Quick Analysis of Quality of Cereals, Oilseeds and Pulses

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ABSTRACT

Quality and purity checking of grains are commonly derived from human vision observation. Analysing the grain sample manually is a longer consuming and sophisticated process, and having more chances of errors with the subjectivity of human perception. Laborious techniques such as manual measurement of individual seeds variation in quality results. To overcome these, we developed image processing-based techniques to analyse the quality of cereals, oilseeds and pulses. The structural analysis that is outer part analysis is important in checking the quality of grains. The structural analysis covers the visualization aspect like measurement of size (length, width), colour, glossiness and aspect ratio and it also should be barren of shrivelled, diseased mottled, molded, discoloured, damaged and empty seeds. Computer vision and machine learning provides one alternative for an automated, speedy analysis and cost-effective technique to accomplish these requirements over other conventional techniques.

Keywords: Computer vision, Image processing, Kernel, Grains, Contour, CNN.

1.INTRODUCTION

Cereal grains vitally important in meeting the nutrient needs of the human population. Cereals are an upscale source of vitamins, minerals, carbohydrates, fats, oils, and protein. Legumes are an important source of protein, dietary fibre, carbohydrates and dietary minerals. Oilseeds are wont to make vegetable oils and biodiesel. Grain quality can have different aims to different people depending upon the sort of grain or seed and its intended use. Sometimes the lesser quality grain is mixed with superior quality grain to urge a far better price. the merchandise made up of this sort of mixture can cause bad quality foods. this sort of adultery essential to be recognized while the choice of cereals, oilseeds and pulses. Consumer preferences affect what people buy then affect market prices. Therefore, it requires a different quiet grain analyser which may provide analysis to satisfy the market needs. Grain form is evaluated with length, width, and thus the magnitude relation of length and dimension of rice grains. The effectiveness and accuracy of inspections are improved through these strategies.

Grain quality depends on individual kernel features. Kernel's features can be measured by either compositional analysis or structural analysis. The structural study of grains targets the exterior part of grains. The structural study covers parameters like size means length and width measurement, colour and glossiness checking, aspect ratio. Structural study is done either by human or image-based analysis. Detailed measurement of grain shape such as length and width commonly depend on laborious techniques such as manual measurement of single grains. Manual analysis of grains is done either by eyes or using measuring instruments. Manual measurement doesn't guarantee quality. The results of the analysis may differ if the samples to be analysed are more numerous. For measuring individual nucleus parameters, image analysis and machine learning techniques have proven to be a very efficient solution. Compared to analysing the samples by visual observation, the instrument measurement has more accurate results.

Our objective is to develop an image processing-based model to check quality of cereals, oilseeds and pulses by structural analysis i.e., size (height and width), colour and glossiness. By checking quality, the aim is to analyse market needs as well as consumer preferences and get better prices, remove impurities and foreign matter, detect adulteration.

2. LITERATURE SURVEY

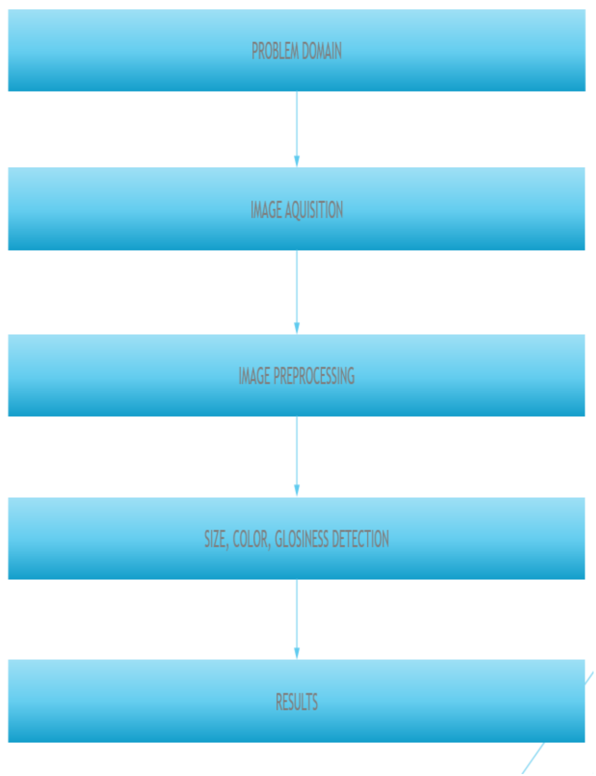
This review presents the recent developments and applications of image analysis within the food business,

the fundamental ideas and technologies related to laptop vision. Image process is recognized as being the core of laptop vision with the event of additional economical algorithms aiding within the larger implementation of this system. The machine-controlled, objective, fast and hygienical scrutiny of various raw and processed foods is achieved by the utilization of laptop vision systems.
Computer vision has the potential to become a significant part of machine-controlled food process operations as exaggerated laptop capabilities and larger process speed of algorithms are regularly developing to fulfil the mandatory on-line speeds. The flexibleness and non-destructive nature of this system conjointly facilitate to take care of its attractiveness for application within the food business.
There are a variety of ordinary procedures for seed quality analysis and sorting that are principally supported the assessment of varied physical, morphological and physiological properties of seeds however in recent past, a powerful would like was felt for the event of additional correct, fast and non-destructive strategies of seed quality analysis. Machine vision or processed image analysis system is found to be terribly convenient technique for seed connected studies because it is free from human errors, additional fast and provides shut analysis of seeds and germinating seedlings.

3. METHODOLOGY

Kidney Beans and two varieties of rice (Basmati and Indrayani) were used in the study. Both Kidney Beans and rice have different varieties in terms of structural analysis. The differences between Kidney Beans Grains and two rice variety grain samples were important to evaluate the effectiveness of the method through the grow-out test.

A total of 500-grain samples of Kidney Beans and two rice varieties were used for image analysis. Images are captured using a camera and all images are captured from the same height and all are of the same size and of the same format i.e., JPGE. The grains (Kidney Beans and two rice varieties) are placed on a black sheet of paper. The captured image was processed and analysed using SPYDER software. The programming language used is Python. Size, aspect ratio, colour is calibrated using image processing. To detect the impurity and adulteration convolution neural network is used.



3.1 Size and Aspect Ratio –

3.1.1 Size –
Image segmentation was processed using SPYDER software by changing a true color RGB image to a grayscale image. Then Gaussian blur is applied to the grey-scale image. Basically, a grayscale image is used to increase quickness and accuracy. Then by applying canny edge detection, edges get to find out. It is used to detect multiple objects. With the help of a Canny edge detector, the converted image will be processed and it scans the entire image. Thenceforth, execute the dilation and erosion method to close holes between edges in the edge frame. The reference object is placed on the left most corner of every image. After that contours were drawn for reference objects and for individual grains and by using the Euclidean distance formula length and width of each and every grain is calculated.

3.1.2 Aspect ratio -
aspect ratio = length of kernel (l) / width of kernel (w) for any grain sample,
generally average value is considered:
aspect ratio avg = average length of kernel (lavg) / average width of kernel (wavg)

3.2 Color and Glossiness–

3.2.1 Colour –

The colour is an important characteristic of every grain type. RGB image represents true colour images and RGB values are between 0 and 255. The colour featured average red (R), green (G) and blue (B) colours. The colours values were measured by considering the centre of the contour.

3.2.2 Glossiness –

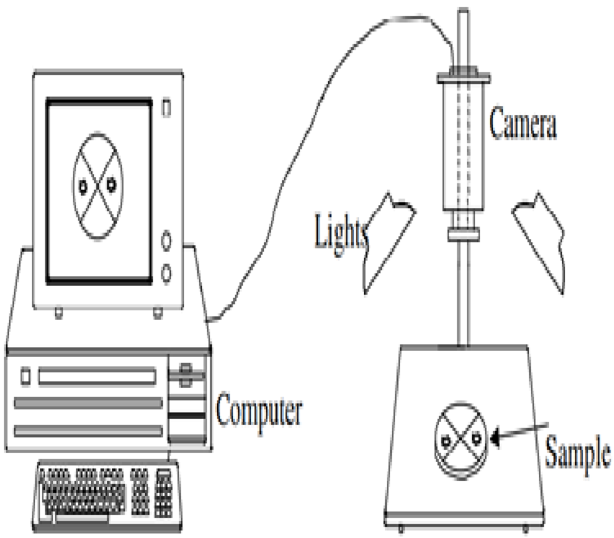
In grinding, bleaching and polishing greatly affect the whiteness of the beans. During whitening, the s skin and the outer layer of the brown rice are removed. Polishing is done to improve the appearance of the white rice.

3.3. Damaged / discoloured grains:

Spoiled grains are the seeds of different types of cereal grains with lower nutritional value through biochemical change in the appearance of bad odors and changes in physical appearance. These types of damage are caused because of moisture content, pest damage, physical damage, insects, and heat exposure. Damaged/discolored grains include broken fragments of whole that are internally damaged or discolored, immature, yellow, red or green color seed.

It can be measured as:

% damaged grain = (Total no. of damaged seed / total no. of seeds) X 100



3.4. Adulteration and foreign matter –

The lesser quality grain is mixed with superior quality grain to urge a far better price. The merchandise made up of this sort of mixture can cause bad quality foods this sort of adultery essential to be recognized while the choice of cereals, oilseeds and pulses. For this purpose, a valid grain detection algorithm based on image processing has been used. The grains along with foreign materials such as stones, debris, dust, leaves, twigs, stems and flowers are essential to de-escalate this model based on machine learning CNN that is used to detect foreign materials.

4. RESULTS

4.1 INPUT

Captured images are given for the process to the grain instrument. For process, 1st it's needed for identification of individual kernels within the input image. contours algorithmic rule is employed to induce the overall variety of regions in an exceedingly given image by change of integrity of the connected pixels. The labelling algorithmic rule scans the image row-wise and uses the merging algorithmic rule within which a pel receives a similar label as its neighbourhood pel, if the pixels gray values in threshold vary then it'll be labelled. It starts from the 1st row and scans all pixels. For the second row's 1st pel it checks higher and higher right pixels. It checks encompassing connected pixels and proceeds for seventy-one by one row. For the last row it checks higher and higher left pixels. Once scanning every pel in image the label array is made. Figure 1, shows the input frame that used for canny edge detection.

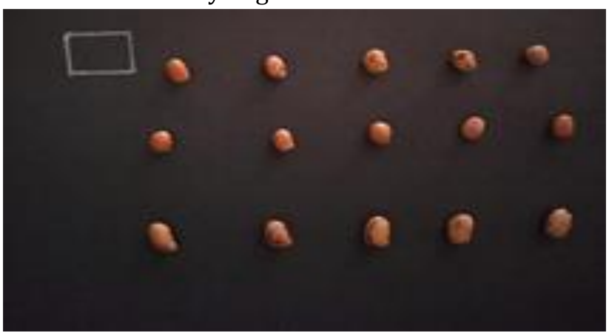


Figure 1. Input frame

The 1st stage in canny edge detector algorithmic rule is to delete the noise within the frames by applying a Gaussian filter. The frame once changing to grayscale and apply Gaussian filter is appeared in Figure 2,

Figure 2. Smoothed input frame

In the gradient stage, we tend to discover the sting gradient and direction for every pel. For the outline the gradient at each pel of ironed frame, cagey operator used. A complete scan of frame is going to be done subsequently receiving gradient magnitude and direction, to eliminate any undesirable pixels which could not establish the sting. During this stage, simply native maxima should be thought-about as edges through applying Non-maximum suppression. Non-maximum suppression exchanges the smoothed edges within the frame of the gradient magnitudes to sharp edges.

The final stage of cagey edge detector algorithmic rule is physical phenomenon thresholding. This stage selects that square measure each edge square measure for sure edges and that aren't edges. the 2 threshold values square measure by trial-and-error elect and their definition can upon on the content of a given frame. This is often achieved via selecting huge and little threshold values. If Edge pixels are stronger than the massive threshold, it's marked like durable. robust edges are going to be measured because the last edges. Also, edges are going to be suppressed If a footing pixel is weaker than the tiny threshold, and it's marked as a weak edge if a footing pel is among the massive and little thresholds.

To obtain the higher result and a lot of correct object detection, the cagey edge detection procedure has been improved with some Morphological operations [19]. These procedures square measure unremarkably a mix of nonlinear procedures performed comparatively on the preparation of pixels while not dynamical their numeral values. erosion and dilation square measure the keys for morphological operations.

In this study, a morphological method is performed like a mix of dilation and erosion. The gap is that the initial procedure within which erosion is followed through dilation. Closing is that the second operation within which dilation is followed through erosion. As a mix of those processes, we tend to square measure capable to accumulate superior determination for discovery edges in-depth frame. Figure five shows that the frame once applied erosion and dilation operation.

To in brief summarize grain measure, after edge detection and shut any gaps between edges, we detect contours by mistreatment associate OpenCV operate that's cv2.findContours to search out the shapes of the grain within the edge map. we tend to organize contours from left to right. The reference object within the frame is for good the left one. By relying on the reference grain, we tend to calibrate the camera and set the worth of parameters. Next, we tend to scan each contour, begin the process on top of each individual contours. After that, the grains are going to be drawn in inexperienced. So, the points of the bounding box parallelogram can attract a little purple round. After that, we will get midpoints as a result of the bounding box being ordered. Finally, we tend to calculate pixels Per Metric variable through dependence on the reference object. The height-distance in pixels can be placed on the hD (height) variable and breadth distance can be placed on wD (width) variable. Then, we tend to calculate the geometer distance among sets of center points.

4.2 OUTPUT

For the experiment, the camera has been effectively capturing the pictures. The proposed system applies four operations such as read capture image, find edges, find objects, and measure the size for each object. When we run the operation, the output displays on the PC screen as appears in(FIG 3). When we run the application, then there are many other parameters that are calculated like length, breadth, color, aspect ratio and validation of that grain and all the data like length, breadth, and validation are stored in an excel sheet (FIG 4). The foreign matter is detected by using the CNN model.

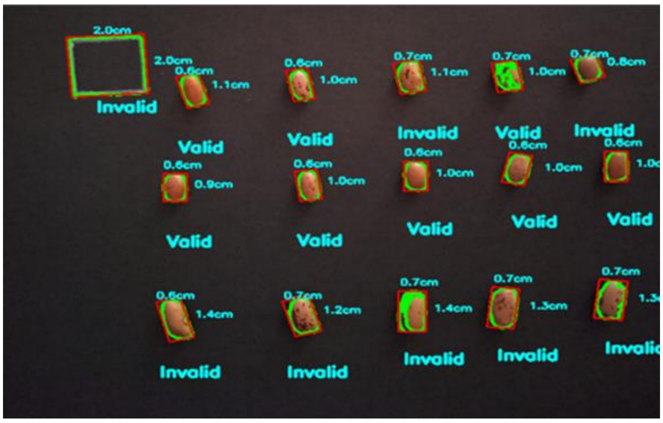


Fig. 3 Calculate the size of grain

Grain #	HEIGHT	WIDTH	RGB VALUES	WHITNESS	ABSTRACT RATIO	VALIDATION
1	2.020151	2	[44 46 54]	1.010075453	18.82352941	invalid
2	0.957046	0.574228	[49 88 173]	1.666666711	40.52287582	valid
3	0.92811	0.605289	[59 90 175]	1.533333333	42.35294118	valid
4	1.086527	0.606968	[40 84 173]	1.790089315	38.82352941	valid
5	1.084652	0.555123	[91 121 198]	1.953893874	53.59477124	valid
6	0.973703	0.548113	[73 100 180]	1.776464592	46.14379085	invalid
7	0.807052	0.605289	[64 84 142]	1.333333333	37.90849673	invalid
8	1.050912	0.66704	[69 98 172]	1.575486998	44.31372549	valid
9	0.973703	0.608308	[54 87 166]	1.600673571	40.13071895	valid
10	1.147746	0.613638	[58 95 169]	1.870395194	42.09150327	valid
11	1.003353	0.645957	[55 84 145]	1.553281345	37.12418301	valid
12	1.005177	0.597505	[51 76 138]	1.682290932	34.64052288	valid
13	1.028992	0.625465	[39 67 128]	1.64516129	30.58823529	valid
14	0.869222	0.651916	[41 61 108]	1.333333294	27.45098039	invalid
15	1.001729	0.599885	[42 60 119]	1.669868682	28.88888889	valid
16	0.939661	0.63194	[28 48 95]	1.486946311	22.35294118	valid

Fig. 4 Data Generated in Excel Sheet

Therefore, size measurement of individual grain, valid and invalid grain detection, colour measurement and impurity detection is done successfully.

4.3 ANALYSIS

In this study, a powerful grain analysis system is introduced and the method proposed is for industrial systems. Computer Vision is used to detect and analyse grain and it gives more than 90% accuracy.

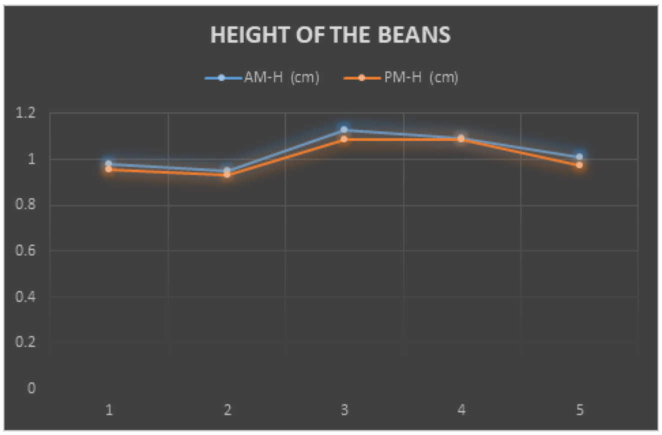
4.3.1 KIDNEY BEANS SAMPLE- In the first sample of grain, we measured the size of beans such as, shows the accuracy of proposed object measurement system for these objects. Abbreviations in the table are as follows; AM-H: Actual Measure-Height, PM-H: Proposed Measure-Height, AM-W: Actual Measure-Width, PM-W: Proposed Measure- Width.

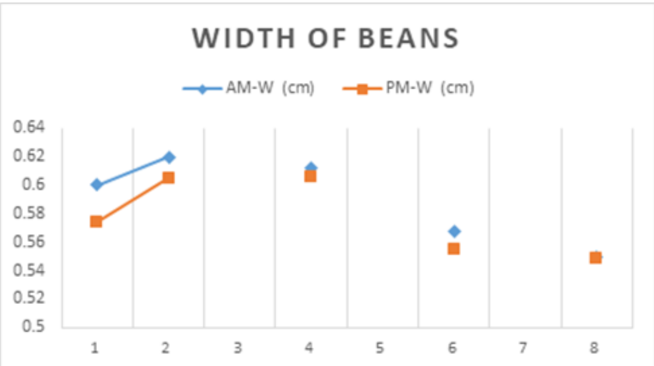
No of Grains	AM-H (cm)	PM-H (cm)	Accuracy (%)	AM-W (cm)	PM-W (cm)	Accuracy (%)
1	0.98124	0.957	97.52%	0.60	0.574	95.66%
2	0.95	0.932	98.10%	0.62	0.605	97.58%
3	1.13	1.086	96.10%	0.612	0.606	99.01%
4	1.09	1.084	99.44%	0.568	0.555	97.71%
5	1.01	0.973	96.33%	0.55	0.548	99.63%

4.3.2 RICE SAMPLE - In the second sample of grain we measured the size of rice such as, shows the accuracy of the proposed object measurement system for these objects. Abbreviations in the table are as follows; AM-H: Actual Measure-Height, PM H: Proposed Measure-Height, AM-W: Actual Measure-Width, PM-W: Proposed Measure-Width.

No of Grains	AM-H (cm)	PM-H (cm)	Accuracy (%)	AM-W (cm)	PM-W (cm)	Accuracy (%)
1	0.785	0.791	97.74 %	0.420	0.490	89.90%
2	0.89	0.93	93.29	0.72	0.69	95.83%

	5	5	%			
3	1.05 1	1.06 7	98.47 %	0.82 3	0.76 3	92.70%
4	1.07	1.06	98.99 %	0.98	0.89	90.81%
5	0.98 6	0.97 3	98.68 %	0.63 1	0.54 8	87.55





CONCLUSIONS

In this study, a powerful grain analysis system is introduced and the method proposed is for industrial systems. Computer Vision is used to detect and analyse grain and it gives more than 90% accuracy. A new calibration file can be generated for the new grain type and grain varieties introduced. One time effort needs to be put into machine learning, then after the same calibration file can give consistent results for the measurement of the same type grain samples.

REFERENCES

Journals
[1] DIGITAL IMAGE ANALYSIS USING FLATBED SCANNING SYSTEM FOR PURITY TESTING OF RICE SEED AND CONFIRMATION BY GROW OUT TEST Analisis Citra Digital dengan Sistem Pemindai Datar untuk Pengujian Kemurnian Benih Padi dan Dikonfirmasi dengan Grow Out Test Mira Landep Widiastutia , Aris Hairmansisb*, Endah Retno Palupia and Satriyas Ilyasa

[2] USE OF THERMAL IMAGING TO IMPROVE THE FOOD GRAINS QUALITY DURING STORAGE Nanje Gowda, N. A. and Alagusundaram, K. Indian Institute of Crop Processing Technology, Thanjavur, Tamil Nadu

[3] Image Analysis: A Modern Approach to Seed Quality Testing Hemender1 , Sushma Sharma1*, V. S. Mor1 , Jitender1 and Axay Bhuker1 1 Department of Seed Science & Technology, Chaudhary Charan Singh Haryana Agricultural University, Hisar, India
[4] Classification of pepper seeds using machine vision based on neural network Ferhat Kurtulmuş 1*, İlknur Alibaş 1 , Ismail Kavdir2