Crack Finding And Crack Extraction Technique - Image Processing

Rajesh F
Department of Software Engineering, BlackSun Information Support Services, Marthanda, North Street, Kanyakumari District, Tamilnadu, India.
email: rajeshfithelis@gmail.com

Abstract. In this paper, a novel crack detection method is proposed based on the digital image of rice grains. This paper discusses about sorting objects based on quality of the object; some object will be good at its morphological characters such as shape, size color etc... beyond this the object will possess cracked inner; so while packing or in movement the object will easily get broken. So to find these kind of object's in early stage this algorithm is used. The defect cracked object can be defined by users as threshold value, so according to the threshold value fixed the defect object will be ejected from the system. This algorithm is designed to works on the RGB images, so if any RGB image is given as input to this algorithm it will detect the cracked object and produce the output. The algorithm was coded using MATLAB-7.0 programming environment.

Keywords: crack detection, canny, machine vision, crack finding, edge detection

I. Introduction

In this research, a detailed survey is conducted to identify the research challenges and the achievements till in the field of crack detection. Accordingly, many research papers are taken related to crack detection, and those research papers are reviewed. The organization of this survey initially starts up with the general architecture of image processing based crack detection, and followed by the analysis based on objective, dataset, error and accuracy level are listed below. The strategy of this approach originated from the strategy plan diagram shown in Fig.1[1-45].

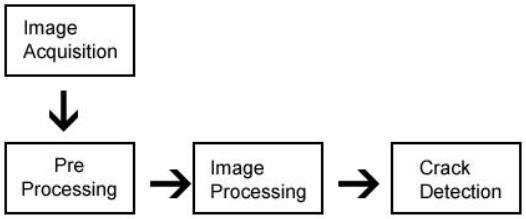

Fig.1. Crack detection process

The above Fig.1. provides the basic architecture for the crack detection using the image processing technique. The major advantage of the image based analysis of the crack detection is that by using the image processing technique it provides accurate result compared to the straight manual methods. The processing difficulty of the crack detection completely depends on the size, lighting and quality of the image. Machine Vision system (e.g. Color sorters) generally use camera-based systems to view processed rice grains. The sorting processes uses CCD camera technology, combined with fast, precise ejectors to reject as many defective products as possible, whilst minimizing the amount of good products ejected by pneumatic air jets from the produce stream.

Fig.2. Good and Normal rice grain possess inner crack

II. Why Detect Edges

The shape information of the rice grain image is enclosed in edges. So first we detect these edges in the image and by using Canny filters and then by enhancing those areas of image which contains edges, sharpness of the image will increase and it will become clear to process or to find crack.

III. Edge Detection

Edge detection is an image processing technique for finding the boundaries of objects within images. It works by detecting discontinuities in brightness.

Fig.3. Coin: crack detection sample

Edge detection is used for image segmentation and data extraction in areas such as image processing, computer vision, and machine vision. Common edge detection algorithms include Sobel, Canny, Prewitt, Roberts, and fuzzy logic methods. The sample output is shown on the below coin image Fig.3.

Edge detection includes a variety of mathematical methods that aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities.

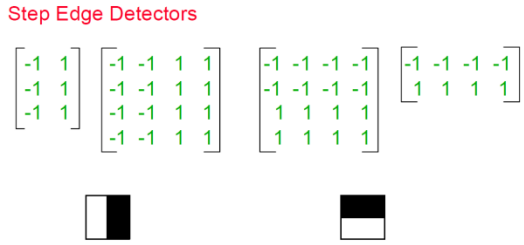

Fig.4. Step edge detectors

The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges. The same problem of finding discontinuities in one-dimensional signals is known as step detection (Fig.4) and the problem of finding signal discontinuities over time is known as change detection. Edge detection is a fundamental tool in image processing, machine vision and computer vision, particularly in the areas of feature detection and feature extraction[45].

The original captured rice image is converted from RGB to grayscale so that it is compatible with the edge function. Canny edge detection is the one used in this paper. There are three adjustable parameters in Canny, two sensitivity thresholds, high and low threshold; and sigma, the standard deviation of the Gaussian smoothing filter.

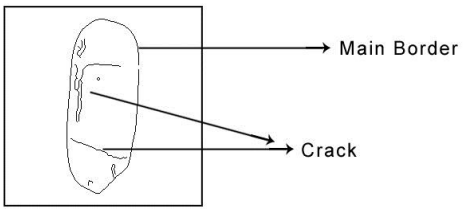

Fig.3. Crack on the image

Gaussian smoothing is a 2-D convolution operator used to blur image detail and noise. In this sense, it is similar to other filters such as mean filter, median filter or conservative filter but it uses a different kernel that represents the shape of Gaussian bell-shaped hump. Briefly, the greater the 20 sigma is, the more the Gaussian filter blurs the image. By experiment, suitable sigma values for this system vary from 0.1 to 3.3.

.

IV. Labeling

Without affecting the main border now the crack region had separated by the connected pixel separation algorithm and the image is stored in a separated variable. The labeling function plays an important role in crack finding, by labeling the binary image given by the 'Connected pixel separation algorithm' we can able to get the number of parts in the image. For labeling, MATLAB built-in function named *'bwlabeln()'* is used. This function will label the black and white image *i.e. binary image*.

Syntax: *Labeling*
[Labeled_Image, Number_Objects]
= label(edge_processed_Image)

From the below experiment we can understand the labeling operation.

V. Canny's Edge Detection

The Canny Edge Detection Algorithm has the following Steps:

- Smooth the image with a Gaussian filter.
- Compute the gradient magnitude and orientation using finite-difference approximations for the partial derivatives.

- Apply non-maxima suppression to the gradient magnitude, Use the double thresholding algorithm to detect and link edges.

Canny edge detector approximates the operator that optimizes the product of signal-to-noise ratio and localization. It is generally the first derivative of a Gaussian.

VI. Crack Finding

After labeling the 'separated edge image' the labeled image should be given as input to the 'regionprops()' function to find the area.

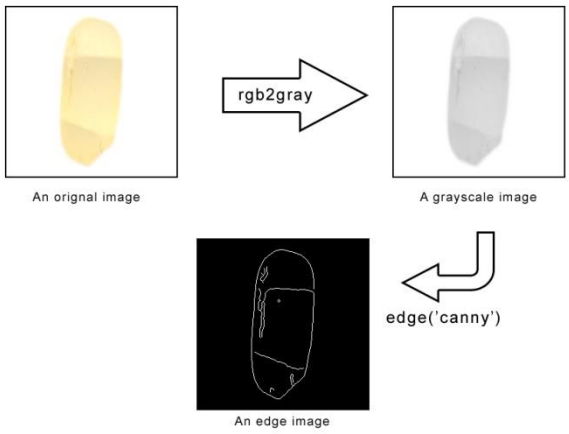

Fig.3. Edge detection process

The 'Area' will be calculated for each labeled parts in the binary 'Edge Image', but we have to leave the main rice border (Fig 3.5) and find the area of the other labeled parts. We know that the main border will have larger area and the crack region will have lesser area than the main border, so we can reject the larger area part (main border) and consider the other areas (crack regions).

VII. Result & Discussion

Edge detection helps to extract useful features form the image. The edge detection is the primary step in identifying an image object, it is very essential to know the advantages and disadvantages of each edge detection filters. In this paper we dealt with study of Canny edge detection techniques to detect the rice grains inner cracks sharply. The algorithm was implemented using MATLAB.

Fig: 4 Input- cracked rice grain

i. Output

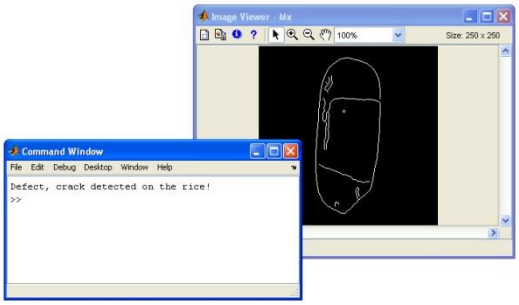

Fig 5. Edge image and MATLAB 7.0 command window

The output (Fig.5) clearly shows the detected edge and the rejected message.

VIII. Conclusion

Collation of all results and observations made during this research lead to the following conclusions, Canny's edge detection algorithm has a better performance to extract the edges of the rice on the image and to trace the crack on it. By using the edge detection process algorithm the machine vision system can sort-out a bad rice grain from the system. The average of 0.2 seconds in a 128 MB RAM with ~1GHz Pentium III processor configuration. This time will be reduced in a higher configuration system, because nowadays processors speed were reached above 3 GHz.

References

[1] J. A. Roese, "Interframe cosine transform image coding", IEEE Trans. Commun., vol. COM-25, pp. 1329-1338, Nov. 1977.

[2] Digital Image Processing and Analysis by Bhabatosh Chanda and Dwijesh Dutta Majumder, Third Printing, February, 2002.

[3] Digital Image Processing, by Rafael C.Gonzalez and Richard E.Woods, Second Edition, First Indian Reprint, 2002.

[4] http://www.zju.edu.cn/jzus, Identification of rice seed varieties using neural network.

[5] School of Biosystems Engineering and Food Science, Zhejiang University, Hangzhou 310029, China), Journal of Zhejiang University SCIENCE, ISSN 1009-3095.
[6] Fundamentals of Computer Algorithms, by Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran. © 1998 W.H. Freeman and Company.
[7] http://www.zju.edu.cn/jzus, Machine vision inspection of rice seed based on Hough transform, Journal of Zhejiang University SCIENCE, ISSN 1009-3095.
[8] www.mathwork.com, MATLAB 7.0 – Image processing.
[9] Nissayan J Artnaseaw A. (2011). Increasing an Efficiency of Jasmine Rice Mill. KhonKaen: KhonKaen University.
[10] Amit Yerpude Rubi Kambo "Classification of Basmati Rice Grain Variety using Image Processing and Principal Component Analysis " IJCTT (International Journal of Computer Trends and Technology) vol. 11 no. 2 pp. 80-85 May 2014.
[11] Rad S. J. M.; Tab F. A.; Mollazade K. "Classification of Rice Varieties Using Optimal Color and Texture Features and BP Neural Networks " Machine Vision and Image Processing (MVIP) 2011 7th Iranian vol. no. pp. 1 5 16-17 Nov. 2011.
[12] Neelamegam P; Abirami S; Vishnu Priya K; Rubalya Valantina S. "Analysis of rice granules using image processing and neural network " Information & Communication Technologies (ICT) 2013 IEEE Conference on vol. no. pp. 879 884 11-12 April 2013.
[13] Harpreet Kaur Baljit Singh "Classification and grading rice using Multi-Class SVM" in International Journal of Scientific and Research Publications (IJSRP) ISSN: 2250-3153 Volume 3 issue 4 pp. 1-5 April 2013.
[14] Shah V; Jain K; Maheshwari C. V. "Non-destructive Quality Analysis of Kamod Oryza Sativa SSP Indica (Indian Rice) Using Machine Learning Technique " Communication Systems and Network Technologies (CSNT) 2013 International Conference on vol. no. pp. 95 99 6-8 April 2013 doi: 10. 1109/CSNT. 2013. 29.
[15] Verma B, "Image processing techniques for grading & classification of rice " Computer and Communication Technology (ICCCT) 2010 International Conference on vol. no. pp. 220 223 17-19 Sept. 2010.
[16] Xiai Chen Shuang Ke Wenquan Chen "Detection of Rice Exterior Quality based on Machine Vision" JDCTA: Vol. 6 No. 16 pp. 28-35 2012.
[17] Nissayan J Artnaseaw A. (2012). "Husk Separation by Air Blower System" Ladkrabang Engineering Journal Vol. 29 No. 1 Mar 2012 pp. 37-42.
[18] Srikuka J. And Piamsa-nga P. (2014). " Features for Classifying Rice Grains by Image Analysis" International Computer Science and Engineering Conference Khon Kaen Thailand July 30-August 1 2014.
[19] He Jing Guan Yu-jun Zhang Yin-pu Bo Tao. "Research on Lights and Pattern Classification of Color Sorter for Rice" Journal of Agricultural Mechanization Research 6 2007 pp. 90-93. 930
[20] Yang Kaizhi Cheng Yinglei. "A Method of SAR Image Texture Feature Extraction Based on Co-occurrence Matrix". Electronic Science and Technology 2011 21(10): 66-68.
[21] CHEN Li-jiang LIU Tie-gen ZHU Jun-chao LIU De-mi LU Ping WANG Lei. "Saturation-based Detecting Method to Chromatic Rice Kernels". Journal of Optoelectronics. Laser 2007 18(1).
[22] Li Rui Peng Xin-de Min Jun Xiao Fang-hua. "Analysis on the Txterior Quality of Rice by Digital Image Processing". Computer Systems &Applications 2011 20(4): 194-198.
[23] Dalen G.V 'Determination of the size distribution and percentage of broken kernels of rice using flatbed scanning and image analysis'; Food Research International (37) 51-58 2004 Elsevier Science Ltd
[24] Lloyd B. J. Cnossen A. G. &Siebenmorgen T. J. 'Evaluation of two methods for separating head rice from broken for head rice yield determination' Applied Engineering in Agriculture 17(5) 643-648 2001.
[25] Yadav B. K. & Jindal V. K. 'Monitoring milling quality of rice by image analysis'. Computers and Electronics in Agriculture 33(1) 19-33.2001 (Pubitemid 34029612)
[26] Yadav B.K Jindal V.K. "Modeling changes in milled Rice kernel dimensions during soaking by image analysis" Journal of Food Engineering Vol. 80 pp. 359-369 2007. Elsevier Science Ltd.
[27] Lan Y. Fang Q. Kocher M. F. & Hanna M. A. 'Detection of fissures in rice grains using

imaging enhancement'. International Journal of Food Properties 5(1) 205-215. 2002 (Pubitemid 34180450)

[28] Wan Y.N Lin C.M Chiou J.F 'Rice Quality classification using an automatic grain quality inspection system' Transactions of the ASAE Vol. 45(2): 379-387 2002 American Society of Agricultural Engineers ISSN 0001-2351

[29] S. O. Belkasim M. Ahmadi M. Shridhar "Efficient algorithm for fast computation of zenike moments", Proc. of IEEE 39th Midwest Symposium on Circuit and Systems, vol. 3 pp. 1401-1404 1997.

[30] C. W. Chong P. Raveendran R. Mukundan "A comparative analysis of algorithm for fast computation of zernike moments", Pattern Recognition, vol. 36 no. 3 pp. 731-742 Mar. 2003.

[31] S. Ghosal R. Mehrotra "Edge detection using orthogonal moment-based operators", Proc. of 11th Image Speech and Signal Analysis (IAPR) Int. Conf. on Pattern Recognition, vol. III pp. 413-416 1992.

[32] S. Ghosal R. Mehrotra "Segmentation of range images: An orthogonal moment-based integrated approach", IEEE Trans. on Robotics and Automation, vol. 9 no. 4 pp. 385-399 Aug. 1993.

[33] J. Huang W. Liu X. Sun "A Pavement Crack Detection Method Combining 2D with 3D Information Based on Dempster-Shafer Theory", Computer-Aided Civil and Infrastructure Engineering, 2013.

[34] Q. Zou Y. Cao Q. Li Q. Mao S. Wang "CrackTree: Automatic crack detection from pavement images", Pattern Recognition Letters, vol. 33 no. 3 pp. 227-238 2012.

[35] R. Medina F. Gayubo L.M. González-Rodrigo D. Olmedo J. Gómez-García-Bermejo E. Zalama J.R. Perán "Automated visual classification of frequent defects in flat steel coils", The International Journal of Advanced Manufacturing Technology, vol. 57 pp. 1087-97 2011.

[36] Q. Li Q. Zou X. Liu "Pavement Crack Classification via Spatial Distribution Features" EURASIP Journal on Advances in Signal Processing, 2011.

[37] H. Oliveira P.L. Correia "Automatic Road Crack Detection and Characterization", IEEE Transactions on Intelligent Transportation Systems, vol. 14 no. 1 pp. 155-168 2013.

[38] T.S. Nguyen S. Bégot F. Duculty M. Avila "Free-form anisotropy: A new method for crack detection on pavement surface images", 18th IEEE International Conference on Image Processing ICIP 2011, pp. 1069-1072 2011.

[39] C. Lettsome Y. Tsai V. Kaul "Enhanced Adaptive Filter Bank-Based Automated Pavement Crack Detection", Journal of Electronic Imaging, vol. 21 no. 4 2012.

[40] Y. Adu-Gyamfi N. Attoh-Okine G. Garateguy R. Carillo G.R. Arce "A Multi-Resolution Information Mining for Pavement Crack Image Analysis", ASCE Journal of Computing in Civil Engineering, vol. 26 no. 6 pp. 741-749 2012.

[41] R. Medina J. Gómez-García-Bermejo E. Zalama "Automated visual inspection of road surface cracks", Proceedings of the 27th International Symposium on Automation and Robotics in Construction ISARC'10, pp. 155-64 2010.

[42] Y. He H. Qiu J. Wang W. Zhang and J. Xie "Studying of road crack image detection method based on the mathematical morphology " in Image and Signal Processing (CISP) 2011 4th International Congress on 2011 pp. 967-969.

[43] X. Guoai M. Jianli L. Fanfan and N. Xinxin "Automatic Recognition of Pavement Surface Crack Based on BP Neural Network " in Computer and Electrical Engineering 2008. ICCEE 2008. International Conference on 2008 pp. 19-22.

[44] PH.P. Darcis C.N. McCowan J.D. McColeskey R. Fields "Crack tip opening angle measurement through a girth weld in an X100 steel pipeline section", Fatigue and Fracture of Eng. Materials and Structures, vol. 31 no. 12 pp. 1065-1078 2008.

[45] https://en.wikipedia.org/wiki/Edge_detection