features and 3 geometrical features need to be extracted [3-8].

a) Color Features

Color features play a vital role in the classification process. The extraction of three color features is done by the captured image, i.e. the mean values of the RGB colors. The mean values of red, green and blue colors are extracted from the image.

b) Geometrical Features

The geometric parameters give us the basic information regarding the size and shape of the grains. Area: This refers to the number of pixels in the region, i.e. the pixels with level "1".

a. Major Axis Length: Length of the major axis of the ellipse with the same second order normalized central moment of the object.

b. Minor Axis Length: Length of the minor axis of the ellipse with the same second order normalized central moment of the object.

c. Convex Area: Area of the smallest convex shape enclosing the object. Eccentricity: Relation between the distance of the focus of the ellipse and the length of the principal axis.

2.5.5 Classification

The classification approach is mainly based on the assumption that the digital image under consideration depicts one or more features, and these features correspond to one of the several distinct and exclusive classes. The two phases that are typically employed by the classification algorithms are training and testing. In the initial training phase, characteristic properties of typical image features are isolated and, based on these, a unique description of each classification category, i.e. training class, is created. In the subsequent testing phase, these feature-space partitions are used to classify image features. In this method we use the PNN classifier. When an input is presented, the first layer computes distances from the input vector to the training input vectors and produces a vector whose elements indicates how close the input is to a training input. The second layer sums these contributions for each class of inputs to produce as its net output a vector of probabilities. Finally, a complete transfer function on the output of the second layer picks the maximum of these probabilities to choose the class [1-8].

2.6   Summary

The goal of this project is to resolve and attempt to reduce food adulteration and Ratio contamination, distributed to the poor and needy, in possession of Below Poverty Line (BPL) card holders by deploying smart sensing devices with the Internet of Things (IoT) to conserve the quality and quantity of food grains stored in warehouses and packaging with the correct quantity and allocation.