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Changing Data Image Into Numeric Data on Kiln Manufacture Machinery Use Optical Character Recognition (OCR)

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***Abstrak*— *Pada proses pembuatan genteng keramik terdapat proses pembakaran menggunakan mesin kiln manufacture atau oven. Untuk memastikan proses pembakaran berjalan dengan baik, dilakukan pemantauan 39 parameter yang ada pada mesin kiln tersebut yang harus di awasi secara manual berdasar data yang dihasilkan citra pada mesin kiln tersebut. Proses pemantauan parameter tersebut tidak efektif yang disebabkan oleh kesalahan atau kelalaian manusia dan sifat manusia lainnya yang mengakibatkan kerugian bagi perusahaan. Oleh karena itu, dibutuhkan sistem untuk menyimpan data parameter mesin pembakaran genteng keramik yang dapat disimpan kedalam sebuah data base. Setelah dilakukan analisis pada perangkat pembakaran (kiln) tersebut, recorder sensor yang menampilkan data parameter dapat diakses melalui jaringan LAN (Local Area Network), akan tetapi data yang dihasilkan dalam bentuk citra bukan dalam bentuk data digital alfanumerik. Data citra yang didapat perlu diterjemahkan menjadi data alfanumerik sebagai sumber data. Melalui pengenalan optical character recognition (OCR) dengan metode template matching, citra tersebut diubah menjadi data alfanumerik sehingga dapat di simpan dalam sebuah data base. Dari hasil penelitian ini, prototype sistem yang dibuat mendapatkan akurasi sebesar 100.00% untuk konversi data citra ke data alfanumerik,*

Kata kunci: Citra Digital, Data Numerik Optical Character Recognition, Kiln Manufacture.

Abstract— In the process of making ceramic tiles, there is a combustion process using a kiln manufacture or oven. To ensure the combustion process goes well, 39 parameters are monitored on the kiln engine which must be monitored manually based on the data generated by the image on the kiln engine. The process of monitoring these parameters is ineffective due to human error or negligence and other human traits that result in losses for the company. Therefore, a system is needed to store the parameter data of the ceramic tile combustion engine which can be stored in a database. After analyzing the kiln, the sensor recorder that displays parameter data can be accessed via a LAN (Local Area Network), but the data generated is in the form of an image, not in the form of alphanumeric digital data. The image data obtained need to be translated into alphanumeric data as a data source. Through the introduction of optical character recognition (OCR) with the template matching method, the image is converted into alphanumeric data so that it can be stored in a database. From the results of this study, the prototype system made obtained an accuracy of 100.00% for the conversion of image data to alphanumeric data,

Keywords: Digital Image, Optical Character Recognition Numerical Data, Kiln Manufacture.

I. INTRODUCTION

PT. XYZ is a leading manufacturer of glazed ceramic tile (and its accessories). One of the manufacturing processes for these products is the combustion process at a temperature of 1100 degrees Celsius using a kiln manufacture machine or oven so that it can produce quality and durable ceramic tiles. In the process of burning ceramic tile products, direct monitoring is carried out by employees for 24 hours by observing 39 data parameters displayed through images on the monitor on the kiln engine panel.

In the process of monitoring the kiln manufacture (oven) machine, the sensor data will be displayed in the form of an image that appears on a screen that will be updated every 5 seconds which must be monitored during the process. The image displayed on the oven screen will then be recorded manually and really must be monitored directly. However, human endurance and physical condition greatly affect the results of the monitoring. Based on the initial analysis of the problem, it can be concluded that the kiln manufacture (oven) machine only displays 39 parameter data on a screen in the form of an image that will be updated every 5 seconds, the data is stored on a small capacity record machine and cannot be accessed by data. To overcome this problem, it would be possible to create a system or tool that can convert the image into alphanumeric data that can provide real-time information (monitoring automation).

Technological developments are increasingly developing more advanced than before, as well as image processing technology or digital images. Image processing is a method of processing images (images / images) into digital form for certain purposes. One of the digital image processing studies is Optical Character Recognition (OCR) which is a character recognition process through preprocessing, segmentation, feature extraction and recognition, Optical Character Recognition (OCR) is one of the study areas of pattern recognition (pattern recognition) in digital images that classifying or describing an object based on quantitative measurements of its main features or properties. With this method is expected to provide a solution to PT. XYZ in overcoming the problems that exist in the kiln manufacture (oven) machine.

The image can be accessed via a Local Area Network (LAN) and through the introduction of optical character recognition (OCR) the image can be converted into data in alphanumeric form as needed and can be stored into a system that can process the data and it is hoped that the application can provide information automatically. quickly and precisely to the user or user.

II. METHOD

2.1 . Study of Literature

a. Image Processing

Image processing is the process of processing pixels in a digital image for a specific purpose. Initially, image processing was carried out to improve image quality, but with the development of the computing world, which is marked by the increasing capacity and speed of computer processing and the emergence of computational sciences that allow humans to retrieve information from an image[3].

The image processing process is a diagrammatic process starting from image retrieval, image quality improvement, up to a representative statement of the imaged image can be seen in the figure 1.

Figure 1 Diagram of the digital image processing process.

b. Optical Character Recognition (OCR)

OCR takes care of the problem of recognizing optically processed characters. Optical recognition is done offline as well as online. Offline after writing or printing is complete whereas online recognition is done where the computer recognizes the characters as they are drawn. Printed and/or handwritten characters are recognizable but the results directly depend on the quality of the input document. The more limited the input, the better the performance of the OCR system. But when it comes to the completely unrestricted handwriting performance of the OCR engine it is questionable. Figure 2.3 shows a schematic representation of the various character recognition areas [2].

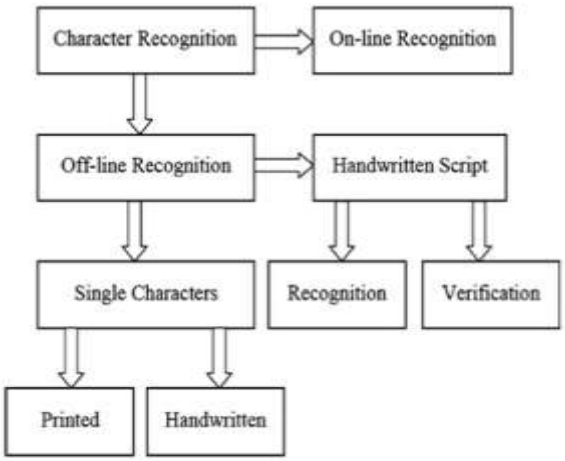


Figure 2 Schematic of Optical Character Recognition (OCR.) Area)

c. Template Matching Correlation

Template matching is a technique in digital image processing that has a function to match each part of an image with the image that becomes the template/reference [4]. This is done by comparing the input image with the template image in the database, then looking for similarities using a certain rule. The image matching process that produces a high level of similarity / similarity determines that an image is recognized as one of the template images.

d. Kiln Manufacture

Furnace or also often referred to as a combustion furnace is a device used for heating. The name comes from the Latin Fornax, oven. Sometimes people also call it a kiln. A kiln is a tool or installation designed as a place of combustion using certain fuels that can be used to heat something [1]. The furnace is simple, composed of stones arranged so that the fuel is protected and heat can be directed. In manufacturing companies, the furnace is made in such a way that the fire or heat that is formed is not too dangerous for the user.

Klin At PT XYZ, the kiln used is a Single Layer Tunnel Kiln which consists of 6 combustion zones, namely sub dryer, pre heating, firing, rapid cooling and cooling, with asbestos insulation and using LNG (Liquid Natural Gas) as fuel. The fuel will produce heat energy for the ceramic tile burning process. The heat that has been used in the firing section is not completely removed. Most of it will be reused to flow to the dryer and sub dryer. But there is also some heat energy that is wasted because it contains carbon which can affect the results of tile products.

2.2 Research Method

This research is applied research to identify character in image in kiln machine by using Optical Character Recognition (OCR) method. Based on the identification of problems obtained in the field observation process, literature study and interviews, namely during the combustion process in the kiln engine, so an application system was created to convert image data into alphanumeric data, using the Optical Character Recognition (OCR) method based on template matching, which then results the conversion can be saved into a database. The research method can be seen in Figure 3.

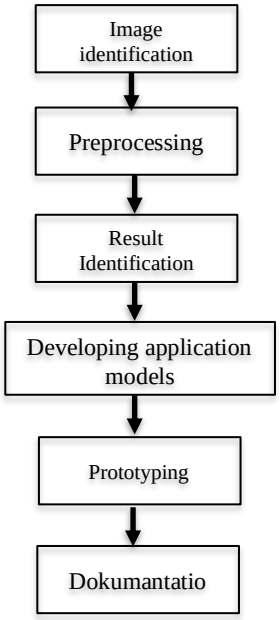


Figure 3 Research Flowchart Block

2.3 Prototype Architectural Design

Figure 4 depicts the prototype architecture for monitoring the parameters of the ceramic tile combustion engine (kiln manufacture) for intensive monitoring of the engine.

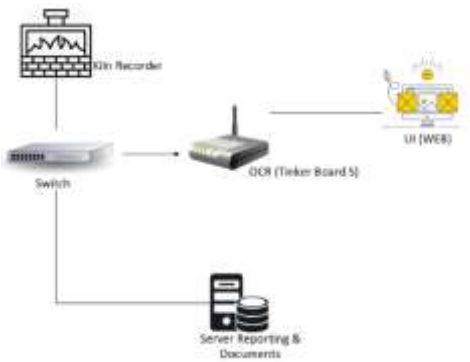


Figure 4 Prototype Architecture

The prototype of this OCR data processing application was made by following the steps shown in Figure 5 below:

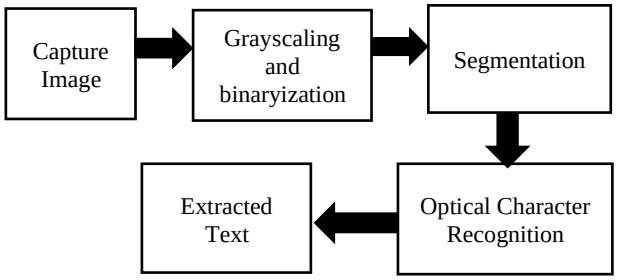


Figure 5. System Workflow

2.4 Test Design

The result of the trial on the application is the result parameter in the conversion of image data into alphanumeric data using OCR. The resulting parameters will be used as a basis for predicting the value that will come out. In order to know how accurate, the prediction will be, before the parameter is formed, the parameter is first evaluated and validated by using a confusion matrix calculation consisting of Accuracy, Precision and Recal [5]. The confusion matrix table can be seen in table 1.

Tabel 1 Tabel *Confusion Matrix*

		True Value	
		TRUE	**FALSE**
Predicted Value	**TRUE**	TP *(True Positive)* *Corect Result*	FP *(False Positive)* *Unexpected Result*
	FALSE	FN *(False Negative)* *Missing Result*	TN *(True Negative)* *Corect Absence Of Result*

So, the Precision, Recall and Accuracy formulas can be seen in formulas 1, 2 and 3.

$$\text{Precision} = \frac{TP}{TP+FP} \quad (1)$$

$$\text{Recall} = \frac{TP}{TP+FN} \quad (2)$$

$$\text{Accuracy} = \frac{TP+TN}{TP+TN+FP+FN} \quad (3)$$

III. RESULTS AND DISCUSSION

3.1 Preparation of Training Data and Test Data

In this study, as many as 100 image data taken from the kiln machine in .png format which will later be prepared for training data and test data which is the result of web capture which will later be converted into alphanumeric data. The figure contains parameters that must be monitored intensively for 24 hours. These parameters contain the temperature, gas pressure and air humidity which are read by sensors in certain parts along the ceramic tile combustion engine. At this writing, 10 of the 39 parameters were taken as samples for testing the conversion of images to alphanumeric data using OCR based on template matching. In detail can be seen in figure 6 table 2 below.

Figure 6 Capture images of the kiln machine.

Tabel 2 Description Sample parameters for the OCR conversion process.

NO	Parameter	Description
1	TR1	Preheating Zone, which is the initial zone or area for the product to be heated before being burned in the next zone. The unit used is degrees Celsius (ºC).
2	TR3	Is firing zone No.1 compaction process (pressure) at high temperatures so that changes in microstructure occur. In this parameter the unit used is degrees Celsius (ºC).
3	TC2	It is a thermocontroller parameter no2 to measure the temperature in the combustion process in the zone before firing zone no 3. The unit used is degrees Celsius (ºC).
4	TC3	In this zone, thermocontroller parameter no 3 is used to measure the temperature in the combustion process in the zone before firing zone no 4. The unit used is degrees Celsius (ºC).
5	TR14	Is the zone after passing through the cooling zone no. 3 or to lower the temperature before entering the sub dryer. The unit used is degrees Celsius (ºC).
6	TR17	It is a drying area (sub dryer) after cooling the product. The parameter unit used is degrees Celsius (ºC).
7	KCH	Is a parameter to see the hydraulic pressure (hydraulic kiln car) in running the conveyor while the machine is running. The unit used is kg/cm²
8	TI3	Is the area to measure the temperature of the product no. 3 (zone temperature) before the product comes out of the machine after the drying process. The parameter unit used is degrees Celsius (ºC).
9	TI7	Is an area to measure the product temperature no. 7 (zone temperature) before the product comes out of the machine after the drying process. The parameter unit used is degrees Celsius (ºC).
10	HI3	Is a sensor to measure the humidity of the air in the kiln machine in zone no 3 (Zone humidity)

3.2 Modelling

Making a model or prototype at this writing, the author makes a prototype which is divided into 3 parts, the first for processing OCR data using thinker board from Asus, the second dummy or imitation to display the image of the kiln machine using Oracle VM VirtualBox, and the third prototype for the application server. The OCR uses Oracle VM VirtualBox to represent it as a documentation server.

3.3 Character Recognition

The OCR system was created using the Tesseract OCR software which was run on python 3.7 for OCR recognition from converted and segmented binary images. Tesseract OCR will recognize each character from the segmentation results in the image after previously training the character template. The process of recognizing the character of the kiln machine image on the template uses four parameters when initialized, namely data path, language, mode, and white list [6] so that to obtain accurate detection results, a template is created as a path source as shown in Table 4.3. below this:

Table 3 Implementation of the Tesseract OCR Template

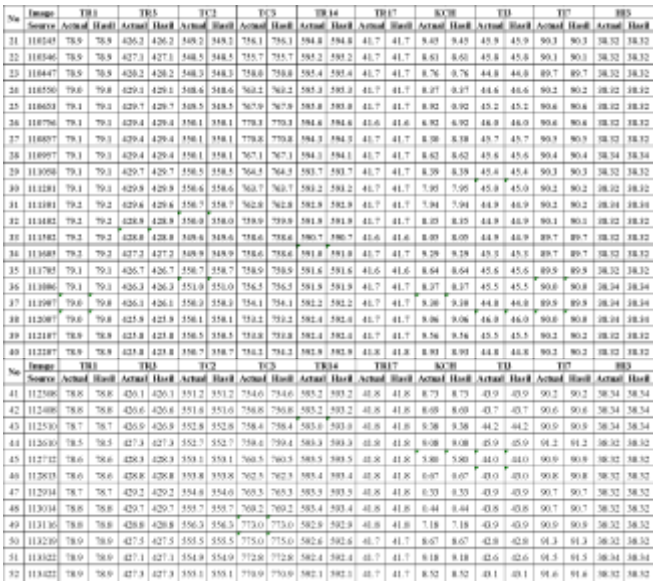
No	Citra Hasil Segmentasi	Template	Karakter
1			0
2			1
3			2
4			3
5			4
6			5
7			6
8			7
9			8
10			9
11			.

3.4 OCR Application Research Results

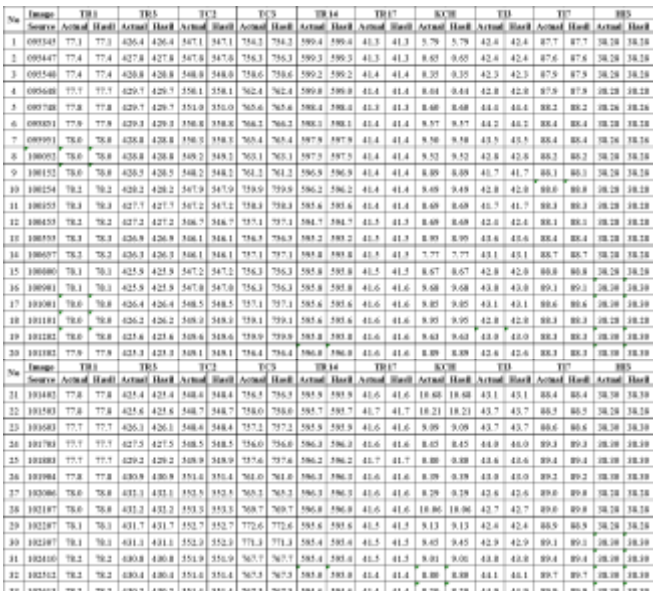
The results of the research on the prototype model of data conversion using OCR on the kiln machine PT. XYZ can be seen from table 4 for Type A tile products and table 5 for MAROON 1000918 products below:

Tabel 4 OCR conversion result for Type A tile products

No	Image Source	TB1 Actual	TB1 Hasil	TB5 Actual	TB5 Hasil	TC2 Actual	TC2 Hasil	TC3 Actual	TC3 Hasil	TB14 Actual	TB14 Hasil	TB17 Actual	TB17 Hasil	KC08 Actual	KC08 Hasil	TD Actual	TD Hasil	T7 Actual	T7 Hasil	HS Actual	HS Hasil
1	104323	78.3	78.3	429.1	429.1	547.9	547.9	755.6	755.6	585.5	585.5	41.6	41.6	8.52	8.52	44.7	44.7	89.3	89.3	38.32	38.32
2	104323	78.3	78.3	430.2	430.2	549.3	549.3	757.5	757.5	585.6	585.6	41.6	41.6	8.56	8.56	45.3	45.3	89.6	89.6	38.32	38.32
3	104423	78.5	78.5	430.2	430.2	550.3	550.3	763.9	763.9	585.4	585.4	41.5	41.5	8.18	8.18	45.7	45.7	89.7	89.7	38.38	38.38
4	104526	78.5	78.5	428.9	428.9	550.8	550.8	769.3	769.3	585.4	585.4	41.5	41.5	8.55	8.55	44.8	44.8	89.4	89.4	38.32	38.32
5	104628	78.6	78.6	427.9	427.9	551.6	551.4	779.0	779.0	585.6	585.6	41.5	41.5	8.02	8.02	43.9	43.9	89.1	89.1	38.38	38.38
6	104729	78.7	78.7	427.2	427.2	551.6	551.4	769.4	769.4	585.7	585.7	41.4	41.4	8.24	8.24	44.1	44.1	89.3	89.3	38.32	38.32
7	104823	78.8	78.8	427.8	427.8	550.9	550.9	768.5	768.5	585.4	585.4	41.4	41.4	8.51	8.51	43.7	43.7	89.4	89.4	38.32	38.32
8	104929	79.0	79.0	426.8	426.8	550.6	550.6	766.1	766.1	585.5	585.5	41.4	41.4	9.03	9.03	44.5	44.5	89.7	89.7	38.32	38.32
9	105031	79.1	79.1	426.3	426.3	550.9	550.0	763.8	763.8	585.4	585.4	41.5	41.5	8.67	8.67	44.7	44.7	90.0	90.0	38.32	38.32
10	105133	79.1	79.1	425.9	425.9	548.0	548.0	762.1	762.1	585.2	585.2	41.5	41.5	9.13	9.13	44.0	44.0	90.2	90.2	38.32	38.32
11	105234	79.2	79.2	425.7	425.7	548.0	548.0	761.3	761.3	585.5	585.5	41.5	41.5	9.08	9.08	44.9	44.9	90.3	90.5	38.32	38.32
12	105334	79.2	79.2	425.6	425.6	547.8	547.8	761.2	761.2	586.5	586.5	41.5	41.5	8.56	8.56	44.5	44.5	90.4	90.4	38.32	38.32
13	105435	79.3	79.3	425.6	425.6	547.6	547.6	759.8	759.8	587.3	587.3	41.5	41.5	8.82	8.82	44.6	44.6	89.7	89.7	38.32	38.32
14	105538	79.2	79.2	425.6	425.6	547.5	547.5	756.5	756.5	587.4	587.4	41.5	41.5	9.10	9.10	43.9	43.9	89.5	89.5	38.32	38.32
15	105638	79.2	79.2	425.7	425.7	547.2	547.2	755.0	755.0	587.3	587.3	41.4	41.4	9.13	9.13	44.3	44.3	89.7	89.7	38.32	38.32
16	105739	79.2	79.2	425.8	425.8	547.0	547.4	757.4	757.4	587.8	587.8	41.5	41.5	9.68	9.68	44.3	44.3	89.8	89.8	38.32	38.32
17	105839	79.3	79.3	425.8	425.8	548.1	548.1	757.4	757.4	586.9	586.9	41.6	41.6	8.97	8.97	44.5	44.5	90.0	90.0	38.32	38.32
18	105941	79.2	79.2	426.8	426.8	548.0	548.0	752.4	752.4	586.8	586.8	41.7	41.7	8.68	8.68	44.6	44.6	90.3	90.1	38.32	38.32
19	110041	79.1	79.1	426.2	426.2	548.6	548.6	753.4	753.4	586.0	586.0	41.7	41.7	8.66	8.46	45.2	45.2	90.4	90.4	38.32	38.32
20	110145	79.1	79.1	426.1	426.1	549.0	549.1	755.3	755.3	585.2	585.2	41.7	41.7	8.59	8.59	45.8	45.8	90.3	90.3	38.32	38.32



Tabel 6 OCR conversion result for product MAROON100918



3.5 OCR Implementation Test Results

The test results of the OCR conversion prototype model on the kiln machine that have been made using 11 training data as in table 4.2 and 100 test data containing 1000 parameters which are divided into two types of tasks / products can be seen in table 4.4 as many as 520 parameters for type A tile products and in table 4.5 there are 480 parameters for the maroon 100918 tile product.

The results of testing the application of OCR can be seen in table 7 below.

Table 7 Confusion Matrix Test Results

		Result Class	
		current	Result
Class current	current	520	0
	Result	0	480

From table 5 and table 6 above, both the parameters of the Type A roof tiles and Maroon100918 products obtained accurate conversion results and it is certain that there are no inappropriate parameters. From table 7, the following accuracy is obtained:

$$\text{Accuracy} = \frac{TP+TN}{TP+TN+FP+FN}$$

$$= \frac{520+480}{520+480+0+0}$$

$$= \frac{1000}{1000}$$

$$= 1 \times 100\%$$

$$= 100\ \%$$

Based on the results of these calculations, the accuracy of 100.0% is obtained.

IV.CONCLUSION

Based on the discussion of the results of the research and testing of the research above, it can be concluded that the application model for converting images to numerical data using the Optical character recognition (OCR) method based on template matching obtained an accuracy of 100.00%.

REFERENCES

[1] Arnofiandi, M. S. (2020) 'Rancang Bangun Tungku Pemanas Dalam Proses Metalurgi Serbuk', *Pembelajaran Olah Vokal di Prodi Seni Pertunjukan Universitas Tanjungpura Pontianak*, 28(2), pp.

[2] Chaudhuri, A., Mandaviya, K., Badelia, P., and Ghosh, Soumya K. (2017) *Optical character recognition systems, Studies in Fuzziness and Soft Computing*. doi: 10.1007/978-3-319-50252-6_2

[3] Putra, D. (2010) 'Pengolahan Citra Digital'. Yogyakarta: C.V Andi Offset (Penerbit Andi), p. 420.

[4] Hossain, M. A. and Afrin, S. (2019) 'Optical Character Recognition based on Template Matching', *Global Journal of Computer Science and Technology*, 19(2), pp. 31–35. doi: 10.34257/gjcstcvol19is2pg31

[5] Andono, P. N., Sutojo, T. and Muljono (2017) *Pengolahan Citra Digital*. Yogyakarta: Penerbit Andi.

[6] Nunamaker, B. Bukhari, S., Borth, D. And Dengel, A. (2016) 'A Tesseract-Based Ocr Framework For Historical Documents Lacking Ground-Truth Text German Research Center for Artifical Intelligence (DFKI) Kaiserslautern , Germany Univeristy of Kaiserslautern , Gemany', *IEEE International Conference on Image Processing (ICIP)*, pp. 3269–3273