INDEX COPERNICUS
INTERNATIONAL

Vol. 18 No.1 2024

WOOD DEFECT DETECTION UNDER REGION OF INTEREST TARGET DETECTION ALGORITHM

Hadi Syahputra*[1], M.Hafizh[2], J. Maddern Harris[3]
[12]Faculty of Computer Science, Universitas Putra Indonesia YPTK Padang,
Jln. Raya Lubuk Begalung, Padang, Sumatera Barat – Indonesia
Institute at Rotorua - New Zealand
Corresponden Email: hadisyahputra@upiyptk.ac.id
Doi : 10.22216/jit.v18i1.2683

Submit :
14/12/2023

Accept :
03/03/2024

Publish :
07/03/2024

Abstract

Good quality wood will provide maximum product results for manufacturers of wooden products such as furniture. Determining the quality of wood to avoid wood defects has now become a special need for wood product manufacturers and craftsmen. This research aims to detect wood defect objects in digital image results to determine wood quality. The detection process will involve the performance of Digital Image Processing (DIP) using the Region Of Interest (ROI) method. The performance of the ROI method can describe image objects based on the object area which can be determined using a masking process on the specified area values. The research dataset uses photographic images of wooden objects which have a pixel resolution of 1024 x 1024, a total of 207 images. Based on the tests that have been carried out, the output from the detection process presents a fairly good image of wood defect objects. The output images of wood defective objects can depict the image of wood defective objects precisely and accurately. The performance of the ROI method in detecting wood defective objects has worked optimally so that wood quality can be determined based on the image output. The results of the detection image output in this research can later be used as a form of recommendation for related parties, especially for wood producers and craftsmen in determining quality wood to increase productivity.

Keywords: Detection**,** Good Quality, Wood**,** Digital Image Processing, Region Of Interest (ROI)

ISSN :1979-9292 / 2460-5611 ©2023 Lembaga Layanan Pendidikan Tinggi Wilayah X
This is an open access article under the CC Attribution 4.0 license (https://creativecommons.org/licenses/by/4.0/).
JIT is Sinta 3 Journal (https://sinta3.kemdikbud.go.id/journals/profile/2143) accredited by Ministry of Research & Technology, Republic Indonesia

INTRODUCTION

Wood is one of the most widely used natural resources as basic building materials [1]. Wood has also become a necessity and a means of supporting human activities [2]. The importance of the need for wood use has increased along with the current human population [3]. As demand for wood increases, wood quality needs to be considered [4]. Inspection of wood defects in determining wood quality has a relatively low-cost advantage. This is a form of hope from manufacturers of products such as furniture that need used wood materials with quality wood. Based on existing reports, the quality of wood is getting lower because a lot of non-quality wood is being traded, so this requires the existence of technology to detect wood quality [5].

Current technology has played an important role in modern industrial fields, such as industrial construction or various manufacturing processes [6]. One form of technology's role in detecting wood quality can be seen in the role of Digital Image Processing (DIP). DIP is a technology developed with the concept of making observations on an image [7]. DIP is also a method that is capable of solving various problems [8]. DIP performance has also provided solutions to overcome structured and unstructured problems in the detection process [9].

Previous research explains that DIP is capable of detecting objects with a fairly good level of accuracy [10]. The same research also explains that the performance of DIP is quite effective in carrying out the detection process with success based on test results of 82.91% accuracy, 77.66% sensitivity, and 87.62% specificity [11]. Based on research on the detection of wooden objects, DIP also provides quite effective and efficient detection results [12]. The same research also explains that DIP with the performance of the Rest Of Interest (ROI) method was carried out to detect the quality of wood paint in pine wood [13].

Based on the explanation of previous research, this research will carry out the process of detecting wood defects by adopting the performance of the ROI method in determining wood quality. The performance of ROI method performs statistical distribution of pixel intensity, which can be done by extracting texture features [14]. Another explanation also illustrates that the ROI method is an analytical method based on wavelet-based multi-resolution analysis [15]. The process of detecting wood defects using the ROI method in this research aims to present a maximum detection algorithm for determining wood quality. The performance of the ROI method is expected to be able to determine wood defect objects in images of wooden objects with precise and accurate output. This research will also be able to contribute to the production of wooden products such as furniture and other parties in efforts to determine quality wood to increase productivity.

RESEARCH METHODS

The process of detecting defective wood objects using the Rest Of Interest (ROI) method can be carried out with an overview of the research framework. The research framework is a form of the stages that will be carried out in the detection process. The performance of the ROI method is adopted to present the results of wood defect detection objects precisely and accurately. An overview of the research framework in the process of detecting wood defect objects can be seen in Figure 1.

Figure 1 shows the process stages in detecting wood defect objects using the performance of the ROI method. The

This work is licensed under a Creative Commons Attribution 4.0 International License

process stages begin with preprocessing and the detection process. Preprocessing involves the process of gray image transformation and image adjustment which aims to improve the quality of the previous input image. The detection process will be carried out based on the preprocessing image output by utilizing the performance of the ROI method and the morphological segmentation process. The image output from the ROI and morphology processes will carry out a labeling process for the images of the detected objects. The image results of the detected image objects will later become the image output in the process of detecting image objects with wood defects.

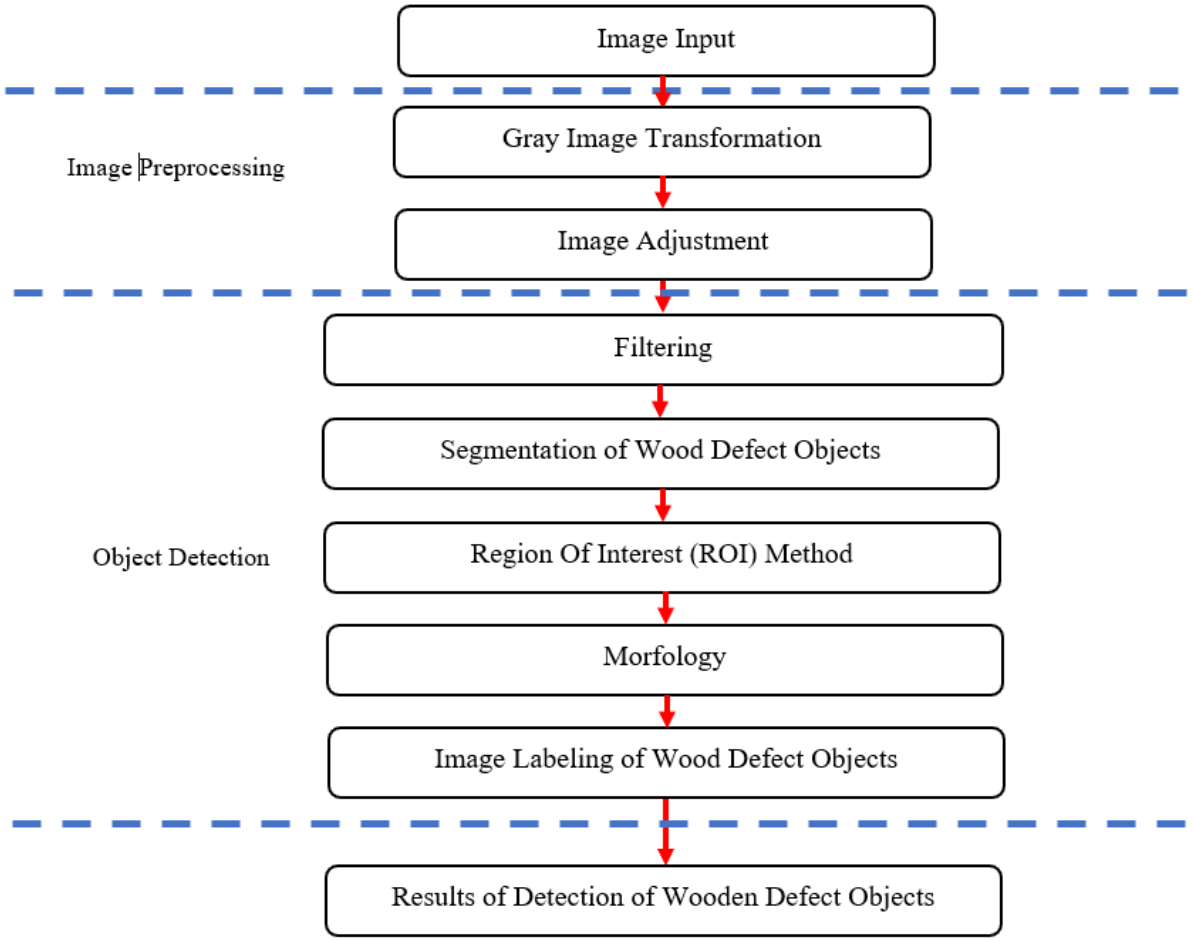


Figure 1. Research Framework for Detection of Wood Defect Objects Region Of Interest (ROI) Method

Region of interest or region of interest (ROI) is a subset of an image or dataset identified for a specific purpose [16]. A dataset can be one of the following: Waveform or 1D Dataset: An ROI is a time interval or frequency on a waveform (a graph of some quantity plotted against time). The goal of determining special regions is to determine the ROI of the rectangular shape in the input image by finding out the region where the road surface is included [17]. The main texture of the road is usually consistent. We can describe the road surface using multiple features instead of all pixels of the road surface. The characteristics of the road surface consist of lane markings, paving stones, road dividers, and even other

This work is licensed under a Creative Commons Attribution 4.0 International License

vehicles. They are converted into a collection of line segments with consistent characteristics. They are elements of ROI.

The proposed ROI method can differentiate between two images and frames at the pixel level. The background subtraction process uses one image to be a reference image and acts as a background image [18]. Masking Frame in the performance of the ROI area method is an image processing technique known as masking which can modify a larger image by reducing several pixel values and other background values [19]. The equation used in carrying out the masking process can be seen in Formula 1.

$$f\ mask = f - mask\ (f) \quad (1)$$

Formula 1 is an equation for calculating the central point of wood defects. The process of measuring the center point of the wood defect C (x, y) is carried out from the detected area of the center point equation. The midpoint measurement process can be done using Formula 2.

$$C\ (x,y) = = \frac{Xmin+Xmax}{2}, \frac{Ymin+Ymax}{2} \quad (2)$$

Formula 2 is the process of calculating the midpoint of the area to be detected. The distance calculation of the overall area of wood defects is aused to calculate the distances C1 (x min,y min) and C2 (x max,y max) between each detected in the frame. The equation that will be used in calculating the overall distance can be seen in Formula 3.

$$d= \sqrt{\sum_1^n (x_{max} - x_{min})^2 + (Y_{max} - Y_{min})^2}$$

Formula 3 is the equation used to calculate the distance value. The midpoint of the detected area of wood defects to determine between two different locations of 1 frame. The performance results of the ROI method will be able to provide an image of the wood defective object.

RESULTS AND DISCUSSION

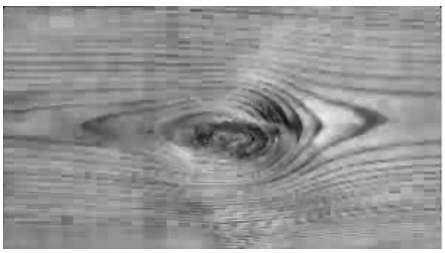
The process of detecting wood defect image objects in this research will be carried out using several stages that have been described previously in the research framework. The detection process will be divided into preprocessing stages and detection stages with the performance of the ROI method. The detection process can be carried out as follows:

1. Image Preprocessing

The image preprocessing process in detecting wood defect image objects is carried out to improve the quality of the input image. The input image uses a photo image of a wooden object which has a pixel resolution of 1024 x 1024 with RGB image format. The photographic images of wooden objects consist of 207 image samples which were used as a research dataset. This image will later become the input image in the process of detecting wood defect objects. The input image will be processed initially with a preprocessing stage which involves gray image transformation and image adjustment processes. The preprocessing can be presented in Figure 2.

This work is licensed under a Creative Commons Attribution 4.0 International License

(a) Input Image (b) Gray Transformation Image Results



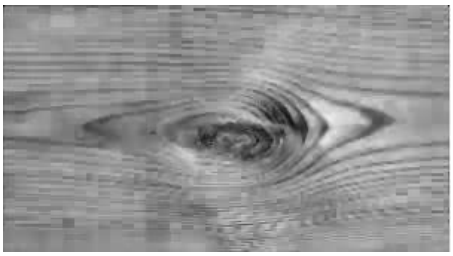
(c) Result Image Adjustment

Figure 2. Image Preprocessing Results

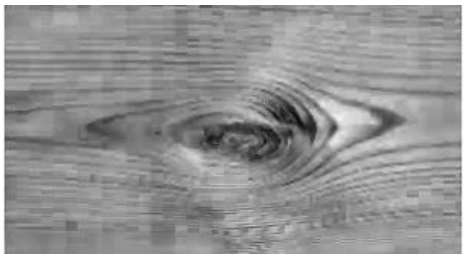
Figure 2 is the result of image preprocessing in the process of detecting wood defect objects. The preprocessing stage has been able to provide improvements to the quality of the previous input image. The output of the preprocessing results will then be continued to carry out the process of detecting wood defect image objects using the ROI method.

3.2 Wood Defect Object Detection Process

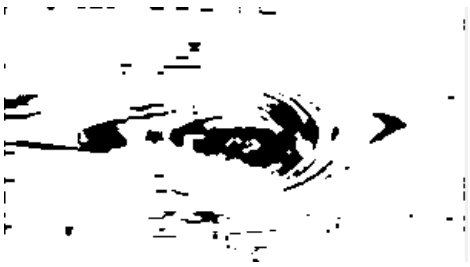
The process of detecting wood defect objects in this research will be carried out based on the preprocessing image output. The image adjustment results will be input into the detection process. The detection process will involve filtering performance which is aimed at eliminating noise that is still present in the previous image. The results of the filtering performance will later be used in the detection process using the ROI and Morphology methods to present image objects of wood defects. The final process in detection will be the process of labeling the wood defect image object later. The results of the detection process can be seen in Figure 3.



(a) Image Preprocessing Results



(b) Filtering Image Results



(c) Image of ROI Results

(d) Image Morphology Results

This work is licensed under a Creative Commons Attribution 4.0 International License

(e) Image Result of Object Labeling

Figure 3. Results of the Object Image Detection Process with Wood Defects

Figure 3 is the result of the process of detecting wood defect image objects using the ROI and morphology methods. The output of the detection process at the filtering stage presents an image output that is able to reduce noise in the image resulting from previous preprocessing. The ROI performance method process in detecting wood defective objects has also been able to describe object detection quite well previously. The image output using the ROI method will later be optimized based on the performance of the morphological process with opening operations to maximize object detection. The final stage of the detection process is giving a label to the detection image to be used in presenting the output image resulting from the detection. The detection image output results can be seen in Figure 4.

(a) Input Image (b) Image Results Detecting Wood Defect Objects

Figure 4. Image Output Results for Detecting Wood Defect Objects

Figure 4 is the output of the detection of wood defect image objects using the ROI method. The performance of the ROI method has been able to provide precise and accurate image output in depicting wood defective objects. Based on this output, the detection process has provided maximum results.

CONCLUSION

The process of detecting wood defects in this research discussion is carried out using the ROI method. The detection process is able to provide quite good results in detecting defective wood objects. This detection process can also provide an effective and efficient detection algorithm in determining wood quality. The performance of the ROI method presented has been able to determine wood defect objects with precise and accurate output. Based on the results obtained, this research can contribute to related parties such as wood product manufacturers to be able to determine the right quality of wood to increase productivity.

This work is licensed under a Creative Commons Attribution 4.0 International License

THANK-YOU NOTE

Thanks are expressed to the Chancellor of Universitas Putra Indonesia and Ketua Yayasan Perguruan Tinggi Komputer (YPTK) who have provided support for the author to complete this research. The publication was fully funded by the Yayasan Perguruan Tinggi Komputer (YPTK) under the SIMLITUPI BATCH 4 2023 grant program with No.211/UPI-YPTK/LPPM/P/KP/IX/2023

BIBLIOGRAPHY

[1] N. Neneng, N. U. Putri, and E. R. Susanto, "Klasifikasi Jenis Kayu Menggunakan Support Vector Machine Berdasarkan Ciri Tekstur Local Binary Pattern," *CYBERNETICS*, vol. 4, no. 02, pp. 93–100, 2021.

[2] A. Budiaman and L. Audia, "Kayu Sisa Setelah Penebangan Hutan Alam di Indonesia: Suatu Tinjauan Sistematis," *J. Ilmu Lingkung.*, vol. 20, no. 2, pp. 427–436, 2022.

[3] M. Ariadin and T. A. Safitri, "Perilaku Manajemen Keuangan Pada Umkm Sentra Kerajinan Kayu Di Kabupaten Dompu," *Among Makarti*, vol. 14, no. 1, 2021.

[4] T. Rubiyanti, W. Hidayat, I. G. Febryano, and S. Bakri, "Karakterisasi Pelet Kayu Karet (Hevea brasiliensis) Hasil Torefaksi dengan Menggunakan Reaktor Counter-Flow Multi Baffle (COMB)(Characterization of Rubberwood (Hevea brasiliensis) Pellets Torrefied with Counter-Flow Multi Baffle (COMB) Reactor)," *J. Sylva Lestari*, vol. 7, no. 3, pp. 321–331, 2019.

[5] A. Santoso, E. Basri, and J. Balfas, "Kualitas kayu laminasi dengan perekat tanin dari ekstrak kulit kayu mahoni," *J. Penelit. Has. Hutan*, vol. 38, no. 3, pp. 151–160, 2020.

[6] M. Kryl, L. Danys, R. Jaros, R. Martinek, P. Kodytek, and P. Bilik, "Wood Recognition and Quality Imaging Inspection Systems," *J. Sensors*, vol. 2020, 2020, doi: 10.1155/2020/3217126.

[7] D. Sundararajan, *Digital image processing: A signal processing and algorithmic approach*. 2017.

[8] R. Singh and S. Srivastava, "Stock prediction using deep learning," *Multimed. Tools Appl.*, vol. 76, no. 18, pp. 18569–18584, 2017, doi: 10.1007/s11042-016-4159-7.

[9] A. Rao and S. B. Kulkarni, "A Hybrid Approach for Plant Leaf Disease Detection and Classification Using Digital Image Processing Methods.," *Int. J. Electr. Eng. Educ.*, 2020.

[10] J. Liu and X. Wang, "Plant diseases and pests detection based on deep learning: a review," *Plant Methods*, vol. 17, pp. 1–18, 2021.

[11] M. Loey, G. Manogaran, and N. E. M. Khalifa, "A deep transfer learning model with classical data augmentation and CGAN to detect COVID-19 from chest CT radiography digital images," *Neural Comput. Appl.*, pp. 1–13, 2020.

[12] T. He, Y. Liu, Y. Yu, Q. Zhao, and Z. Hu, "Application of deep convolutional neural network on feature extraction and detection of wood defects," *Measurement*, vol. 152, p. 107357, 2020.

[13] Y. Xu and R. Zhao, "A Prediction Model of Endometrial Cancer Lesion," vol. 2021, 2021.

[14] R. Ashraf *et al.*, "Region-of-interest based transfer learning assisted framework for skin cancer detection," *IEEE Access*, vol. 8, pp. 147858–147871, 2020.

[15] K. Balasamy and S. Suganyadevi, "A fuzzy based ROI selection for

This work is licensed under a Creative Commons Attribution 4.0 International License

encryption and watermarking in medical image using DWT and SVD," *Multimed. Tools Appl.*, vol. 80, no. 5, pp. 7167–7186, 2021.

[16] S. S. Jamal, M. M. Hazzazi, M. F. Khan, Z. Bassfar, A. Aljaedi, and Z. ul Islam, "Region of interest-based medical image encryption technique based on chaotic S-boxes," *Expert Syst. Appl.*, vol. 238, p. 122030, 2024.

[17] C. E. Boom, B. Anatomi, and A. Kardiovaskuler, "Tinjauan Pustaka Tinjauan Pustaka Infark Miokard Perioperatif Modifikasi Alat Pelindung Kaki dalam Mencegah Timbulnya Ulkus Kaki pada Penderita Diabetes Melitus in Diabetes," vol. 24, no. 67, 2018.

[18] M. Usman, B. D. Lee, S. S. Byon, S. H. Kim, B. il Lee, and Y. G. Shin, "Volumetric lung nodule segmentation using adaptive ROI with multi-view residual learning," *Sci. Rep.*, vol. 10, no. 1, pp. 1–15, 2020, doi: 10.1038/s41598-020-69817-y.

[19] A. H. Ahamad, N. Zaini, and M. F. A. Latip, "Person Detection for Social Distancing and Safety Violation Alert based on Segmented ROI," *Proc. - 10th IEEE Int. Conf. Control Syst. Comput. Eng. ICCSCE 2020*, no. August, pp. 113–118, 2020, doi: 10.1109/ICCSCE50387.2020.9204934.

This work is licensed under a Creative Commons Attribution 4.0 International License