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Implementation of Out seal PLC Integrated Sensor Flowmeter YF-S401 on Ship's Auxiliary Engine

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Abstract
The container transportation system aims to facilitate the transfer of goods by simplifying the loading and unloading system so that it is effective and efficient. To operate a container ship, fuel is an important aspect that requires operating costs in the range of 70% of the ship's operating costs. To avoid fraud on board the ship for fuel consumption, it is necessary to have a system for monitoring the consumption of fuel cargo on board the ship that works automatically and in real time. By not using a fuel consumption monitoring system that works automatically, shipping management does not know for sure the ship's fuel consumption, thus triggering fraud committed by ship crews against fuel. As a result, research was conducted using a flowmeter sensor that uses a PLC as a flowmeter sensor data monitor, from which the data will be sent to a web server that the party in charge can access. Therefore, innovation is needed to overcome these problems. design of a simple automatic main engine and auxiliary engine fuel consumption monitoring system in real time. Based on the system that has been created, by using this system, fuel usage can be monitored at any time. Based on the test results of the flowmeter sensor readings through the PLC out seal, the error percentages are 1.15%. Therefore, it can be concluded that the flowmeter sensor can be used as. an out-of-seal PLC-based auxiliary engine fuel monitoring system with a per-liter time of 3 minute, 29 seconds.
Keywords:*, Monitoring, Out Seal PLC, Webserver*

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I. INTRODUCTION

In Indonesia's maritime sector, it is very necessary to increase the fleet both for marine exploration purposes and as a means of supporting the economy in Indonesian waters[2]. One of the efforts to support economic development in Indonesia is by conducting foreign trade, which consists of exporting and importing goods using a container transportation system. The container transportation system is a combination of various modes of transportation carried out using containers, aiming to facilitate the transfer of goods by simplifying the loading and unloading system so that it is effective and efficient[1]. To operate a container ship, fuel is an important aspect that requires operational costs that are in the range of 70% of the ship's operating costs. Therefore, all shipping companies should always monitor the consumption of fuel oil cargo on their ships closely so that there is no wasteful fuel consumption.

1.1.1 Flow Calculation

At this stage, the flowmeter will use the Hall effect function, which means that when water flows through it, the rotor will rotate and produce pulse data based on the amount of water flowing[3]. This concept will then be formulated into a formulation that is in accordance with the desired system design[5]. The measurement of the water discharge of the reservoir is possible because it will be made conical in the flow of the water, so that the flow of water that enters the pipe will be connected to the sensor. This principle applies the work function of Bernoulli's principle. This is done to ensure that all the flowing water can be measured according to the meaning of the discharge[4]. The discharge is the amount of flow measured in liters per second. The water flow rate can be calculated by counting the pulses from the sensor output.

1.1.2 Block Diagram

The monitoring method used in this fuel monitoring system is the fuel monitoring method through the auxiliary engine. The input of this monitoring system is the flowmeter sensor. While the output of this monitoring system is the auxiliary engine.

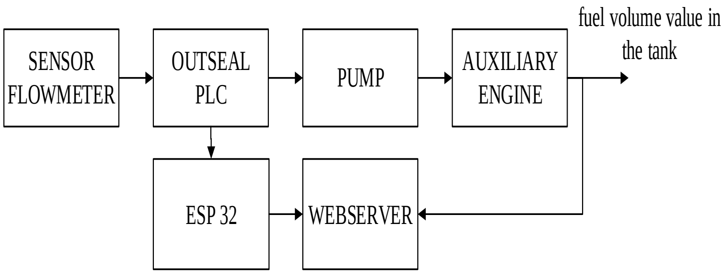


Figure1: Auxiliary Engine Monitoring System Diagram

The RHSCU, WHSCU, and DIV instruction methods are used to read the pulse flowmeter in the Auxiliary Engine fuel tank fuel monitoring. There will be a pulse value that is read by the flowmeter, and the DIV instruction will divide it into volume in liters.

Table 1: Input and Output conditions when controlling

Input Condition	Output Condition
Volume Flowmeter 0 L	Pump ON
Volume Flowmeter 2 L	Pump ON
Volume Flowmeter 4 L	Pump ON

1.1.3 Flowmeter Sensor

The flowmeter sensor wiring system on the Arduino is shown in Figure 6. Each flowmeter sensor has three legs, two of which, vcc and gnd, will be jumped together with vcc and gnd on the Arduino and a 12 volt power supply whose voltage has been reduced to 5 volts. One leg remaining on the flowmeter will be inserted into the digital output port, namely the interrupt pin on the Arduino Mega 2560, namely pin 3 for the first flowmeter, pin 18 for the second flowmeter, and pin 19 for the third flowmeter. Then the results of this flowmeter sensor reading will be displayed on the I2C LCD.

1.2 THE SIMULATION

1.2.1 Testing of the fuel volume monitoring system on Auxiliary Engine

In this research, testing of the fuel volume monitoring system on the auxiliary engine was carried out. The test is carried out in two parts: calibration testing on each flowmeter sensor and actuator used, and system testing that has integrated all its components.

1.2.2 Flowmeter sensor calibration

Testing flowmeter sensor aims to determine the accuracy of the flowmeter readings on the fluid of an object. The test method used is to compare the value issued by the flowmeter through the outseal studio display with a measuring cup of 1000 mL or 1 liter. Ultrasonic sensor testing is followed by calculating the percentage error with the previously described formula, namely

$$1.\% = \frac{1000 - 1329}{1000} \times 100\% = 0,33\%$$

$$2.\% = \frac{2000 - 2656}{2000} \times 100\% = 0,33\%$$

$$3.\% = \frac{3000 - 3858}{3000} \times 100\% = 0,29\%$$

The data obtained in the test can be seen in Table 2.

Table 2: Data from the Test Results for Reading Volume (L) Flowmeter

Test to-	Reading Sensors (L)	Reading Measuring Tool (L)	Error(%)
1	1	1.02	1.96
2	2	2.01	0.49
3	3	3.03	0.99
Average			1,15

Based on the data in Table 1, the average error percentage value on the flowmeter is 1.15%. So, based on the test data, the module used is still feasible to be used in this research.

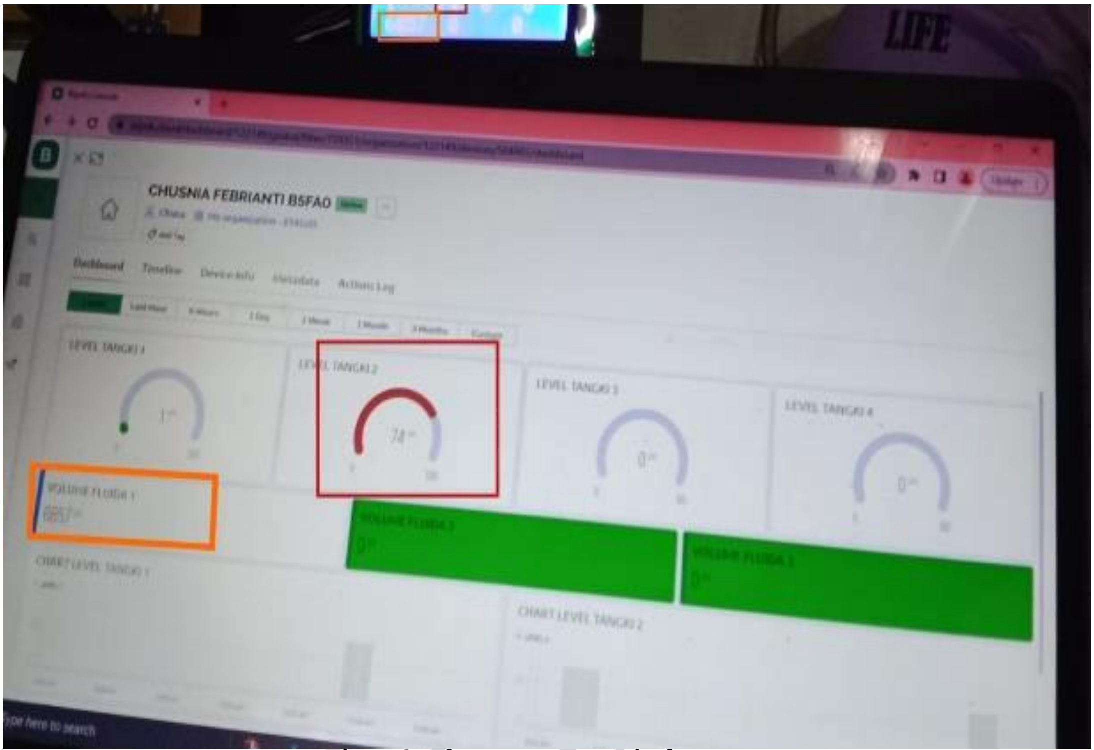


Figure2: Flowmeter Test Display

1.2.3 Flowmeter Reading Time Test Results on Out seal PLC

Table 3: Test Results When Reaching Temperature Set point on the Shared Connection Panel (PHB)

Sensor Value	Time
1	1 minute 58 seconds
2	3 minutes 16 seconds
3	5 minutes 13 seconds

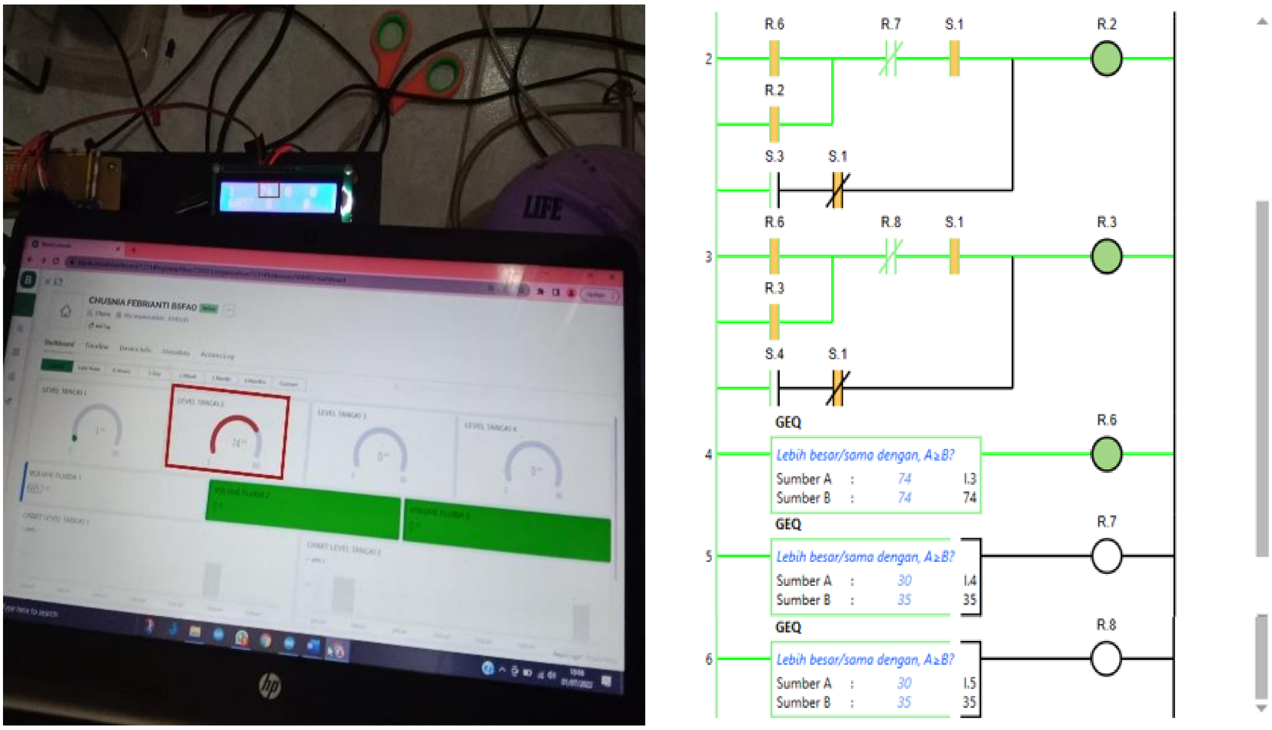
The test results in table 3 show the average per 1L that enters the flowmeter through Out seal, which is 3 minute 29 seconds.

II. RESULT AND DISCUSSION

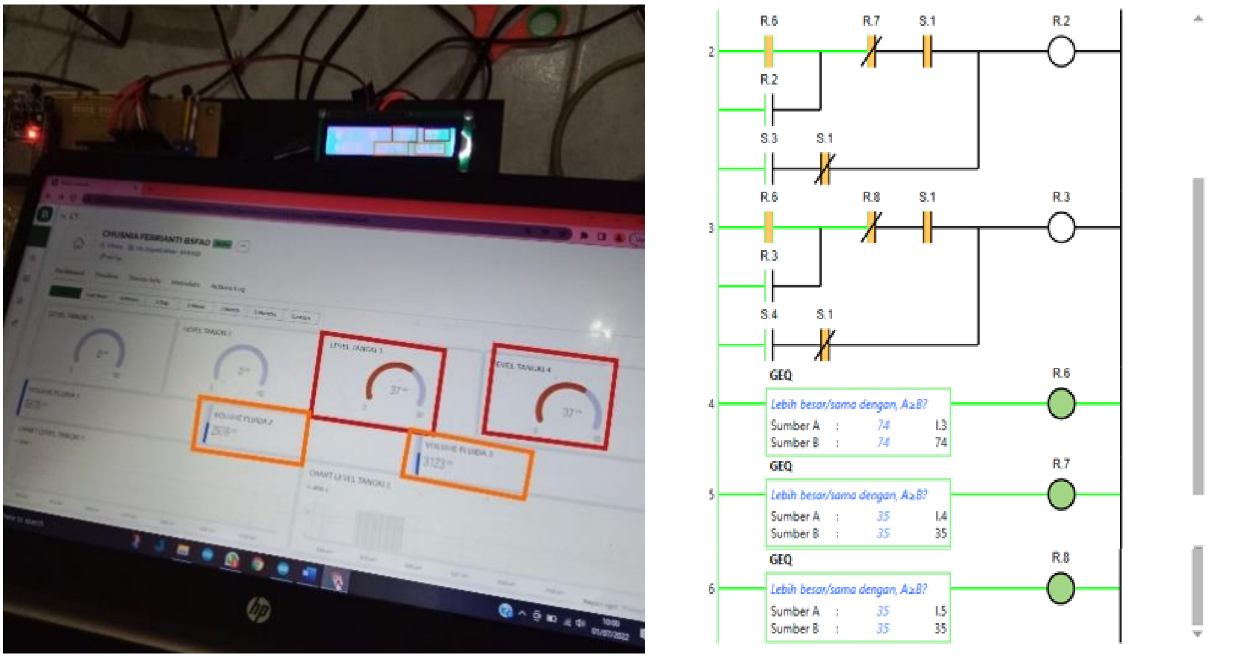
The results obtained are as discussed below

1.3.1 Testing on the maximum level 35 cm

Figures 3 a and b show the logical changes of R7 and R8 as NC contacts, R2 and R3 as NO contacts. Figure 3 a when R7 and R8 are open, R2 and R3 are closed. While Figure 3 b when R7 and R8 are closed, R2 and R3 are open. Figure 3 a is the condition before the sensor detects the fluid level (I4) and (I5) according to the ladder diagram settings in the GEQ Source B instruction, which is 35 cm. While Figure 3 b is the condition of the sensor having detected the fluid level of Source A I4 and I5 according to the ladder diagram settings in the GEQ Source B instruction, which is 35 cm which causes R2 and R3 or pump 2 and pump 3 to die.



(a)



(b)

Fig. 3 (a) (b). Change of R7 and R8 of NC Contact, Change of R2 and R3 of NO Contact

In addition to showing the level and pump conditions, Figure 3 a and b also show the change in the value of the flowmeter. Figure 3 a show the condition of flowmeter 2 and flowmeter 3 that has not been valued, while Figure 3 b shows that flowmeter 2 and 3 have values of 2976 mL and 3123 mL, because the flowmeter has been flowing with fluid.

Based on the results of the calibration test on the input and output, the results of the comparison of readings of all input sensors are 3 flowmeter sensors to read the volume (L) of the incoming fluid from the pump to the flowmeter then the data is processed by out seal to be read to produce an error percentage sequentially, namely 1.15%. While the output in the form of a pump actuator is 0%. Based on Table 3, it is shown that the achievement of time per liter read by the flowmeter is with an average of 3 minute 29 seconds per liter.

III. CONCLUSION

The way to design a prototype for Monitoring Fuel Consumption of Main Engine and Auxiliary Engine Based on Out seal PLC is by using inputs such as switches and flowmeters to generate data values that will be entered into the controller. Then for the controller using arduino mega as the controller of the flowmeter sensor where this level sensor will be an influence on the pump control automatically. While the controller for the switch is an out seal PLC which is programmed on a ladder diagram. Then there is also ESP32 which is a board used for connectors and processors from the Internet of Things that can transmit data in real time. The pump here is the output which becomes the actuator of sending fluid from one tank to another.

The volume value issued by the flowmeter and processed by the outseal can be used as a fuel monitoring container and pump control. Based on the results of the calibration test, it shows that the flowmeter sensor used has an average error of 1.15%. Based on the test results, it can be concluded that the flowmeter sensor can be used as a monitoring of fuel usage on the Auxiliary Engine Ship based on PLC outseal.

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