Implementation of Grain Identification & Quality Check using Image Processing & Neural Network

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Certificate

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Abstract

There are various varieties of Rice and lentils. Price fabrication and adulteration have been some of the various issues faced by the consumers, farmers and wholesale retailers. Traditional methods for Identification of these similar types of grains and their quality analysis are crude and inaccurate. Methods were tried to implemented earlier but due to financial inability and low efficiency, they weren't successful.

To overcome this problem, the project proposes a method that uses a machine learning technique for identification and quality analysis of these grains. Rice and Lentils which have the maximum consumption have been selected. Lentils are designated into classes based on colors. The method of determining the class of a lentil is by seed coat color. Red lentils may be confirmed by the cotyledon color. Lentil varieties may have a wide range of seed coat colors from green, red, speckled green, black and tan. The cotyledon color may be red, yellow or green. The size and color of each Indian Lentil type (i.e. Red, Green, and Yellow, Black, White) are determined to be large or Medium or small, then size and color become part of the grade name. An intelligent system is used to identify the type of Indian lentils from bulk samples. The proposed system facilitates kernel size and color measurement using image processing techniques. These Lentil size measurements, when combined with color attributes of the sample, classify three lentil varieties commonly grown in India with the highest accuracy.

Rice is one of most consumed grains in India so its quality is of utmost importance. In this project, we identify and grade five types of rice and grade them with the help of their distinguished features such as size, color, shape, and surface.

The project works in three phases viz., Feature Extraction, Training, and Testing. Various rice grain has a different shape, size, surface and various lentils come in different colors, Hence the feature that will be extracted is texture and colors. The method of regression will be adopted for the grading mechanism where the output will be in terms of percentage purity. The methodology for the extraction of the feature will be GLCM and Edge Detection where for supervised learning SVM and Back Propagation will be utilized. The project provides an efficient replacement for the traditional grading mechanism and standardizes the pricing of farm products based on their quality only.

C O N T E N T S

Chapter 1: Overview

1.1 Importance of the Project

Agriculture is the most important sector of the Indian Economy. The Indian agriculture sector accounts for 18 percent of India's gross domestic product (GDP) and provides employment to 50% of the countries workforce. India is the world’s largest producer of pulses, rice, wheat, spices, and spice products. The agricultural market still continues to be in bad shape in rural India. In the absence of sound marketing facilities, the farmers have to depend upon local traders and middlemen for the disposal of their farm produce which is sold at a throw-away price. In most cases, these farmers are forced, under socio-economic conditions, to carry on the distress sale of their produce. In most small villages, the farmers sell their produce to the moneylender from whom they usually borrow money. According to an estimated 85 percent of wheat and 75 percent of oilseeds in Uttar Pradesh, 90 percent of Jute in West Bengal, 70 percent of oilseeds and 35 percent of cotton in Punjab is sold by farmers in the village itself. Such a situation arises due to the inability of the poor farmers to wait for long after harvesting their crops. In order to meet his commitments and pay his debt, the poor farmer is forced to sell the produce at whatever price is offered to him. The Rural Credit Survey Report rightly remarked that the producers, in general, sell their produce at an unfavorable place and at an unfavorable time and usually they get unfavorable terms.

According to the data provided by the Department of Economics and Statics (DES) the production of food grains for the year 2013-2014 is 264 million tons which are increased when compared to (2012-2013) 257million tons. This is a good symptom for the Indian economy from the agriculture sector. India remains among the main three as far as the production of different agricultural things like paddy, wheat, pulses, groundnut, rapeseeds, natural products, vegetables, sugarcane, tea, jute, cotton, tobacco leaves and so on. On the other hand, on the advertising front, Indian agribusiness is as yet confronting

the issues, for example, low level of business sector reconciliation and integration, availability of dependable and convenient information needed by farmers on different issues in farming.

Indian is an agriculture-based country, where more than 50% of the population depends on agriculture. This structures the main source of income. The commitment of agribusiness in the national income in India is all the more, subsequently, it is said that agriculture in India is a backbone for the Indian Economy. The contribution of agriculture in the initial two decades towards the total national output is between 48% and 60%. In the year 2001-2002, this contribution declined to just around 26%. The aggregate Share of Agriculture and Allied Sectors, including agribusiness, domesticated animals, and ranger service and fishery sub-segments as far as the rate of GDP is 13.9 percent during 2013- 14 at 2004-05 prices. Agricultural exports constitute a fifth of the total exports of the country.

In perspective of the overwhelming position of the Agricultural Sector, gathering and support of Agricultural Statistics expect incredible significance.

Most of the Indians are directly or indirectly depending on agriculture. Some are directly attached to farming and some other people are involved in doing business with these goods. India has the capacity to produce food grains which can make a vast difference in the Indian Economy.

In the absence of an organized marketing structure, private traders and middlemen dominate the marketing and trading of agricultural produce. The remuneration of the services provided by the middlemen increases the load on the consumer, although the producer does not derive similar benefits.

Many market surveys have revealed that middlemen take away about 48 percent of the price of rice, 52 percent of the price of groundnuts and 60 percent of the price of potatoes offered by consumers.[1]

In order to save the farmer from the clutches of the money lenders and the middlemen, the government has come out with regulated markets. These markets generally introduce a system of competitive buying, help in eradicating malpractices, ensure the use of standardized weights and measures and evolve suitable machinery for settlement of disputes thereby ensuring that the producers are not subjected to exploitation and receive remunerative prices.

Even after the implementation of the regulations imposed by the government, there are hardly any efficient means for identification and grading of grains. For an efficient flow of the proposed regulation a proper identification and grading system is required. This project aims to be an efficient replacement for the traditional grading mechanism. It will be a tool for standardization of price for the products.

1.2 Literature Survey

Nadeesha Nagoda, Lochandaka Ranathunga's "Rice Sample Segmentation and Classification Using Image Processing and Support Vector Machine"[2] provides an approach to separate and classifies objects of rice samples based on color and texture features with the help of image processing and machine learning techniques. This method starts with image acquisition using a CCD camera. Grayscale conversion, noise reduction, binarization, morphological operations are applied to the acquired images. Contours of the objects are estimated by using contour detection. The watershed algorithm is used to segmentation of touching and overlapping rice kernels. Local Binary Pattern (LBP) texture feature and color features extracted from segmented images. These features used to predict the rice sample objects using Linear Kernel-based Support Vector Machine (SVM). The experiment performed on six rice categories to evaluate the suggested solution. The accuracy of segmentation and classification is 96.0% and 88.0% respectively.

Piyumi Wijerathna, Lochandaka Ranathunga's "Rice Category Identification using Heuristic Feature Guided Machine Vision Approach"[3] describes the process of rice category identification by using a guided visual feature-based machine vision approach. Segmented rice seed images are the basic inputs and pre-processing is done to the images of rice seeds. By using these pre-processed image samples, morphological features are extracted and by using original color image samples, color features are extracted. Then features are optimized for getting the highest accuracy of classification. Extracted optimized features are given to the artificial neural network model and this neural network model is trained according to the training rice seed images. This proposed method is able to identify the rice category of unknown rice seeds sample and it is able to give the rice category as final output. The overall method is shown an average accuracy of 82.21%.

Muhammad Junaid Asif, Tayyab Shahbaz, Dr. Syed Tahir Hussain Rizvi, Sajid Iqbal's "Rice Grain Identification and Quality Analysis using Image Processing based on Principal Component Analysis"[4] present's 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 are done by comparing the sample image with the database image. The canny edge detector is applied to detect the edges of rice grains. Eigenvalues and Eigenvectors 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. The proposed system can work well within minimum time and low cost.

Devraj Vishnu, Gunjan Mukherjee, Arpitam Chatterjee's "A Computer Vision Approach for Grade Identification of Rice Bran"[5] presents a study on identifying the qualitative grades of rice bran using

computer vision. The study is performed using three samples of rice bran collected from rice mills along with their test reports to confirm their qualitative difference. The images of individual samples were captured in a controlled illumination environment. The image features were extracted from the cropped images after the required color conversion. The constructed feature sets were subjected to principal component analysis (PCA) for observing the cluster formation and also the K-Means cluster analysis to derive the cluster centers. The clustering analysis results show the potential of the presented method for the identification of rice bran grades.

Narendra V G and Muhammad Abdorrazzaghi's "An Intelligent system for identification of Indian Lentil types using Artificial Neural Network (BPNN)"[6] identifies lentils based on their color(Red & Yellow). The method of determining the class of a lentil is by seed coat color. Red lentils may be confirmed by the cotyledon color. Lentil varieties may have a wide range of seed coat colors from green, red, speckled green, black and tan. The cotyledon color may be red, yellow or green. The size and color of each Indian Lentil type (i.e. Red, Green, and Yellow) are determined to be large or Medium or small, then size and color become part of the grade name. An Intelligent system is used to identify the type of Indian lentils from bulk samples. The samples were acquired from the proposed image acquisition system with image resolution 640x480. The proposed system facilitating kernel size and color measurement using image processing techniques. These Lentil size measurements, when combined with color attributes of the sample, classify three lentil varieties commonly grown in India with an accuracy approaching 97.08

With the help of various research papers and other sources, we have analyzed various pre-processing techniques, feature extraction techniques such as GLCM, GLRM and PCA and various classifier models such as SVM, BPNN, K-NN, and ANN. With the help of the literature survey, we can identify the exact pre-processing technique, feature extraction and classifier to be used and implement it with high accuracy and efficiency. The project basically consists of two sections viz., identification and quality analysis. For identification purposes, the concept of classification in neural networks will be used and for the purpose of grading the concept of regression will be used. SVM and Back Propagation Network are the primary options for Neural Networks.

1.3 Motivation

As a general rule, there is hardly any grading of the commodities to be marketed. Therefore, the purchaser has little, if any, confidence in the quality of the products.

[7]The British Government passed the Agricultural Produce (Grading and Marketing) Act in 1937 to solve this problem. But nothing really has happened. As per the Act, licenses are issued on a selective basis to reliable merchants, under the supervision and control of the Government staff.

The graded commodities are subsequently passed on to the market under the label of “AGMARK”. However, due to the financial inability of farmers, the method could not be implemented on a large scale.

India, being an agrarian country, it is imperative that people in agriculture sector should be high on spirits. In order to maintain their spirits, the minimum requirement is to provide them the right price for their hard work. Hence, we are building a standardized tool that will grade the products efficiently and correspondingly provide the right price.

1.4 Scope of the Project

Lack of grading & standardization: The rural farmers are not aware of the impact of grading and standardization of their products. Due to this unawareness, the dishonest functionaries in the market take undue advantage of farmers. They may declare any produce as low-grade and quote a low price for such stocks, which in turn creates a big loss to farmers.

Advancement in image processing and Machine Learning can make grading of the products completely automatic.

By comparing the features of ideal products with the feature of given products an efficient grading tool can be developed. This project can be further used to check the condition of the crops and detect the disease if any, also it can provide the corresponding remedies.

With more research, the health of the crops can be predicted which will, in turn, increase the yield.

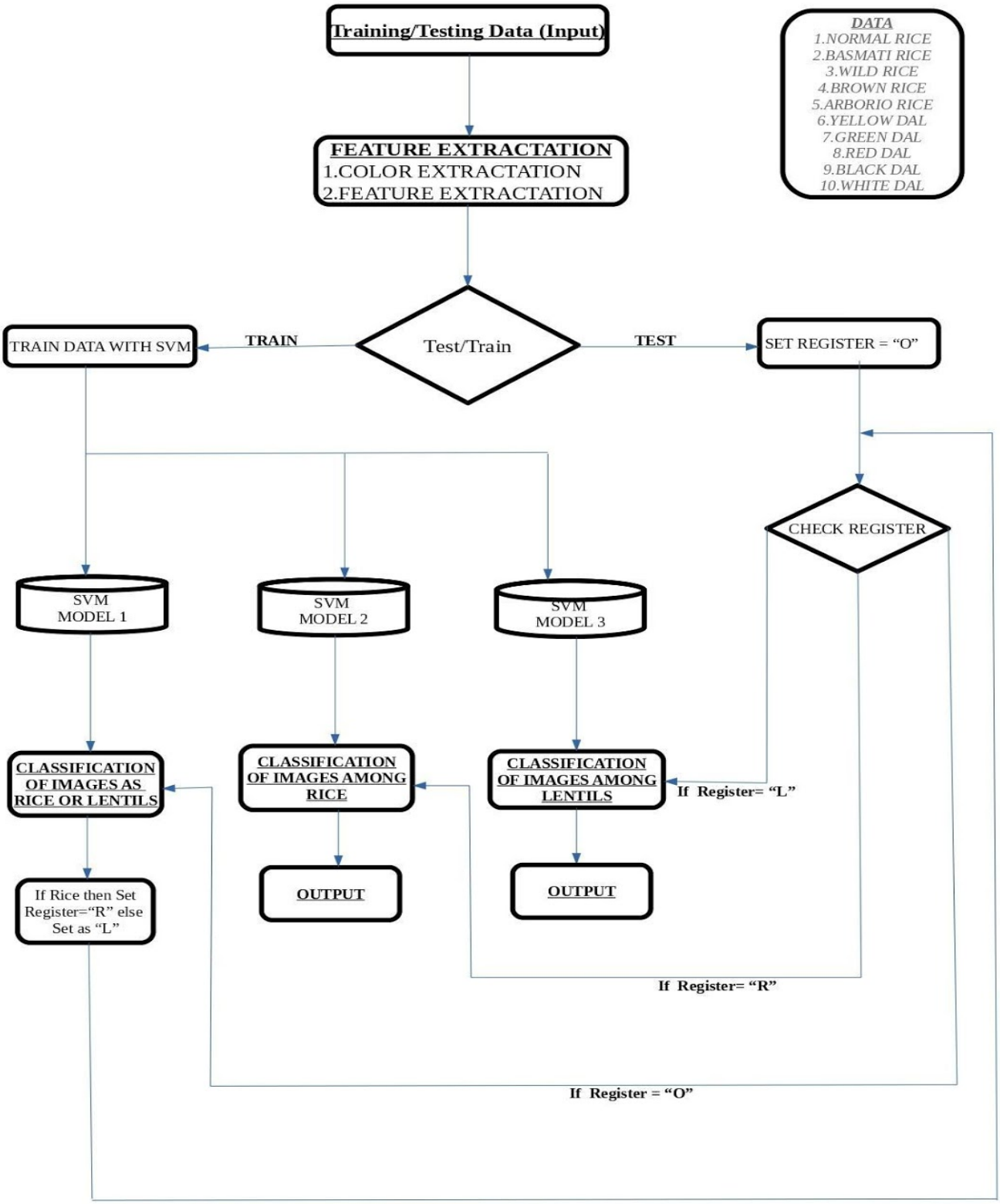
Chapter 2: Proposed Work

2.1 Problem Definition

There is no efficient tool available in the market to grade the grains, rice, lentils or the other products of the farm. The traditional method which is being practiced since decades is by human inspection. The human inspection comes with a lot of variables depending on factors such as knowledge, experience, alter motives, etc. This leads to unfair grounds for doing business. Hence, there is a need for developing an integrated tool for not only identifying the farm products but also grade them efficiently. This will keep maintain the quality and provide a fair price for the products.

We propose to develop an integrated tool to identify and grade farm products using Image Processing and Neural Networks

2.2 Data Flow Diagram



As evident from the flow chart, there are three important steps feature extraction, training, and testing. The input images will go under feature extraction where we target to obtain its features such as length, width, contrast, correlation, homogeneity, energy by image processing and GLCM (Gray Level Cooccurrence Matrix)[8].

The input image along with its features will be then fitted to the training part of the system where we plan to develop 3 SVM (Support Vector Machine) models[9].

The first model would be for the classifying between rice and lentils. The second SVM model would be for the identification of the type of rice and the third SVM model would be for the identification of the type of lentils.

The third and final step is the testing phase where initially the register is set as O and the input images along with its extracted features is directed towards the SVM model 1 where it will classify the product either as rice or lentils and set the register to R if it is rice or else set the register to L if it is lentils. Based upon the output of the SVM model 1 the images would be then again redirected to either SVM model 2 or SVM model 3 to identify the exact type of rice or lentils.

Chapter 3: Analysis & Planning

3.1 Feasibility

A thorough Literature survey is necessary for developing any project. Based on the research papers and resources available online, it is expected to complete the given task in a month.

Creating Data Set: Due to the unavailability of the Data Set, a completely new data set will be created which will be project-oriented. There are 5 types of rice and 5 types of lentils to be identified and graded where each type will be allocated 100 photos which makes it a total of 1000 photographs. Out of the 100 photos allocated to every type 60 photos will be reserved for the training phase and remaining for the testing phase. The above task is given a timeline of 2 weeks.

The images captured will be of higher resolution which will affect the processing speed. In order to solve the issue and compare the efficiency of the output of Higher and Lower resolution images resizing of the image to lower resolution is necessary. The resizing task is allocated a timeline of 1 week

The inner working of the project consists of two-phase identification and grading. Performing various image processing methods for identification and various Machine Learning techniques for grading in order to get the highest efficiency based upon the Literature survey, it is allocated a timeline of one month.

The project is proposed to be developed on Python where it will be used for developing codes, GUI, and debugging of the code.

The prototype is expected to be ready within four months of the allocated time frame for the project and the remaining time will be utilized for improving the efficiency and making the product industry-ready.

3.2 Scheduling

Week no.	Activity	Outcome	Comment on outcome	Resources utilized
1	Decided project and finalized it	Project guide accepted the project	Project approved	Google.com, IEEE.com
2	Literature Survey	Researched various papers articles	Obtained detailed information based on the project	IEEE & Research Gate papers
3	Studying and Reviewing the Literature Survey	Acquired required information	Analysis of the acquired information	IEEE & Research gate papers
4	Submission of Literature survey	Research Papers Submitted	Research paper analyzed	IEEE & Research gate papers
5	Paper presentation	Presentation to all domain teachers	Analysis of improvement required in the project	IEEE & Research gate papers
6	Identification of flow of project	Suggestion by mentor on the flow of project	Methods and techniques to be properly studied	Image processing course on Coursera
7	Presentation on project	Presentation to all domain teachers	Analysis of improvement required in the project	IEEE & Research gate papers
8	Database creation	Setup required for collecting image	Created a setup for image collection	DSLR
9	Database creation	Gather different types of lentils and rice	Obtained dataset for various grains	Grains
10	Identification of image preprocessing techniques	Study various preprocessing technique	Studied and analyzed preprocessing technique	PyCharm, spyder

11	Feature Extraction	Study various feature extraction techniques	Implemented feature extraction on a random image	PyCharm
12	Identify the image processing algorithm	Study various image processing algorithm	Studied and analyzed various image processing algorithm	Google.com, Coursera & Udemy

3.3 Project Planning

This project is planned to have 3 stages:

- **Study/Analysis and Data collection:** This stage is where the literature survey is done to understand the various existing techniques and identify which best works in our system. Data collection includes the performance analysis, accuracy, feasibility of different methods. It also includes the formation of a database of images of various types of rice and lentils adequate enough to train the system. Dataset is divided into the training and testing set.
- **Selection Of Methodology**: This stage is the core of the project, where the implementation of the selection of various types of Extraction and Machine Learning Methodology will be decided. The decision will be based on efficiency and processing time. The entire system is divided into three parts viz., image pre-processing, feature extraction and implementing machine learning algorithm for identification and grading. The goal of training is to create an accurate model that provides output with maximum efficiency. The procedure used has to be thoroughly scavenged for loopholes and be rectified.
- **Final Phase:** It involves the compilation of the entire procedural code and obtaining the required result. The inner working of the project consists of two-phase identification and grading. Compiling and integrating various image processing codes along with Machine Learning techniques to get the desired output is the objective of this stage.
- After the successful development of the prototype, further possible enhancements will be done to make the product industry-ready.

Chapter 4: Conclusion

4.1 Conclusion

Image Processing in resonance with the Neural Network can evolve the present scenario of identifying and grading mechanism available in the market. Grading of the farm products is an important part of maintaining a fair business grounds for the farmers and the retailers or consumers in some cases. Identification of various features of the given products using image processing and formulating them as an input for Neural Network can develop a tool whose out can be considered a standard output for all future transactions.

It is observed that in the majority of the literature survey the output efficiency is above 80% but the research is carried out on only a single product. So, this project proposes to develop an integrated tool to identify and grade farm products using Image Processing and Neural Networks.

Since lentils come in different colors and different kinds of rice have a different texture. So, the main feature that will be extracted is Color and Texture.

Features such as contrast, Homogeneity, colors, energy, shape, size are the prominent features to be extracted which will be done with the help of GLCM and edge detection.

For identification purposes, the concept of classification in neural networks will be used and for the purpose of grading the concept of regression will be used. SVM and Back Propagation Network are the primary options for Neural Networks.

Based upon all the resources that have been studied the project aims to utilize the latest and efficient methods such as Support Vector Machine, GLCM, Back Propagation Network to develop a tool that will be capable of identifying and grading the farm products efficiently.

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