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Visualization of Geometrical Defects of Radiators using Edge Detection Techniques

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Abstract: Quality of products is needed to be inspected before they are used in the industries. A radiator is a heat exchanger composed of layers of tubes and fins bonded together known as the core of the heat exchanger. Any damages to the fins of the radiator, reduces the heat dissipation capacity of the core. The traditional inspection system of the products classify defects only based on their gray value, which is far from satisfactory because of its low productivity, low reliability and poor economy. This paper proposes an efficient approach for the detection of defects using Edge detection methods based on canny edge detector. From the pre-processed image, defect areas are located by specifying the region of interest. The total matched percentage is calculated with the number of white and black points by comparing the images.

Keywords: Pre-processing technique, Image enhancement, edge sharpening, edge detection filters.

I. INTRODUCTION

Radiators are heat exchangers used for cooling internal combustion engines, mainly in automobiles but also in piston-engine aircraft, railway locomotives, motor cycles, stationary generating plant or any similar use of such an engine. Internal combustion engines are often cooled by circulating a liquid called engine coolant through the engine block, where it is heated, then through a radiator where it loses heat to the atmosphere, and then returned to the engine. Engine coolant is usually water-based, but may also be oil. It is common to employ a water pump to force the engine coolant to circulate, and also for an axial fan to force air through the radiator.

The radiators have cores with special dimple tubes that enable superior heat transfer performance. They are made using super-long-life alloys that give them enhanced corrosion resistance, while the patented 'SRX' system offers enhanced structural durability. All of these factors have given the products the longest life expectancy in the industry.

Figure: 1 Engine coolant radiator

The radiators cover the following applications:

- Automotive
- Industrial
- Construction and Mining
- Road Machinery
- Tractors & Agricultural Equipment
- Power Generation Equipment

Figure 2 Radiator

2. PROBLEM DEFINITION

In recent years, industries reject any materials with defects in manufacturing processes because a minor defect in a manufactured part might result in a disaster at a later stage. Therefore, early detection of defects can reduce product damage and significant manufacturing cost. Out-of-quality end products may cause returns or even result in losing a customer Manual inspection of end products slows down the entire process as it becomes costly, time consuming and also may impact the effectiveness of human labor due to the hazardous atmosphere of industry. Therefore, the process of inspection is also to be automated and inspection results should be fed back to the upstream manufacturing process for improvement of product quality.

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A radiator is a heat exchanger composed of layers of tubes and fins bonded together known as the core of the heat exchanger. The hot fluid flows in the tubes. Cooling air from a fan flows through the fins in the core. The heat from the hot fluid is taken away by the cooling air through the core. Any damages to the fins of the radiator reduce the cooling air flow through the radiator core as they reduce free flow area of the core. This in turn reduces the heat dissipation capacity of the core. Any damages or dents to the tubes of the core renders a potential leaking point enabling the core useless as hot fluid will leak out of the tubes. Hence such kinds of fin and tube damages have to be eliminated from the process itself as far as possible. A strong visual inspection system will help in a defective product being passed through the quality control system and its quality is needed to be inspected before they used in the manufacturing activities.

2.1 Types of Defects: Defect is caused by many reasons such as poor quality of raw material or malfunction of rolling process. More problematic is the fact that many times these defects do not become visibly noticeable until the operation is complete. Here are some of the images of core defects of radiators:

Defected Fins

Figure 3: Defected Dent Tube

Figure 4: Deformed Fin

Marker section shows the tubes of a radiator dents. These dented tubes may have thinner material thickness than designed and hence potentially prone to leakages during service. The section also shows deformed fins as result of the damages. Such defects are not acceptable by the industries. The above image shows the fins are deformed due to external damages or impact. Such deformed fins will not allow free air flow through the radiator resulting in insufficient air flow through the radiators causing overheating problems. The method provides

- Earlier detection of defects saves valuable time and production
- Accurate classification of metal defects
- Non destructive approach for the inspection.

3. LITERATURE REVIEW

Sr. No	Author and Year	Work	Methods / Algorithm	Tools / Parameters
1	John Canny 1986 [2]	Computational approach to edge detection	Feature Synthesis: Gaussian Operator	Edge points and profile
2	Mitra Basu [3]	Survey on Gaussian based edge detection method	Gaussian Filter	Edge Detection
3	Suzana and Zeljko, 2006 [4]	Color and surface defect detection in ceramics tiles	Canny Edge detector and the sub-pixel corner locator method	Thresholds, minimum distance
5	N. Senthil Kumaran and Rajesh 2009 [7]	Survey on Edge Detection techniques for Image Segmentation	Soft computing approach based on the Fuzzy logic, GA and NN	Edge Detection
6	Diwan P Ariana and Renfu Lu 2010 [8]	Evaluation of internal defect and surface color of whole pickles	Hyper spectral Imaging	Reflectance and Transmittance
8	Domingo Mery, Vladimir Riffo, Ivn, Hans, Alvaro, Aldo,Jos [9]	Automated fish bone detection using X-Ray imaging	Image Acquisition, Preprocessing, segmentation	X-ray
9	T.Aarthi , M.Karthi, M.Abinesh [11]	Detection and Analysis of Surface Defects in	Wavelet Transform	Calculation of mean, variance, standard

		Metals Using Wavelet Transform		deviation, skewness and kurtosis from the acquired image.
10	S.Saqna Varhney, Navin Rajpal, Ravindar Purwar	Comparative study of Image Segmentation Techniques and Object Matching using Segmentation.	PCA	Back-Projection for object Recognition
11	Hema.L Chavan, Santhosh A. Shinde	Defective Product Detection using Image Processing	High and low pass filters, PCA, Euclidean Distance	Euclidean Distance
12	Mayuri Dharma Shinde	To detect and identify the defects of Industrial Pipe	Morphological, Dilation and Erosion Operations	Eccentricity
13	Jijina K.P, Sreeja.SS, Vinod.P.R	Real Time Detection and Classification of Metal Defects using Image Processing	Wiener Filter, GLCM, Neural Network	Geometric Features, gray-scale features.
14	Tiwari Priti Ramesh, Yashoda Bisht	Detection and Classification of Metal defects using Digital Image Processing	Back Propagation Neural Network, ROI	Morphological Operations
15	Y.Ramadevi, T.Sridevi, B.Poornima, B.Kalyani	Segmentation and Object Recognition using Edge Detection Techniques	EM Algorithm, Genetic Algorithm	Clustering the pixels
16.		Review of vision-based steel surface inspection systems	SVM, SOM, UDWT	

4. RELATED WORK

In [16], the paper is to improve the quality of the industrial products using 2D or 3D image processing techniques. It proposes a novel 2D/3D image processing methodology for the quality control management for sensitive industrial products. High pass and low pass filters will highlight regions with high frequencies and smoothing the image and noise reduction. Pixels are classified as foreground; non-foreground and uncategorized pixels and using canny methods the edges are detected. PCA is used to extract features of stored and test images. Finally, Euclidean distance is applied to both the images and highest similarity is calculated. The formula used is:

Euclidean Distance

$$(Img_{ref}, Img_{test}) = \sqrt{Abs(Imgref, Imgtest)}^2$$

$$\text{Matching} = \frac{2\,|A \cap B|}{|A| + |B|}$$

$$\text{Mis-Matching} = 1 - \frac{2\,|A \cap B|}{|A| + |B|}$$

In [17], Tsai proposed a fast normalized cross correlation computation for defect application. A sum-table scheme is utilized, which allows the calculations of image mean, image variance and cross-correlation between images to be invariant to the size of template window. The proposed system is compared with traditional normalized correlation operation, which does not meet speed requirements, for industry applications. The computational complexity can be dramatically reduced. Since the proposed method is invariant to the window size, a user can select a proper window size to maximize the detection effectiveness for the object under inspection without trading off the computational efficiency.

In [19] Mayuri divided their work into three divisions. In the first section, preprocessing steps include gray scale conversion, threshold effect and noisy objects elimination. In the second section, the separation of pipe from image is performed by filling the regions by selecting points, interactively. In the third section, mathematical operations are done on the defected image and faults are detected. Dilation and erosion operations are performed and calculate the area and eccentricity of defected surface. Using the eccentricity value, the defect is classified accordingly.

In [18], the image is captured and smoothened during preprocessing stage. The target image is compared with the reference image and defect is detected with ROI. A wiener filter is used to filter the available noise. Defect is segmented using morphological operations. Finally, the defects are classified by the characteristics of defects including geometric ones, gray ones and texture features. With the help of neural network, defects are classified according to their classes.

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5. Proposed System:
The software process of the defect detection system is as follows.

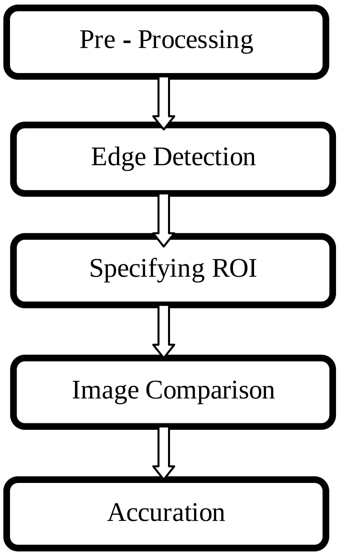
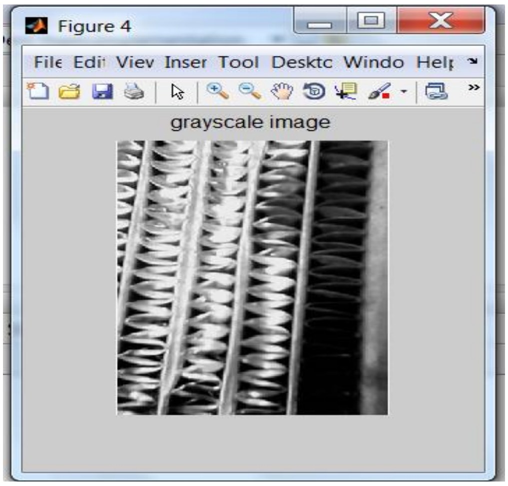


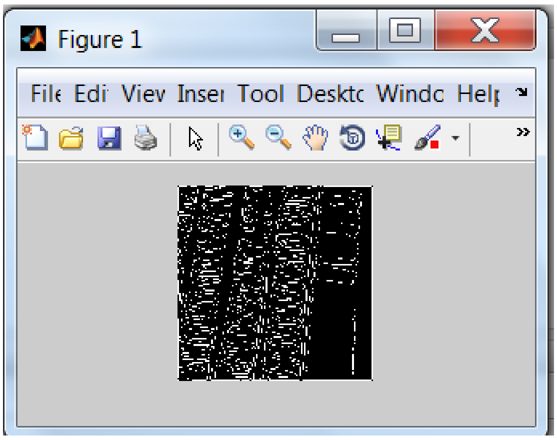
Figure 5: Proposed System

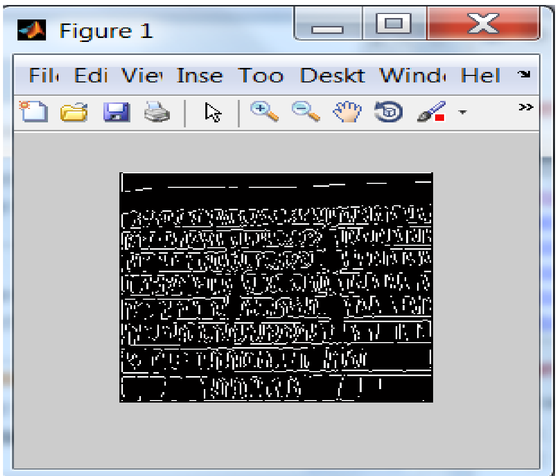
It mainly consists of five stages: Pre-processing, Edge detection, Image Comparison and Specifying ROI and defect Extraction. The input to the program is the images collected; all of defects information are got and saved. Experimentation is performed on gray scale image using MATLAB 7.9.Section 4 discusses about the problem definition, section 5 discusses about the Literature review. In this discussion is done on various techniques used for defect detection by various authors. In Section 6, the methodology for the proposed system is discussed and section 7 discusses on results and conclusions.

5.1. Pre-Processing:
In the Pre-Processing stage, first read the image, then, resize the image to the graphics file. Return the image in matrix form and finally convert the RGB image to grayscale intensity image.



5.2. Edge Detection:
In this section, apply the edge detection for both the original and defected image based on canny edge detection algorithm to obtain the number of black and white points for both the images.





5.3. Image Comparison:
In the comparison section, images are compared with the total number of black and white points received. The matched percentage is calculated with the total points with the number of white points.

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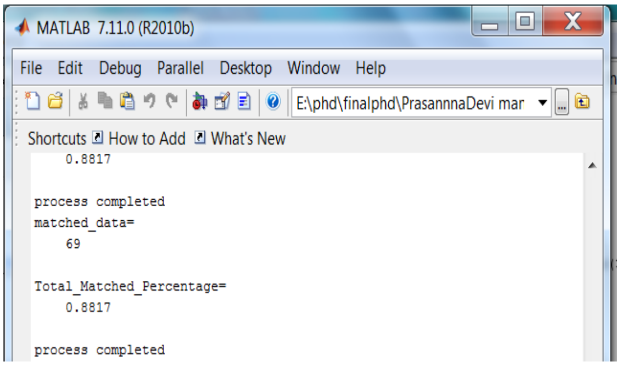
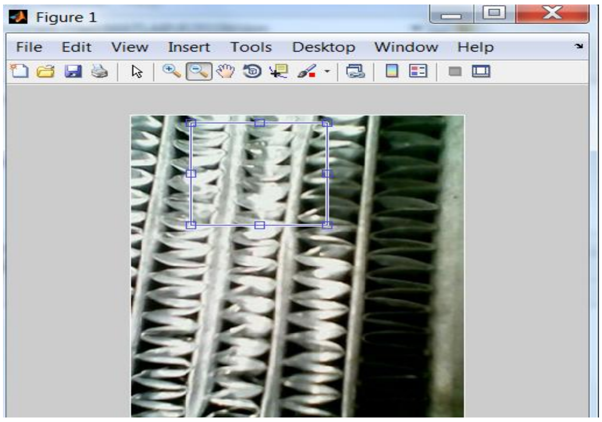


5.4. Specifying ROI:

A region of interest (ROI) is a portion of an image that we want to filter or perform some other operation on. Define an ROI by creating a binary mask, which is a binary image that is the same size as the image that is to be processed with pixels that define the ROI set to 1 and all other pixels set to 0.



5. CONCLUSION

This paper discusses about the literature review of the defect detection in metal surfaces using various edge detection techniques. The proposed system detected the defect and identified the region of interest the future work will be segmenting the Region of interest using segmentation methods and classify the defects based on geometrical transformations.

REFERENCES

[1] S.K. Sethi, B. Ravi, B.K. Mohan “Automated Visual Inspection of Cracks in Cast and Welded Components” Technical Paper submitted to
[2] Transactions of the AFS Oct 1996
[3] J The American Foundrymen’s Society, International Atlas of Casting Defects, AFS, Des Plaines, Illinois, 1974..
[4] The Institute of British Foundrymen, Atlas of Defects in Castings, IBF, London, 1961...
[5] W.A. Perkins, "INSPECTOR: A Computer Vision System that Learns to Inspect Parts," IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. PAMI-5, No. 6, November 1983, pp. 584-592.
[6] WANG Yao-Nan, LI Shu-tao, MAO Jian-xu, Computer Image Processing and Recognition Technology, Higher Education Press, Beijing, 2007
[7] Luiz A. O. Martins, Fl´avio L. C. P´adua, Paulo E. M. Almeida “Automatic Detection of Surface Defects on Rolled Steel Using Computer Vision and artificial Neural Networks ”
[8] Zhang Yichi, Wu Lv, Liu Xuedong “Defects Detection of Cold-roll Steel Surface Based on MATLAB” 2011 Third International Conference on Measuring Technology and Mechatronics Automation
[9] Yong-Ju Jeon, Doo-chul Choi, Jong Pil Yun “Detection of Scratch Defects on Slab Surface” 2011 11th International Conference on Control, Automation and Systems Oct. 26-29, 2011 in KINTEX, Gyeonggi-do, Korea
[10] Mohammad Reza Yazdchi, Arash Golibagh Mahyari, Ali Nazeri “Detection and Classification of Surface Defects of Cold Rolling Mill Steel Using Morphology and Neural Network” CIMCA 2008, IAWTIC 2008, and ISE 2008
[11] Jong Pil Yun, YoungSu Park, Boyeul Seo and Sang Woo Kim Se Ho Choi, Chang Hyun Park, Ho Mun Bae and Hwa Won Hwang **“**Development of Real-time Defect Detection Algorithm for Highspeed Steel Bar in Coil(BIC)**”** SICE-ICASE International Joint Conference 2006 Oct. 18-2 1, 2006 in Bexco, Busan, Korea
[12] Segmentation Techniques Comparison in Image Processing R.Yogamangalam#1, B.Karthikeyan#2,# School of Computing, SASTRA University, Thanjavur, TamilNadu, India, iswaryaramalingam3@gmail.com,2 karthikeyan@it.sastra.edu
[13] Gomez-Moreno, H., Maldonado-Bascon, S., & Lopez-Ferreras, F.(2001). Edge detection in noisy images using the support vector machines. IWANN (1) (pp. 685–692).
[14] S. Vasilic and Z. Hocenski, ”Detecting Methods in Ceramic Defects Detection”, In Industrial Electronics, 2006 IEEE International Symposium, vol. 1, pp. 469- 472, 2006.
[15] Gaurav Kumar, Pradeep Kumar Bhatia, ”A Detailed Review of Feature Extraction in Image Processing Systems”, Fourth International Conference on Advanced Computing Communication Technologies, 978-1-4799-4910-6/14 2014 IEEE.
[16] N. Senthilkumaran and R. Rajesh, ”Edge Detection Techniques for Image Segmentation-A Survey of Soft Computing Approaches”, International Journal of Recent Trends in Engineering, vol. 1, no. 2, pp. 250254, 2009.
[17] “Defective Product Detection using Image Processing”, Hema.L Chavan, Santhosh A. Shinde,
[18] “Fast Normalized cross correlation for defect detection”, D. M. Tsai and C. T. Lin,
[19] “Real Time Detection and classifications of metal defects using image processing”, Jijina K.P., sreeja.S.S, Vinod P.R.
[20] “To detect and identify the defects of Industrial pipes”, Mayuri, Dharma, Shinde, IJSR, 2016.
[21] R. E. Sorace, V. S. Reinhardt, and S. A. Vaughn, “High-speed digital-to-RF converter,” U.S. Patent 5 668 842, Sept. 16, 1997.
[22] (2002) The IEEE website. [Online]. Available: http://www.ieee.org/
[23] M. Shell. (2002) IEEEtran homepage on CTAN. [Online]. Available: http://www.ctan.org/tex-archive/macros/latex/ contrib. /supported/ IEEEtran/
[24] FLEXChip Signal Processor (MC68175/D), Motorola, 1996.
[25] “PDCA12-70 data sheet,” Opto Speed SA, Mezzovico, Switzerland.
[26] Karnik, “Performance of TCP congestion control with rate feedback: TCP/ABR and rate adaptive TCP/IP,” M. Eng. thesis, Indian Institute of Science, Bangalore, India, Jan. 1999.
[27] J. Padhye, V. Firoiu, and D. Towsley, “A stochastic model of TCP Reno congestion avoidance and control,” Univ. of Massachusetts, Amherst, MA, CMPSCI Tech. Rep. 99-02, 1999.
[28] Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification, IEEE Std. 802.11, 1997.