The Spirit of Society Journal
International Journal of Society Development and Engagement
LPPM - Universitas Narotama
ISSN : 2594 - 4777 (Online)
2597 - 4742 (Print)
https://jurnal.narotama.ac.id/index.php/scj/index

Design of a System for Checking Paint Results on the Ship's Hull to Prevent Corrosion

M.Basuki Rahmat[1], Dianita Wardani[2*], Agus Khumaidi[3], Ratna Budiawati[4], Sri Wiwoho Mudjanarko[5]

[1,3,4]Teknik Kelistrikan Kapal Politeknik Perkapalan Negeri Surabaya
[2]Teknik Bangunan Kapal Politeknik Perkapalan Negeri Surabaya
[5]Universitas Narotama Surabaya

Correspondent author: dianitawardani@ppns.ac.id

Abstract: Corrosion is damage caused by chemical reactions between metal materials and other natural elements and is destructive to metal. Corrosion is a weakness in ships made of steel, namely because the rate of ship corrosion, fatigue life is reduced, tensile strength and other mechanical properties are reduced. Corrosion is concentrated on only certain parts. In metal corrosion current flow out onto other parts of the metal surface. Corrosion gastric plates result in reduction Hull panel strength, slowing the ship and reduces security guarantees. The hull must be protected from corrosive attacks routine to prevent loss of additional plates substantially due to seawater corrosion. For Prevent hull corrosion in the painting process for coating, cathodic protection process. In this article, a system for automatically detecting ship hull painting results using image processing is explained. This system will be developed into a portable system. The results obtained show that the system is able to recognize whether the painting results can be accepted or rejected. Accepted means no need to repaint. and if it is rejected, it means a repainting process is needed.

Keywords: image processing, corrosion, hull, metal

INTRODUCTION

Indonesia is a maritime country that has a large water area (Sudibyo and Iswanto, 2016). However, different levels of salt in each water area can cause the ship's hull to experience corrosion or damage. Therefore, it is important for sailing ships to carry out regular maintenance and repairs. Corrosion is damage caused by chemical reactions between metal materials and other natural elements. (Widodo & Siswanto, 2016). Corrosion including destructive attacks on metal through chemical or electrochemical reactions with environment. There are weaknesses for ships made of steel, namely due to the rate of ship corrosion, fatigue life is reduced, tensile strength and degradation of other mechanical properties are reduced. This is what causes very high costs if the ship is made of steel. (Kurniawan, et al., 2020).

One effort to protect ship hulls from corrosion is to use coating technology. The application of epoxy coating can increase corrosion resistance on the surface of ship hulls (Triwulan et al., 2021). The use of anti-corrosion coating can extend the service life of ship hulls by up to 20 years (Zhang et al., 2018).

Apart from coating, sandblasting can also be used to increase the resistance of ship hulls to corrosion. sandblasting can increase the surface roughness of the ship's hull so that the paint used for coating can adhere more firmly to the surface (Huang et al., 2016). In order to increase the resistance of a ship's hull to corrosion, proper maintenance and repair is necessary. Proper maintenance and repairs can extend the service life of the ship's hull and reduce overall maintenance and repair costs (Abdulhameed et al., 2021).

Painting and coating in shipyards usually uses the spray gun method because it is considered relatively cheaper and more efficient (Sulaiman et al., 2020; Wijaya et al., 2021). However, there are often many points or locations on the ship that are corroded and require repainting, which requires a long time and requires more inspector power (Ibrahim et al., 2019).

To overcome this problem, experiments have been carried out using image processing methods to identify areas and corrosion points on the ship's hull. In this method, images of the ship's hull are taken and analyzed using image processing techniques to help inspectors find areas that require maintenance, so that the painting and coating process can be carried out on target. The image processing method can be an effective and efficient method for identifying corrosion on ship hulls, and can be used to speed up the inspection process on ships that require routine maintenance.

METHODOLOGY

The research was carried out following the following steps: first, identifying standards related to the quality of ship hull painting and also collecting images of actual painting results. All data is entered into the database, namely the standard painting database, the received image database. The process is carried out in the image recognition system. The steps in the recognition process are as follows, the image data resulting from the painting is entered into the system. Next, the data will be matched with standards and images with acceptable criteria. Next, it is processed in an NN manner. The results will be displayed, whether the painting results were accepted or rejected.

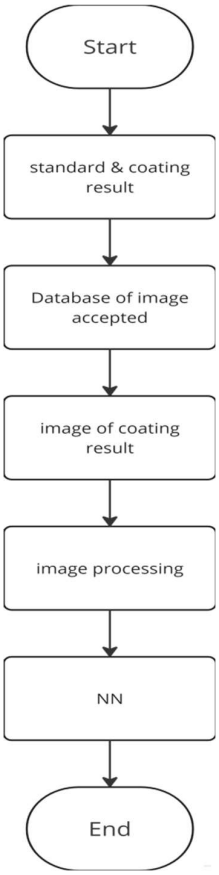


Figure 1. Algorithm System

The process of compiling a database for image processing begins by taking pictures of parts of the ship that have received metal coating as well as parts of the ship that have not had metal coating applied. This is intended to obtain 2 classes which are the basis for determining acceptable conditions (accept) and conditions that require recoating (reject). Metal coating on research objects is carried out using the painting method and using international paint which has the following specifications. Types of coating and painting on the KM.Aviani ship at PT. Lamongan Beach Dock shown byTable1.

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

No.	Bagian *Coating*	Bagian *Coating*	Jenis *Painting*
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 use of international paint is intended so that the data obtained in this research is in accordance with international standards and can be used as a reference for testing coatings using image processing methods on other ships.

RESULT AND DISCUSSION

Data input

In this process, the images obtained come from taking pictures directly during the coating process by CV Sinar Abadi, producing 50 images for each class. This research consists of 2 classes which include images of ship hulls that need to be re-coated because they have been damaged and ship hulls that have been coated. Each class consists of 25 image data.

Image normalization

This normalization aims to obtain uniform and standardized images so that it will not hinder the process of dataset formation and classification. To obtain standardized image data, the images are made in the same format and uniform size. The specified size is 320 x 240 pixels for each image.

Figure 2. Results of inputting image data on the ship

Image data processing with GLCM

To be able to detect the condition of the coating on the ship's hull that requires repainting or not, the software requires the ability to recognize appropriate image features. The image data that has been obtained can be processed using the GLCM method to obtain these features. The data processing process includes the following stages:

1. Convert from RGB to Gray

This stage is changing the image in the RGB colour domain to Gray, and a sharpening process is carried out to sharpen the image texture.

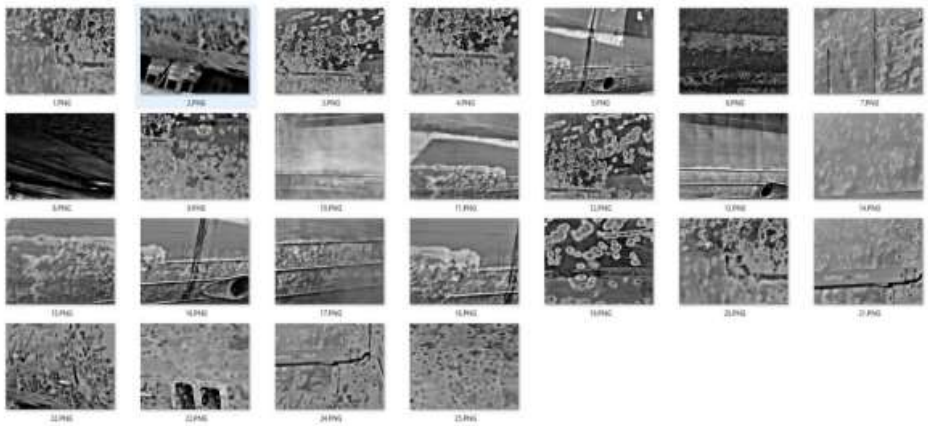


Figure 3. Class reject image after conversion to Gray

1.Edge detection

This edge detection is carried out using the Canny Edge method which has the ability to produce thin, sharp and precise edge lines, so it is often used in image processing applications, such as object recognition and pattern recognition.

2.Feature Extraction

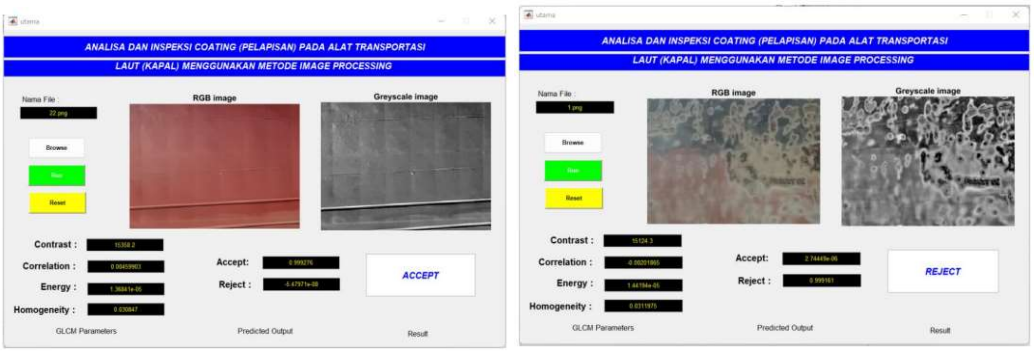
At this extraction stage, researchers used 4 main features which include Contrast, Correlation, Energy, and homogeneity.

Neural Network Formation

This stage is a training process which aims to obtain the most optimal neural network. In this research, the following data was obtained:

1. There is 1 input layer with 4 inputs (Contrast, Correlation, Energy, and homogeneity)
2. There is 1 output layer with 2 outputs (Reject and Accept)
3. There are 3 hidden layers

The neural network was then tested to determine its ability to distinguish between suitable coating conditions and those that require repainting. The test results show that the entire image processing process that has been carried out is able to differentiate between conditions that are acceptable (accept) and those that are not suitable (reject) and require further treatment.



(a) (b)

Figure 4. test results
(a). rejected (b). accepted

CONCLUSIONS

In this research, inspections were carried out on the results of coating and before coating on the ship (KM. Aviani) and images were taken of each of these results. The images obtained are then processed into a database that can be used to identify whether the condition of the ship's hull requires repair or not. The test results show that the data obtained is able to recognize accept conditions (no need to repaint) and reject (require repaint). This shows that the database obtained is suitable for use as a reference for carrying out inspections on other ships in the future.

Acknowledgments: Thank you to PPNS for supporting this research through DIPA PPNS funding

Conflicts of Interest: This research was developed scientifically to support the development of portable equipment for detecting the results of ship hull painting. there is no underlying personal or commercial interest

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