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To cite this article: Ari Wibawa Budi Santosa *et al* 2020 *IOP Conf. Ser.: Earth Environ. Sci.* **519** 012046

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IOP Conf. Series: Earth and Environmental Science **519** (2020) 012046 doi:10.1088/1755-1315/519/1/012046

Detection of Oil and Filter Feasibility in Ship Gearbox with SVM (Support Vector Machine) Method Based on Microcontroller

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Abstract. Lubrication systems on ships are vital for a ship to operate while sailing. Lubrication serves to prevent direct friction between components on the ship engine, especially the gearbox. Gearbox is one of the components of the ship crane that acts as the propeller of the ship. Obviously related to friction between components, therefore a lubrication system is needed. Some lubrication systems on Indonesian warships still use manual systems to monitor oil and filter change schedules. This can make the operator forget about the oil and filter change schedule. With the development of technology that is now the author makes a prototype with an oil and filter feasibility detection system on a ship gearbox. The author uses the SVM method that is able to classify properly or not like an oil. By using a viscosity sensor and a temperature sensor to be processed by the SVM method and a color sensor to detect a color in the oil filter. The results of the SVM method are quite accurate with 100% accuracy can distinguish good and bad oil from the samples used are new oil and used oil. There is a change in the intensity of the light that causes the color sensor readings in conditions of 100%, conditions of 30%, conditions of 40%, and conditions of 50%.

1. Introduction

The lubrication system at the time of updating is vital for the ship to operate in. Lubrication system is used to reduce the level of wear on objects that rub against each other. Besides lubrication also functions as a successful fluid on some transition machines. A ship must have a good lubrication system in order to work optimally. One component that requires lubricating oil is a gearbox. The function of this gearbox is to change the direction of rotation of the propeller shaft. Besides the gearbox as a link between the main engine crankshaft with the propeller shaft. Of course, with such a process, it requires a lubrication system to avoid friction between components. In general, the lubrication system for gearbox filters, especially on Indonesian warships still uses manuals with the assistance of operators to oversee oil change schedules and filter cleaning based on engine rotating

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IOP Conf. Series: Earth and Environmental Science **519** (2020) 012046 doi:10.1088/1755-1315/519/1/012046

working hours. By utilizing the advances in technology that are developing at this time, researchers in this research will make a prototype that can reduce the occurrence of human error with the title " Detection of Oil and Filter Feasibility in Ship Gearboxes With SVM Method Based on Microcontroller"

2. Methodology
Shows the working principle of the system in this thesis, namely, the oil in the tank will be detected by a temperature sensor and then pumped through a pipe that will pass the viscosity sensor. The two inputs will be classified by the SVM method, whether a good or bad oil is detected. The color sensor will detect the filter. If an SVM detects good oil, valve 1 will open and will go to the filter. Instead the sensor detects bad oil, then activates valve 2, the drain pipe. The color sensor detects the filter in bad conditions and activates the pneumatic valve, which is the compressor.

2.1. Optic Through Beam Sensor
This sensor is a through beam type proximity sensor that consists of an emitter as an infrared signal transmitter and receiver that functions as an infrared receiver. The working principle of this sensor is that when an infrared signal sent by the emitter is blocked by an object, the receiver will respond. In this final project the optical through beam sensor is used as a measure of the viscosity of the liquid in the oil, which then results in the form of an ADC which will be converted with the results of the measurement of oil viscosity from measurements using a viscosity tool

2.2. TCS 3200 Sensor
TCS3200 Color Sensor is a color detection sensor that has a Taos TCS3200 sensor chip to control 4 RGB LEDs and white LEDs. TCS3200 can detect and measure almost unlimited colors. Its applications are reading test strips, color sorting, ambient light sensing and calibration, and color matching. In this final project the sensor is used to read the colors in the filter.

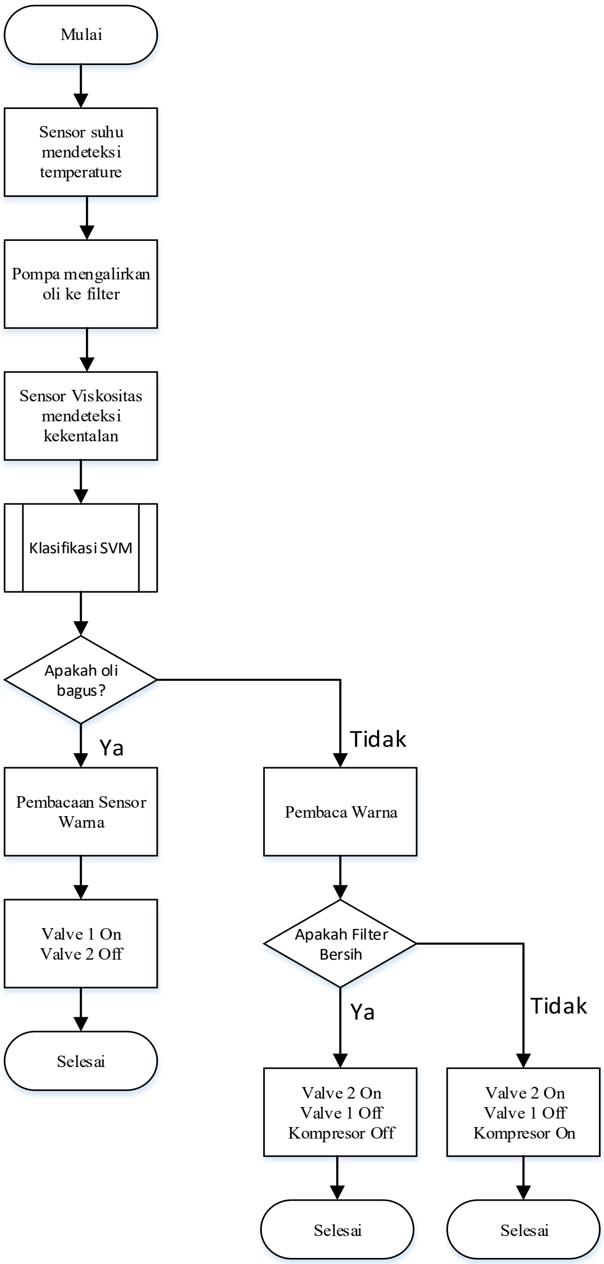

Fig *1. Flowchart Diagram System*

2.3. DS18B20 Sensor

DS18B20 is a digital temperature sensor This sensor is capable of reading temperatures with a precision of 9 to 12-bits, a range of -55 ℃ with accuracy (+/- 0.5 ℃). Each sensor produced has a unique 64-Bit code embedded on each chip, allowing the use of sensors in large numbers through only one cable In this final project the researcher uses the DS18B20 sensor to measure the temperature of the oil, which will be converted by an Arduino UNO microcontroller.

2.4. Arduino

In this Final Project, researchers use Arduino as a controller for the process of controlling and reading sensors (TCS3200,DSB18B20, and Optic through Beam).

2.5. SVM (Support Vector Machine)
Support Vector Machine is a technique for making predictions, both in the case of classification and regression. The SVM has the basic principle of linear classifier, which is a classification case that can be linearly separated, but SVM has been developed so that it can work on nonlinear problems by incorporating the concept of the kernel in a high-dimensional workspace.

3. Testing and Data Analysis
3.1. Optic Through Beam Sensor Testing

Table 1. Testing Sensor with Oil

No	Laboratory Test	Temperature	Sensor	Scalling	Error %
1	103,21	31,06	567	105,54	2,26
2	103,21	31,06	557	103,68	0,46
3	103,21	31,06	560	104,24	1
4	103,21	31	556	103,49	0,28
5	103,21	31	549	102,19	0,98
6	103,21	31	546	101,63	1,52
7	103,21	31,06	550	102,38	0,80
8	103,21	31,06	555	103,31	0,1
9	103,21	31	550	102,38	0,80
10	103,21	31	550	102,38	0,80
		Error Average			0,9 %

From the results of the above test, the authors took a sample of up to 10 times the experiment with a new oil sample with SAE 20 to get the sensor output in the form of ADC values with a range of 550 to 567. Then the ADC output was scaled, the average percentage of error was 0.9%. Indicates that this sensor can be used to detect the thickness of the oil.

3.2. TCS3200 Sensor Testing

This color sensor testing uses paper media that has been printed in color according to the RGB values of red, green, and blue. Tests carried out in a closed room that may have no influence from outside light except the light from the sensor

Table 2. TCS3200 Sensor with Red Paper

Data Sensor			Data Paint		
R	G	B	R	G	B
255	13	23	255	0	0
255	13	34			
255	43	46			
255	81	97			
255	60	74			

Table 3. TCS3200 Sensor with Green Paper

Data Sensor			Data Paint		
R	G	B	R	G	B
0	136	34	0	255	0
0	115	0			
73	166	68			
0	111	0			
28	158	68			

Table 4. TCS3200 with Blue Paper

Data Sensor			Data Paint		
R	G	B	R	G	B
0	179	238	0	0	255
0	132	221			
10	158	238			
0	145	227			
0	153	233			

This color sensor testing uses paper media that has been printed in color according to the RGB values of red, green, and blue. Tests carried out in a closed room that may have no influence from outside light except the light from the sensor.

3.3 DS18B20 Sensor Testing

In this test using three samples, namely plain water, cold water, hot water where each sample is taken 10 times and the comparison uses a digital waterproof thermometer to determine the error generated by the sensor.

Table 5. Testing DS18B20 with Sample Water

No	Sample	Sensor DS18B20	Thermometer	Error (%)
1	Dingin	12°C	12°C	0
		12°C	12.2°C	1.6
		13°C	13°C	0
		12°C	12.3°C	2.43
		14°C	14.2°C	1.4
		14°C	14°C	0
		15°C	15.4°C	2.59
		17°C	17.2°C	1.73
		17°C	17.2°C	1.16
		16°C	16.2°C	1.2
2	Biasa	26°C	26°C	0.3
		26°C	26.2°C	0.76
		27°C	27.2°C	0.73
		26°C	26.2°C	0.76
		27°C	27°C	0
		27°C	27°C	0
		27°C	26.9°C	0.37
		28°C	27.9°C	0.35
		28°C	28.1°C	0.34
		28°C	28°C	0
3	Panas	98°C	98.1°C	0.1
		98°C	98°C	0
		97°C	97.2°C	0.2
		95°C	95.2°C	0.2
		92°C	92°C	0
		88°C	64°C	0
		88°C	65.9°C	0.1
		85°C	67.2°C	0.3
		84°C	68°C	0
		80°C	70.1°C	0.1
		Average Error		0,56%

After doing some tests above, it can be concluded that the DS18B20 sensor is a fairly accurate temperature sensor because it produces a fairly small average error of 0.56%.

3.4. System Testing

In testing this whole system where sensors and actuators are expected to work in accordance with the conditions stated Each condition was tested 10 times in 10 attempts on oil and 10 times on filters.

Table 6. The Expected Condition

No	Oil and Filters	Actuator
1	Good Oil, Clean Filter	Solenoid Valve 1 On
2	Bad Oil, Clean Filter	Solenoid Valve 2 On
3	Good Oil, Dirty Filter	Splenoid Valve 1 On, Pneumatik Solenoid On
4	Bad Oil, Dirty Filters	Solenoid Valve 2 On, Pneumatik Soleneoid on

3.4.1. Condition Test 1

In testing condition 1, the writer tests the whole system by placing a new oil sample and clean filter on the plant that has been made. From The test obtained 0% error percentage.

Table 7. Overall System Test Results Condition 1

No	Condition	Target	Output	*Error*
1	Good Oli	1	1	0%
2		1	1	
3		1	1	
4		1	1	
5		1	1	
6		1	1	
7		1	1	
8		1	1	
9		1	1	
10		1	1	
	Average Error			0%
No	Condition	Suitable	Unsuitable	*Error*
1	Clean Filter	√		
2		√		
3		√		
4		√		
5		√		
6		√		
7		√		
8		√		
9		√		
10		√		
		Average Error		0%

3.4.2. Condition Test 2

In testing this condition 2 the authors test the overall system by placing new oil samples and clean filters on the plant that has been made.

Table 8. Overall System Test Results Condition 2

No	Condition	Target	Output	*Error*
1	Bad oil	-1	-1	0%
2		-1	-1	
3		-1	-1	
4		-1	-1	
5		-1	-1	
6		-1	-1	
7		-1	-1	
8		-1	-1	
9		-1	-1	
10		-1	-1	
	Average Error			0%
No	Condition	Suitable	Unsuitable	*Error*
1	Clean Filter	√		
2		√		
3		√		
4		√		
5		√		
6		√		
7		√		
8			√	
9			√	
10			√	
		Average Error		30%

3.4.3. Condition Test 3

In testing condition 3, the writer tests the whole system by placing a good oil sample and dirty filter on the plant that has been made. From this test the percentage of error results obtained on the filter is 40%.

Table 9. Overall System Test Results Condition 3

No	Condition	Target	Output	*Error*
1	Good Oli	1	1	0%
2		1	1	
3		1	1	
4		1	1	
5		1	1	
6		1	1	
7		1	1	
8		1	1	
9		1	1	
10		1	1	
		Average Error		0%
No	Condition	Suitable	Unsuitable	*Error*
1	Dirty Filter	√		
2		√		

No	Condition	Target	Output	*Error*
3		√		
4		√		
5		√		
6		√		
7			√	
8			√	
9			√	
10			√	
	Average Error			40 %

3.4.4. Condition Test 4

In testing condition 4, the writer tests the overall system by placing a good oil sample and dirty filter on the plant that has been made. From this test the percentage of error results obtained in the filter is 50%.

Table 10. Overall System Test Results Condition 3

No	Condition	Target	Output	*Error*
1	Bad oil	-1	-1	0%
2		-1	-1	
3		-1	-1	
4		-1	-1	
5		-1	-1	
6		-1	-1	
7		-1	-1	
8		-1	-1	
9		-1	-1	
10		-1	-1	
	Average Error			0%
No	Condition	Suitable	Unsuitable	*Error*
1	Dirty Filter	√		
2		√		
3		√		
4		√		
5		√		
6			√	
7			√	
8			√	
9			√	
10			√	
	Average Error			50%

After testing the whole system with each condition with 10 times the percentage error is obtained. The method used is SVM able to classify with a percentage of 100% success. As for the filter eligibility system, there are several percentage errors, namely 0% in condition 1, 30% in condition 2, 40% in condition 3, and 50% in condition 4. There is an error in each filter testing condition because at the time of testing there was a change in the light intensity that affects the TCS3200 sensor readings.

4. Conclusion

Based on the results obtained in the analysis and testing of the system that was made, it can be concluded that, The system is able to detect the feasibility of oil with the SVM method that can classify good and bad oil with 100% success, where the range of 500-700 is classified as good oil while the range value of 992 -1023 is classified as bad oil. The filter eligibility detection system can distinguish clean and dirty filters with the percentage error in each condition 1 namely 0%, condition 2 30%, condition 3 40%, and condition 4 50%. This is due to changes in light intensity which makes the TCS3200 sensor very sensitive to changes in light.

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