

Coating Inspection on Sea Transportation Equipment (Ship) Using Image Processing

Dianita Wardani¹, Agus Khumaidi², Rizal Fahmi³, Imah Luluk
Kusminah⁴, Basuki Rahmat⁵

^{1,2,3,4,5}Politeknik Perkapalan Negeri Surabaya, Surabaya, Indonesia
e-mail: dianitawardani@ppns.ac.id

Abstract

Research in the last decade, particularly in this research there are methods and steps for completion, namely 4 process steps, including: First of all, take samples and image data from the parts of the ship that are being repaired and maintained, Then, in making the prototype tool resulting from the coating, it is assembled using several tools, mini PC is installed with a web camera, next the image for the observation further processes and processed using the edge method contours detection with the help of canny to obtain the contrast and contour from the ship's hull. For next process, uses Neural Network for image creation processes taken from prototype plating or plating on observed ship parts. Some mixed results from the process. The images taken are and then the data obtained is processed and its form is observed for shape, pattern, corrosion, contour and so on layers formed. There are two classifications of RGB and GLCM results, the rejected results can match the corrosion spot found on the hull, and the accepted results mean no corrosion spot found.

Keywords: *Coating, Edge detection, Neural Network, image*

INTRODUCTION

The country of Indonesia has a cluster and consists of many islands, so that the seas of each region have different salt content or levels which are corrosive or Corrosion damage to the ship's hull is easier. So many ships sailing in the area have to carry out maintenance periodically, this is to repair the ship and protect the ship so that it can last longer than it should. Parts of the ship's hull that come into direct contact with sea water must be protected more than other parts. (Woloszyk & Garbatov, 2024)

Painting with various types of paint is appropriate. Its function is necessary to protect the ship's hull. The sandblasting process is also needed to protect and create an agar profile. The metal surface of the paint can adhere firmly to the metal surface of the ship's hull or other parts of the ship. The

¹ dianitawardani@ppns.ac.id

painting and coating process in shipyards often uses the spray gun method (Gao et al., 2023). It is considered relatively cheap and more efficient by looking at the number of spots or locations of ships that are corroded and require repainting.

This method requires identifying individual areas and points of corrosion of the hull which means more time is consumed and more inspectors are needed. Therefore, an experiment using the image processing method was carried out to make the inspection process more effective and efficient.

METHODOLOGY

Sampling and imagery of ship parts that need to be maintained and re-coated serve as the initial database to find which part of the ship in which corruptions are more likely to occur and the forms of corrosion that can occur on the ship's parts. The creation of a database is used for data collection as an indicator and reference to determine the contour, contrast, and uniformity of the coatings. The database that has been created is used as a reference for the coating standards required from several shipyards and refers to the existing standard coating references.

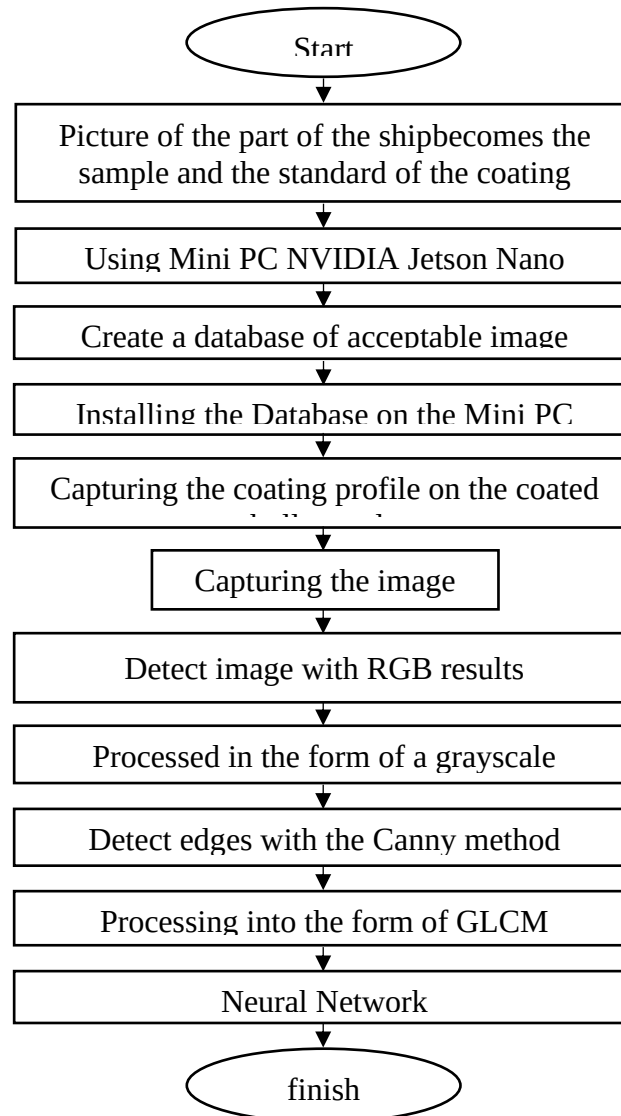


Figure 1 Reserch Flowchart:

The design of the ship's hull is important in ship construction because it will affect the stability of the ship, the speed of the ship, and fuel consumption, and the draft/depth of the hull must suit the depth of the destination ports and the shipping lane traversed by the ship.

1.1.1.1 Grayscale.

Grayscalecolor images usually require less additional information provided at each resolution, i.e. pixel resolution, compared to some color images. The other

colors are RGB, RGB is R for (Red), G for (Green), and B for (Blue) using the same intensity. So the resulting gray scale images require a single standard intensity value to be comparedcolor which requires a combination of three intensity values for each pixel resolution.(Divyanth et al., 2023)

1.1.2 Canny Edge Method

The edge detector used in this algorithm and the only one that can produce the best edge image of all edge detectors is the 'canny' edge detector. It's important to have an edge detector that can select a threshold automatically, but the automatic threshold in standard canny produces too much edge information.(Nayak et al., 2023). Making a few modifications to the edge detection produced by the Canny can give better results.

1.1.3 Metal Coating

The metal coating is a method to give certain properties to a workpiece surface, where the object will experience improvements both in terms of microstructure and resistance, and it's also possible to improve its physical properties. Coating using the painting method on metal is usually used at a final stage in the production process of a product.(Nunes et al., 2002)

RESULTS AND DISCUSSION

On the image captured, coating with the painting method is carried out using international paint with the following specifications:

Table 1 Types of coating and painting on the ship KM.Aviani at PT. Dok Pantai Lamongan

No.	StageCoating	PartCoating	TypePainting
1	Prime/ First Coat	Topside, Vertical dan Flat bottom	KHA, Intertuf 262
			Thinner GTA 220
2	Sealer/Second Coat	Topside, Vertical dan Flat bottom	FAJ, Integard 263
			Thinner GTA 220
3	Finish/ Top Coat	Topside	PHY, interthane 990
			Thinner GTA 733
		Vertical dan Flat bottom	AF Interswift 6600
			Thinner GTA 007

The data were analyzed using Gray Level Co-Occurrence Matrix. Then the data were processed by looking for edge detection using canny to get the contours of the bilge cross-section of the ship. Features were searched using the Neural Network as an artificial material(Olilima et al., 2023).

a. Data Analysis Using GLCM

The data were analyzed using Gray Level Co-Occurrence Matrix. Then the data were processed by looking for approach the edge with using canny to get the contours of the bilge cross-section of the ship (Zhu & Wang, 2023). Features were searched using the as an artificial material neural tissue.

1. Image Classification. Images are divided according to the results of image capture by the camera used, with a resolution of Stages of image classification that have been carried out for the classification of coatings on the ship's hull Input Image. In this process, the image was obtained by taking pictures directly from the coating process at CV SinarAbadi by producing 50 images in each class. In this study, there are 2 classes which include the image of the hull of the ship which must be re-coated because it is damaged, and the hull of the ship that has been coated/has not yet entered the repair stage. Each class consists of 25 image data.

Image normalization: this process is to standardize the image size so that it is uniform and does not hinder the process of dataset formation and classification. The image size were set at 320 x 240 pixels.

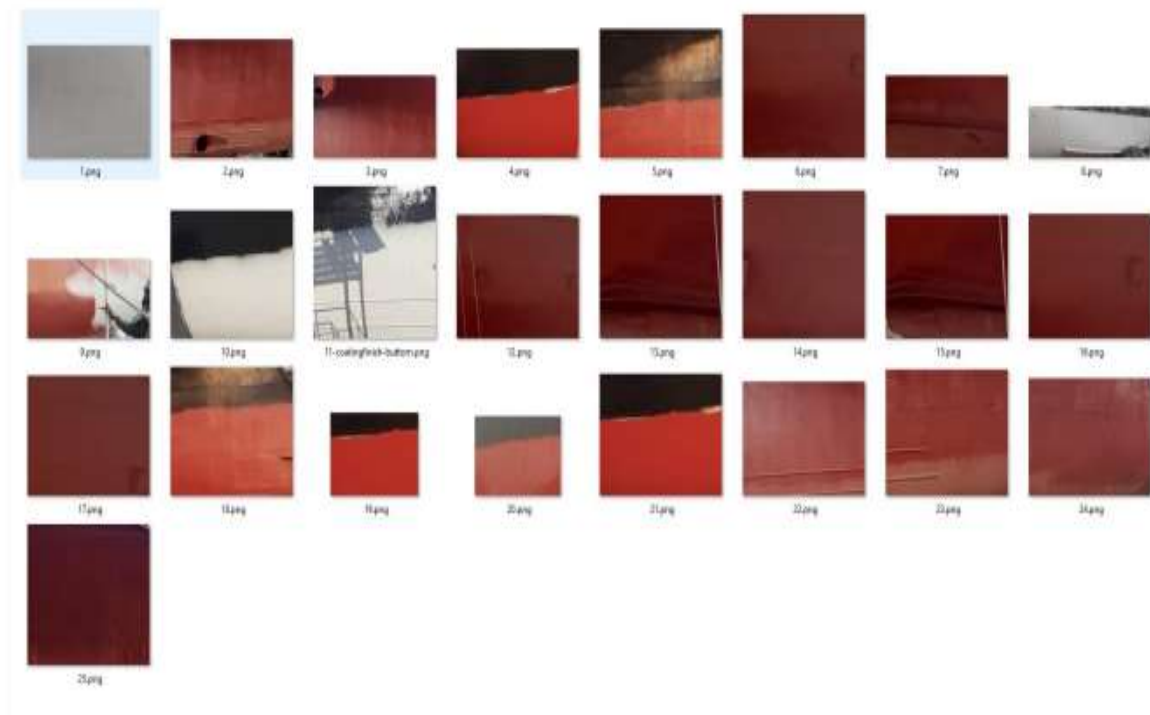


Figure 1. Data input of the ship hull images

RGB and Grayscale Conversion: this stage is to change the image in the RGB color domain to Grayscale. After that, the sharpening process is carried out to sharpen the image texture. Conversion to grayscale was needed because the extraction process requires an image with a graycolor domain due to the GLCM method used in this process. For the Gray Level Co-occurrence Matrix (GLCM) is a method used to observe texture/feature extraction results. Image extraction to obtain GLCM data parameters. In this extraction, the researcher uses 4 main features which include Contrast, Correlation, Energy, and homogeneity. The following is a table of image extraction results, as shown in the table in the appendix.

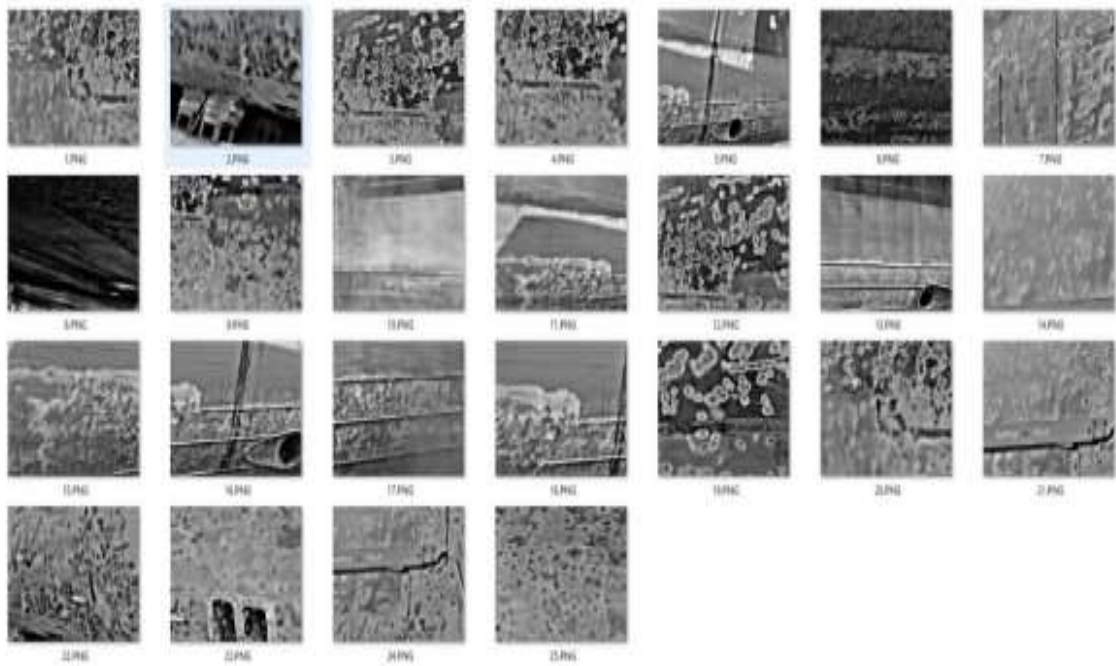


Figure 2. Rejected image results

Is a training process that aims to get the most optimal neural network. In this study, the following data were obtained:

1. In the layer there are 4 inputs namely (Contrast, Correlation, Energy, and Homogeneity)
2. There is 1 output layer with 2 outputs (Reject and Accept)
3. There are 3 stacked layers

Image classification. The first step by making a GUI so that it is easy for the operating system, The GUI that has been created and tested is as follows (Olilima et al., 2023). The system has been able to recognize the reject and accept coating conditions. The following pictures are examples of the accepted and rejected criteria from the images captured by the camera and then processed by the image processing method.

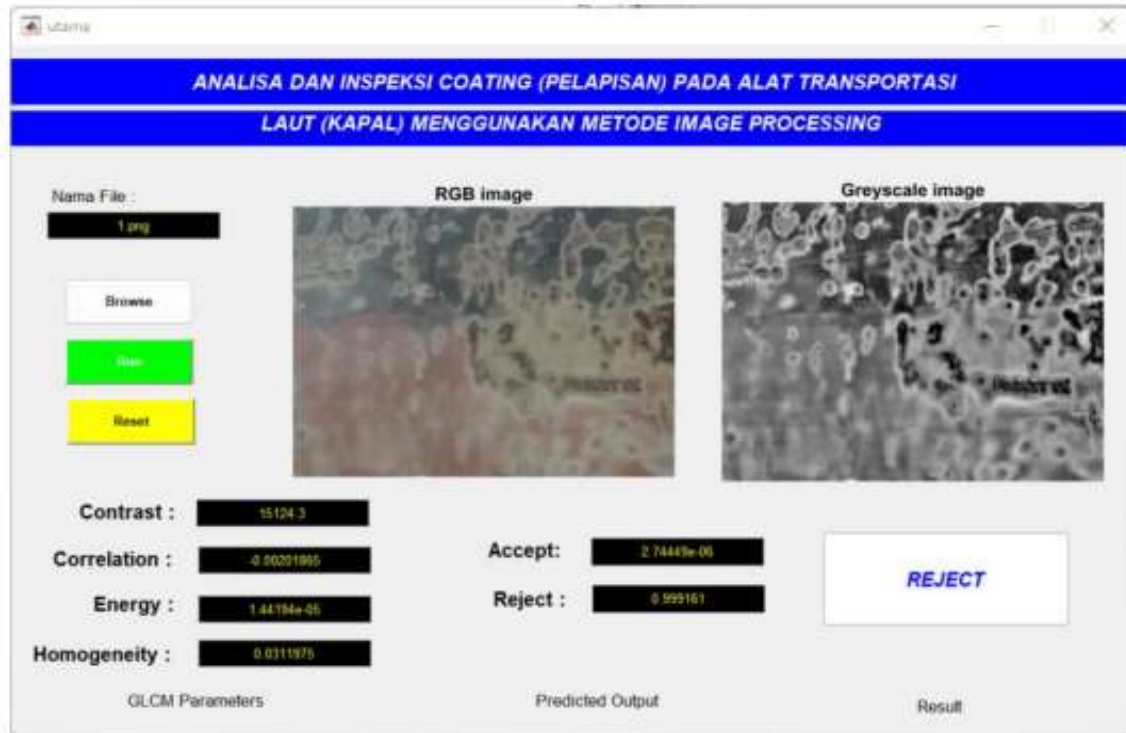


Figure 3. Example of rejected test results



Figure 4. Example of accepted test results

Figures 3 and 4 are the results of image processing and testing using the image processing method, the GLCM scale from the software, and RGB conversion. In those pictures, it can be seen that part of the hull with corroded spots, which means that it does not meet the standards that have been entered during the programming process.(López-Pérez et al., 2023) Therefore, it can be observed that using the RGB and GLCM scales can determine the inspection results on the existing coating on the ship, as a mode of sea transportation.

CONCLUSION

In this study, inspections have been carried out on the coating results and before coating on the ship (KM. Aviani). There are two classifications of RGB and GLCM results, the rejected results can match the corrosion spot found on the hull, and the accepted results mean no corrosion spot found.

REFERENCES

- M. G. Fontana, *Corrosion Engineering*. Tata McGraw-Hill, 2005.
C. HUDA, "Analisis Laju Korosi Material Aluminium 5083 Sebagai Aplikasi Bahan

- Lambung Kapal,” *J. Pendidik. Tek. Mesin UNESA*, vol. 6, no. 02, p. 251226, 2017.
- Surya, R. A., Fadhil, A. & Yudhana, A., 2017. Ekstraksi Ciri Metode Gray Level Co-Occurrence Matrix (GLCM) dan Filter Gabor Untuk Klasifikasi Citra Batik Pekalongan. *Jurnal Informatika: Jurnal Pengembangan IT*, Volume 02.
- Sukanto pratama, “Bab II Landasan Teori,” *J. Chem. Inf. Model.*, vol. 53, no. 9, pp. 1689–1699, 2019.
- E. F. SETYAJI, “Teori Logam,” pp. 7–37, 2012.
- J. Myers and W. Zheng, *Modern Protection Systems to Prevent Corrosion of Structural Steel Elements Due to Deicing and Roadway Salts*. 2011.
- C. Perez-Garcia, F. Tissir, A. Goffinet, and G. Meyer, “Perez-Garcia et al., 2004.” Jul. 10, 2013.