



A Versatile Mobile Application for Quality Prediction of Wheat Grain using Machine Learning Algorithms

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Abstract: Indian agriculture field is second largest producer of wheat after china which is major backbone to Indian economy. The new innovations can be applied to this field to get new products. Manually quality prediction of wheat grain is very tedious task and it is time consuming so an automated quality prediction system is developed using mobile application and various image processing techniques. The objective of this is paper to accurately predict the quality of wheat grain without any intermediate person. Finding the quality of wheat grain is performed in MATLAB using various machine learning algorithms. Through mobile application wheat grain image is sent to server for identifying its quality. Server processes and classifies the image using various machine learning algorithms like SVM and K nearest neighbor and sends back result to mobile application which contains the quality/purity level of wheat grain and based on quality also gives the price for grain.

Keywords: Image Processing, Mobile Application, SVM, KNN.

I. INTRODUCTION

Indian agriculture field is second largest producer of wheat after china, which is major backbone to Indian economy. Indian agriculture field involves of growing different food grains like wheat, rice, corn, paddy and there a need to do the quality prediction of this food grains. Wheat food grain is an important grain of Indian agriculture field hence its quality prediction is very important. In the present grain quality prediction system quality of wheat grain can be done manually by seeing the product which is time consuming task and not reliable. Farmers and traders identify the quality manually and decide the price for the grain which is not correct so the farmer will not get correct price for the particular grain. Also the decision making capabilities of grain quality prediction affected by many factors like its moisture content, foreign particle count, broken grains count etc. To overcome the drawback of manual quality prediction of wheat grains using some technology can be used. An automated quality prediction system need to developed to help farmers to identify the quality of their wheat grains so they can get the better price based on the quality of wheat grain using machine algorithms.

Technology is discovering its application in agriculture field. Machine vision can be widely used in this field for identification and quality prediction of food grains. With the help of these new technologies there a need to develop a mobile application for quality prediction of wheat grain which overcomes the drawback of existing manual quality prediction system in agriculture field. Also this mobile application helps for marketing and selling of grains directly from farmers to buyers. These days mobile phone has become important part of human life anybody can use this mobile phone with some fundamental knowledge. Farmers with some knowledge of mobile phone can use this mobile application for determining the quality of wheat food grain. so based on the quality of grain farmer gets the correct price for their agriculture grain. In the current quality prediction system farmers takes their agriculture produce to nearest anajmandi where an agent by visual inspection determines the quality of agriculture grain and decide the price for that grain and sometimes fools the farmers by giving the very less price for their grain. Hence there is need to develop a versatile mobile application for camera embedded smart phone, which can take image of wheat food grain and sends to server and determine the quality of grain. Based on the result of quality farmers can get correct price for their grain without contacting to agents and can increase the profit.

Problem Definition

In Indian agriculture field quality prediction of food grains is very important. Quality of food grains is determined by visual inspection by licensed traders in anajmandi which is time consuming and not reliable task. Also this prediction affected by mood of traders in anajmandi. So to overcome this drawback of current system new proposed system is developed with mobile application and various image processing techniques which accurately predict the quality of wheat grain and its price



II. RELATED WORK

The paper [1] implements an automated grading system using machine vision which takes the input image and processes and transfer to pattern recognizer. The pattern recognizer performs processing and classifies the object. Cashew is taken as case study. Grading is performed using color, texture, size and shape feature. Five different classifiers were used among these classifiers BackPropogation neural network proved more optimal.

[2] Proposed a solution for manual grain quality analysis. The proposed solution of grading and quality analysis of rice grain is based on grain size and shape. Edge detection algorithm was used to find the endpoints of each grain. This solution requires very less time and very less cost.

Paper [3] proposed model with various image processing features for grading and quality testing of food grains which overcomes the limitation of manual grading.160 images were used for testing and got result 80-90% accurate. Morphological features were given to network for training. Then trained network identifies the unknown grain type, impurities and its quality accurately.

[4] Proposes mobile application for grading agriculture produce. Jawar is taken as case study. Application sends an image to server and gets the result which contains grade of jawar and its price. Grading is done in matlab using various image processing techniques. Seven features were extracted for each image and nearest neighbor classifier was used for classification.

[5]proposed a solution for detecting good quality wheat grains from impurities. Proposed work based on the image processing.

[6] Proposes an automated system for classification and quality determination using neural network. Proposed model uses color and geometrical features for classification. Success rate for identification was 98% and success rate of quality analysis and grading of rice grain was 90% and 92%

[7] Proposes a model which classifies wheat grains based on its quality. Classification was done using two machine algorithms SVM and Neural network. On captured images thresh holding was performed and features were extracted them algorithms implemented. Accuracy of SVM was 86.8% and Neural Network was 94.5%.

[8] Proposes an image based wheat quality examination mechanism that defines the quality of wheat grain. This method is defined with assistance of image processing mechanism. On captured image first pre-processing was done once this step over next segmentation was performed and features were extracted and finally quality of wheat is identified.

[9] Proposed a model which provides the quality identification of rice grains based on its size. Based on this grains are graded as grade1, 2, 3. This proposed model overcomes the drawback of manual process. Total 105 images of different varieties of rice grain like Basmati, sonamasuri, boiled rice etc were taken and classification was performed using decision tree based classification.

[10] Proposed model using image processing techniques. In this work image of food grain selected, further image is enhanced to reduce noise from image. Lastly image is segmented with segmentation technique. In the testing phase model is tested with various rice images.

III. SYSTEM OVERVIEW

In the current grain quality prediction system quality of wheat grain is done manually by seeing the product which is time consuming and not reliable ask. Farmers takes their grain to the nearest anajmandi's where group of licensed traders by visual infection determine the quality of grain and based on quality decides the price for grain. Also quality prediction and deciding price for grain process affected by mood of traders also this decision making capabilities are depends on the various factor like foreign practical's, broken grain, mousier.

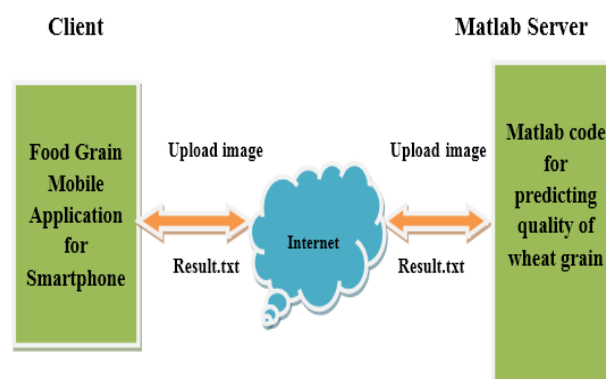


Fig 1: Overview of Quality Prediction System



Another issue which is present in current system is for the farmers at distance places is difficult to come to anajmandi's for inspection so the traders can fool the farmer by giving the very less price to their grains.

To overcome the drawback of manual quality prediction system there is need to develop a mobile application with various image processing techniques. New technologies finding the application in agriculture field with the help of these new technologies a proposed system is developed. In the proposed system a mobile application is developed on Android platform and which runs on Android emulator. This mobile application takes the wheat grain image from phone gallery and sends it to server for processing. on server side matlab preprocess the image which is sent from mobile application performs classification and sends back result to mobile application which contains the quality of wheat grain and based on that also returns the price for grain.

IV. PROPOSED SYSTEM

The proposed work finds application in various anajmandi's where manual quality prediction is performed which takes the more time. With this proposed work time will reduce and provides accurate results.

This proposed work also beneficial to farmers. With some basic knowledge of smart phone farmer can use this application on their phone so without depending on any agents farmer can sell the wheat grain to any anajmandi also gets the correct quality and its price using this mobile application.

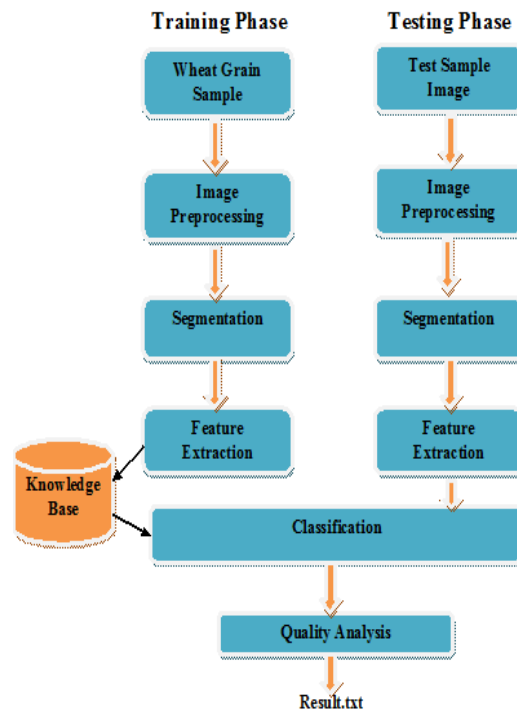


Fig 2: Detail Processing workflow on Matlab server side

Workflow of Proposed System:

- Image Acquisition/ Capturing the wheat grain image and uploading to server
- Image pre-processing
- Image Segmentation
- Feature extraction
- Classification
- Quality analysis

Image Acquisition

Food grain image acquisition is most important step of quality prediction system; it identifies quality grains, which has more effects on system overall performance. A total of around 150 wheat food grain images are captured. Wheat food grain images are acquired by keeping the background of green color. The wheat food grains are placed on the background and the image is captured. Mobile application uploads this image to matlab server for processing.



Image Pre-processing

Captured wheat grain image is further given for preprocessing for removing noise. To remove the shadow effect of grains here red channel of the image is taken which doesn't have shadows in case when background is green. Further Gaussian filter is applied to remove noise and smoothen it. Further binary image is generated. This image has lots of dots and overlapping particles so morphological opening are used to remove stray dots and open up slightly overlapping particles.

Segmentation

On binary image segmentation is performed. Here binary image is taken as input and gives the segmented grains as output, here first it will find connected components in the binary image. Then further all components with pixel area less than threshold are removed then each remaining component is a particle segment.

Further Segmentation is done on binary image by applying watershed segmentation technique. Here the first binary image of segments is taken and obtains its distance transforms. Further this distance transform is inverted and it will remove the unwanted minima's and finally watershed segmentation is applied.

Feature Extraction

This step plays important role in proposed system. The various features such as RGB Mean, Area, Major Axis Length, Minor Axis Length and eccentricity are calculated for each wheat grain image and stored in knowledgebase. Total 7 features as listed in table 1 are stored suitably for later usage.

Color feature extraction

With help of matlab code was developed to extract the features of each wheat grain. Once the image segmented then further RGB colors mean values were computed and finally stored in knowledge base. These features are further given for classifier for performing classification on wheat grain image. Total 3 features are extracted for each wheat grain sample image

Morphological feature extraction

With Matlab Programming language code is developed to extract these features for each input sample of wheat grain image. There are various features are extracted for accurate quality prediction of wheat grains.

These various features are as follows:

Area: The algorithm figured the quantity of pixels inside, and including the seed limit.

Major axis length: Major axis length was separation between the end purposes of the longest line that could be drawn through the seed. The real axis endpoints were found by registering the pixel remove each blend of outskirts pixels in the seed limit.

Minor axis length: Minor axis length was the separation between the end purposes of the longest line that could draw through the seed while keeping up oppositeness with significant axis.

Eccentricity: Eccentricity is connection between the separation of the concentration of the oval and the length of the foremost axis.

The below table shows the Morphological and colors features used for quality predication of wheat grain

Table 1: Color and morphological features

Type of Parameters	Parameter
Color Features	Red mean
	Green mean
	Blue mean
Morphological Features	Area
	Major axis length
	Minor axis length
	Eccentricity



Classification

Classification is important approach in image processing which is based on assumption that digital image depicts one or more features which corresponds to one of the several distinct classes. Classification is mainly involves training and testing phases. In the training once features of different wheat grain are extracted then these features are stored in knowledgebase.

Testing phase is important step of quality prediction system. In the testing phase one image is selected from gallery for testing and uploaded to server for processing where automatically image will be pre-processed, segmented and features are extracted as training image. And those features are matched with training feature from the database created for training image and classification will performed.

Quality Analysis

Quality Analysis is final step of quality prediction system. Based on the classification result quality of testing wheat grain image is identified and result is stored in the text document which is send back to the mobile application.

The Algorithm: Quality Prediction of wheat food grain

Input: Original image

Output: Wheat grain Quality

Step1: Capture the wheat grain image and upload to server.

Step2: Perform image pre-processing to remove noise

Step3: Perform image segmentation.

Step4: Extract various color and texture features.

Step 5: Use these feature for classification and identify quality of wheat grain sample using SVM and K-NN Classifier.

Step 6: Send the result back to mobile application

V. RESULT AND ANALYSIS

Training Phase

In the training phase of implementation various seven features like RGB Mean, Major axis, Minor axis and eccentricity features were extracted for the images samples of wheat grain which are present in the training dataset. All these features values are stored in the knowledge base.

Testing Phase

The below Fig shows the Login page of proposed mobile application. If the user is already performed the registration then user can login to home page by proving correct username and password. If user has not performed registrations then user need to register by new user registration form finally user can login to homepage by providing correct username and password.

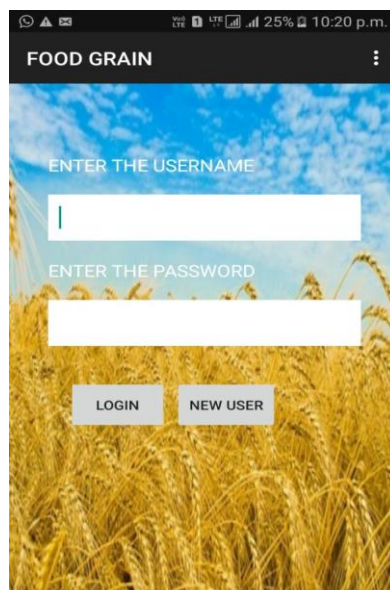


Fig 3: Login Page

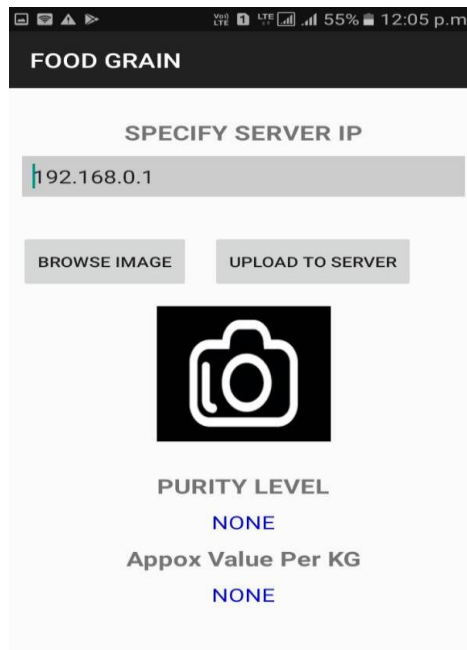


Fig 4: Home Page

The above fig 4 shows the Home Page of Application. Here user need to specify the server IP address where image need to send for processing. After providing the IP Address of server the user should select the any wheat grain image from mobile gallery by clicking browse image button.

The below fig shows the various wheat grain sample images present in mobile gallery user can select any one of the image and send to server for further processing.

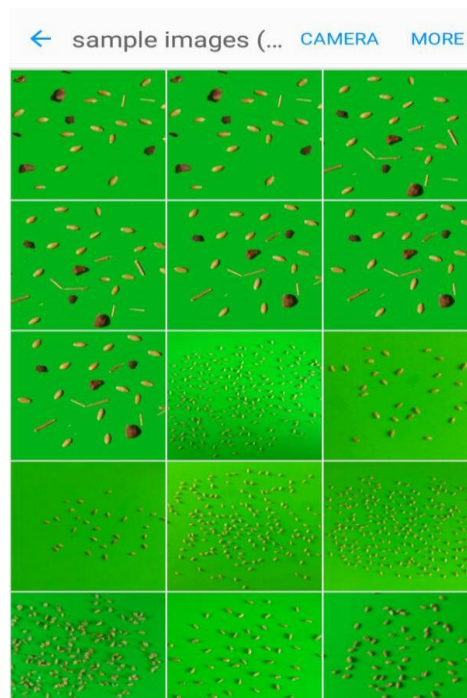


Fig 5: Mobile Gallery Images

After selecting any one image from mobile gallery the same image need to be uploaded to server by using the upload to server button. Once the image uploaded to server, server creates the binary image of original image. Based on this preprocessed image server computes the purity level within the image. Finally server send back purity level and based on that price of wheat grain to mobile application.



Results of Various Samples:



Fig 6: Result of Wheat grain with foreign practical's or impurities

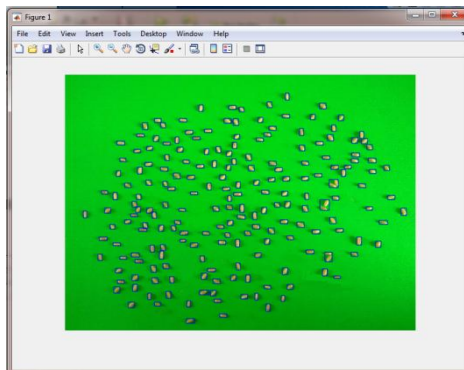


Fig 7: Matlab server side result for pure wheat image

Here all full grains are indicated by the blue boxes

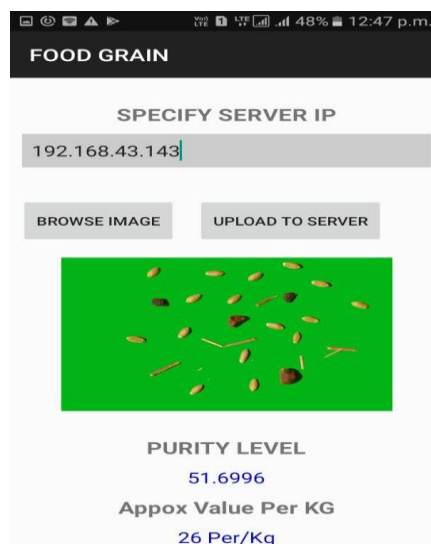


Fig 8: Result of Wheat grain with foreign practical's or impurities

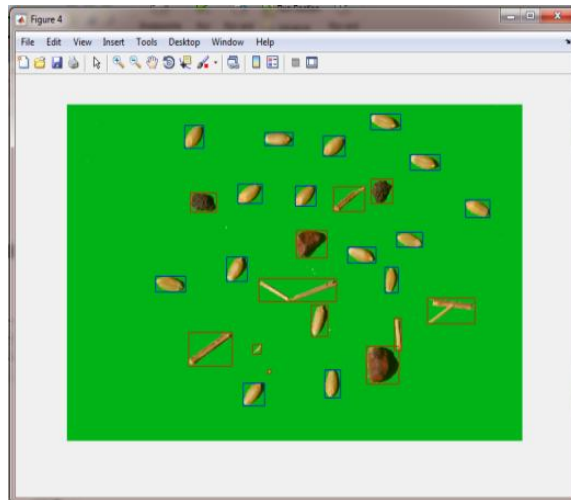


Fig 9: Matlab server side result for wheat grain with impurities image

Here blue boxes indicate full wheat grain and red boxes indicate foreign practical's or impurities.

Result Analysis:

More than 150 images were used to test the proposed application. And it was found that accuracy of identifying the quality of each wheat grain was between 80%-90%. In the proposed application quality identification is performed with different classifiers like SVM, K-NN. And the accuracy of identifying the quality of wheat grain of these classifiers was 88% and 86% respectively. The testing results of these classifiers are shown in below table.

Table 2: Comparison result of different classifiers

Grain Type	Classifier used	Accuracy in %
Wheat	Support Vector Machine	87%
Wheat	K-NN	81%

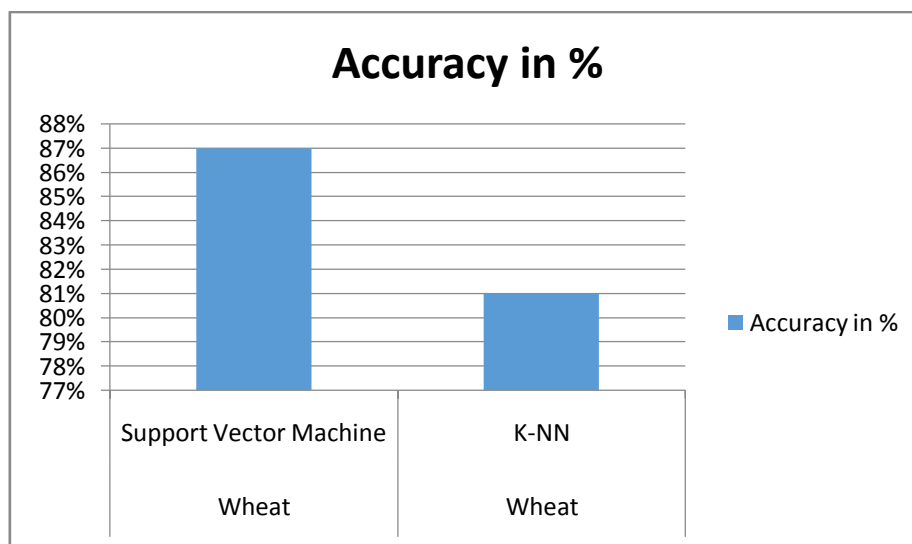


Chart 1: Comparison result of different classifiers

VI. CONCLUSION AND FUTURE SCOPE

The proposed system identifies the quality of wheat grain which is based on appearance features such as shape and color, with technology of image processing, mobile application and machine learning algorithms like Support Vector Machine, K-NN Classifier. More than 150 images were used to test the system and it was found that accuracy of identifying quality of wheat grain was between 80-90% with different classifiers.



A very simple system is proposed for identifying the quality of wheat grain which requires limited features, power thus overcoming the disadvantage of existing system which consumes more time and also very tedious to work. Also identifying quality of wheat grain is also based on the moisture of grain, foreign practical's etc.

The designed system can further be implemented by adding the texture features and different machine learning algorithms to get detailed quality of wheat grain.

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