Classification of Wheat Grains Using Machine Algorithms

Meesha Punn[1], Nidhi Bhalla[2]

[1, 2]Swami Vivekanand Institute of Engineering and Technology, Banur, Punjab, India

Abstract: ***India is the second largest producer of wheat in the world after China. Specifying the quality of wheat manually requires an expert judgment and is time consuming. To overcome this problem, machine algorithms can be used to classify wheat according to its quality. In this paper we have done wheat classification by using two machine learning algorithms, that is, Support Vector Machine (OVR) and Neural Network (LM). For classification, images of wheat grain are captured using digital camera and thresholding is performed. Following this step, features of wheat are extracted from these images and machine learning algorithms are implemented. The accuracy of Support Vector Machine is 86.8% and of Neural network is 94.5%. Results show that Neural Network (LM)is better than Support Vector Machine(OVR).***

Keywords: Classification, Computer Vision System, Image Processing, Grading, Quality, SVM, Wheat

1. Introduction

India is the second largest producer of wheat in the world after China. Determining the quality of wheat is critical. Specifying the quality of wheat manually requires an expert judgment and is time consuming. Sometimes the variety of wheat looks so similar that differentiating them becomes a very tedious task when carried out manually. To overcome this problem, machine algorithms can be used to classify wheat according to its quality.

Machine vision is widely used in the field of agriculture for identifying the varieties of various food crops and for identifying their quality as well. A machine vision system (MVS) provides an alternative to the manual inspection of biological products. It makes use of Machine algorithms and digital images. These images are obtained with the help of digital camera and are then stored in the computer for future work. In a Machine Vision System, the camera acts as an eye and the computer acts as the brain.

Digital images stored in the computer are processed by Image processing algorithms. They extract the features from the digital images and use them to generate pattern. These patterns are input to the machine algorithms based on which the objects are classified into their respective classes. Such machine algorithms used for classifying objects are referred to as pattern classifiers.

The present paper deals with classifying the wheat grain. For doing this, two machine learning algorithms are used, that is, Support Vector Machine (OVR) and Neural Network (LM).

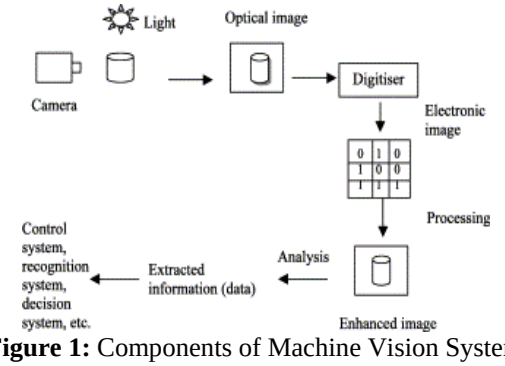


Figure 1: Components of Machine Vision System

2. Previous Work

Studies have been done on classification of wheat using machine algorithms and image processing. These studies have used different machine classifiers and have performed feature extraction for carrying out their work. Some studies extracted two classes of features while others extracted more than two classes of features.

In a study [1], four varieties of wheat were identified by integrating machine vision and artificial neural network using Matlab software. Different colour and morphological features of wheat were extracted for carrying out the process of identification. Given these features, testing of ANN was performed. It was concluded that colour features or morphological features alone could not recognize wheat so a combination of both was used. The overall accuracy was found to be 95.86%.

Another study [2] classified the rain fed wheat grain cultivars using Artificial Neural Network. For this purpose, colour features, morphological features and textural features were extracted. These features were fed to multilayer perceptron neural network. The classification accuracy was concluded to be 86.58%. After using UTA algorithm for feature extraction, the accuracy was increased to 87.22%.

A study by [3] used Discriminant Analysis and K Nearest Neighbor for classification of wheat and barley grain kernels. The system training was performed with only morphological features, only colour features and combination of morphological features, colour features as well as textural features. It was concluded that accuracies higher than 99% can be achieved when morphological, colour and textural feature types are used together as compared to using them alone.

3. Methodology of Proposed Work

The methodology comprises of different steps which are as follows:

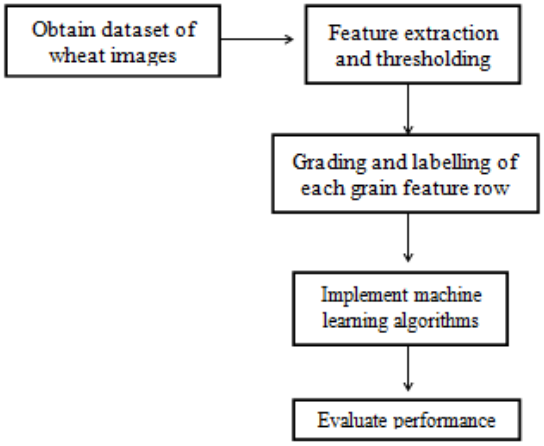


Figure 2: Methodology of wheat classification

3.1 Obtain dataset of wheat grain images

The first step for classification of wheat is to acquire images of wheat grains. In order to obtain the image of wheat grains, the wheat grains were placed on a black background and special precaution was taken so that no light gets reflected on the black background. This is so in order to obtain clear image of wheat grains. Digital camera was used to obtain the images which were then stored in the computer machine.

Figure1: Captured image of Wheat grains

3.2. Feature extraction and Thresholding

The next step in wheat classification is performing thresholding of images. Thresholding [7] is the simplest method of image segmentation. From a grayscale image, thesholding can be used to create binary images by turning all pixels below some threshold to zero and all pixels about that threshold to one. Feature extraction [5] defines a set of features which represents the information that is important for classification of wheat. Different features were extracted and they were fed to machine classifiers for wheat classification. The following features were extracted from wheat images:

Table 1: Features extracted from images of wheat Features Formula

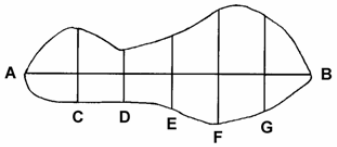
Features	*Formula*
Area	Using offset method: First measure the length of the longest axis of the area (line AB). This is called the *length line*. Next, divide the length line into equal sections, for example 10 ft. These lines are called *offset lines*.  Length line(AB) = 60 pixel, distance between offset lines is 10 pixel apart Length of each offset line; C = 15 pixel, D = 10 pixel, E=15 pixel, F = 25 pixel, G =20 pixel Total length of offset lines = C + D + E + F + G = 15 + 10 + 15 + 25 + 20 = 85 pixel Area to measure = Distance between offset lines x sum of the length of the offset lines = 10 pixel x 85 pixel = 850 pixel
Perimeter	Number of horizontal and vertical links+(Number of diagonal links*√2)
Volume	volume=1/ 2[x1(y2 - y3) + x2(y3- y1) + x3(y1-y2_](z1+ z2 + z3) / 3 Where, (x1, y1), (x2, y2) and (x3, y3) are the planar co-ordinates of the triangle vertices and z1, z2 and z3 are the corresponding elevation
Roundness Ratio	4*pi*area/perimeter^2
Percentage of broken grain	No. of broken grain/no. of whole grain*100

Table 2: AGMART STANDARDS [10] for grading wheat grains

Grade Designation	Foreign matter (% by wt.)	Damaged grains (% by wt.)	Slightly damaged grains (% by wt.)	Immature shrivelled and Broken Grains	Weevilled Grains (% by wt.)
I	1	1	2	2	1
II	1	2	4	4	3
III	1	4	6	10	6
IV	1	5	10	10	10

3.3. Grading and labeling each grain feature row

The grading of wheat grain is done on the basis of Agricultural Procedure (Grading and Marking) Act, 1937 AGMART STANDARDS. According to this act, wheat grains are divided into four classes.

Table 3: Criteria for finding grade of wheat grains

S.No	*Features*	*Criteria*	*Formula*
1	Damaged grain	Roundness ratio≈ 0.98	No. of damaged grain ---------- *100 total no. of grain in sample
2	Foreign matter	Pixel value < 5 and volume > 50	No. of particles with pixel value less than 5---------- *100 total no. of grain in sample
3	Slightly damaged grains	Roundness Ratio ≈ 0.8	No. of slightly damaged grain---------- ------*100total no. of grain in sample
4	Broken grains	Length < ¾ of full length	No. of broken grain---------- ---------- *100 total no. of grain in sample
5	Weevilled grains	Volume < 15	No. of grains with volume less than ---------- --- *100 total no. of grain in sample

3.4. Implementing Machine Algorithms [6]

The two machine learning algorithms, Neural Network (LM) and Support Vector Machine (OVR), are implemented separately.

Neural Network (NN) [8] has been the successfully used classifier in numerous fields. So, it is of interest to use it for wheat grain classification. It can be modeled on a human brain. The basic processing unit of brain is neuron which works identically in NN.

Support vector machine (SVM) [9] is a computer algorithm that learns by example to assign labels to objects. It maximizes a particular mathematical function with respect to a given collection of data.

In order to implement the algorithms, the numeric parameters are calculated to access quality of each grain. These parameters are fed to each algorithm separately and them the performance is evaluated.

3.5. Evaluate Performance

After implementing the algorithms, their performance is measured to see whether desired results are achieved or not.

4. Results

After implementing the algorithms and the results of their evaluated performance were obtained. The results show that the accuracy of Support Vector Machine (OVR) comes out to be 86.8% and that of Neural Network (LM) comes out to be 94.5%. This means that Neural Network (LM) Performed better than Support vector Machine (OVR).

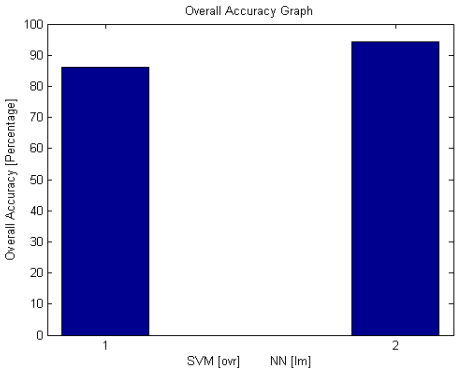


Figure 3: Overall accuracy of NN (LM) and SVM (OVR)

5. Conclusion

Our objective was to classify wheat grains effectively using machine algorithms. For this we used two machine algorithms, that is, Support Vector Machine and Neural Network.

The accuracy of SVM is 86.8% and Of Neural Network is 94.5%. Based on these results it is concluded that this algorithm performed better than that algorithm. The accuracy of this algorithm emerged out to be more than that algorithm.

6. Future Scope

This work can be carried forward by using machine algorithms, which have better accuracy and has less computational cost, other than used in this research work. Moreover, research can be done on different variety of wheat and different feature set can be used.

References

[1] Arefi, A. Modarres Motlagh, and R. Farrokhi Teimourlou, “Wheat class identification using computer vision system and artificial neural networks”, 2011.
[2] Alireza Pazoki and Zohreh Pazoki, “Classification system for rain fed wheat grain cultivars using artificial neural network”, 2011.
[3] F. Guevara-Hernandez and J. Gomez-Gil, “A machine vision system for classification of wheat and barley grain kernels” 2011.
[4] Sanjivani Shantaiya and Mrs. Uzma Ansari, “Identification Of Food Grains And Its Quality Using Pattern Classification”, 2010
[5] W. Philpot, “Feature Extraction”
[6] Francisco Pereira a, Tom Mitchell b, Matthew Botvinick a, “Machine learning classifiers and fMRI: A tutorial overview”, 2009
[7] https://www.comp.glam.ac.uk/pages/staff/getaylor/papers/gim98.PDF
[8] Vincent Cheung, Kevin Cannons, “An introduction to Neural Networks”, 2002.
[9] William S Noble, “What is Support Vector Machine”, 2006.
[10] http://agmarknet.nic.in/Wheat_manual.html

Authors Profile

Meesha Punn is pursuing M.Tech (Computer Science) form Swami Vivekanand Institute of Engineering and Technology, Banur, Punjab, India. She did her B.Tech (Information Technology) form Doaba Institute of Engineering and Technology, Kharar, Punjab, India.

Nidhi Bhalla is working as Assistant Professor in Swami Vivekanand Institute of Engineering and Technology, Banur, Punjab, India. She did her B.Tech (Information Technology) and M.Tech (Computer Science) form Lovely Professional University, Jalandhar, Punjab, India.