Prototype of ultrasonic sensor-based generator fuel monitoring as a generator fuel level measuring device in the Organizing Unit Dr. F.L Tobing Airport

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ABSTRACT

Dr. Ferdinand Lumbantobing Sibolga Airport Management Unit has three generators with different capacities. The first engine has a capacity of 50 KvA, the second engine is 125 KvA, and the third engine, which is a standby engine and connected to an Acos panel, has a capacity of 250 KvA. This 250 KvA generator serves as a backup if the power supply from PLN goes out, to provide electricity for the Terminal, Office, AFL, Power house, and Dr. F.L. Tobing Airport Tower. This airport gets a current supply of 345 KvA from PLN. Generators are widely known for acting as a backup power source when PLN is off, used at various scales, including at airports. Genset is important to maintain the availability of electricity in aviation safety services. However, generator fuel monitoring at UPBU Dr. F.L. Tobing needs to be improved, because currently it only uses an indicator hose without a fuel exhaustion alarm. This can result in the shutdown of the generator set when fuel is low, so it is necessary to check the fuel capacity periodically while operating to avoid interruptions in power supply. The research method used is quantitative method.

Keywords: Dr. Ferdinand Lumbantobing Airport, Genset, Quantitative

1. PENDAHULUAN

The increase in the use of electrical energy at Dr. Ferdinand Lumbantobing Airport is a problem that causes large expenditures, especially due to human factors that are inefficient in energy use. Factors such as increased air conditioning use, bad weather, and power outages affect energy consumption. This constraint resulted in increased airport monthly fees. From these data, Dr. Ferdinand Lumbantobing Airport (UPBU) seeks to reduce the use of electrical energy from PLN, the biggest example of electricity waste is the use of Air Conditioner (AC) air conditioning machines and lights that remain turned on even though they are not needed. In fact, AC electricity consumption is above 45%. So it is expected to make innovations that can help overcome electricity wastage. Like the example of the room I saw, namely the airport meeting room located in the main airport office, the room has 2 split air conditioners that continue to turn on outside operating hours and the room is not used. The air conditioner has a capacity of 2 PK which has an electric power of 1780 Watt.

When it is seen that the air conditioner is on for up to 24 hours in one day which means waste occurs at that time. With this, there is a desire to make tools that can overcome this and at the same time develop knowledge and experience in technological developments, especially in the field of airport electricity. The results of the review obtained, there was a desire to raise the problem with the idea of making a tool that helps in efforts to overcome the waste of electricity from air conditioners is not needed due to negligence that occurs in airport offices.

2. METHOD

The research method used is quantitative method. This method is a method of collecting survey data from the data collection process to its interpretation using many numbers or counting processes

3. RESULTS AND DISCUSSION

Dr. Ferdinand Lumbantobing Airport Management Unit has an engineering and operational unit, this unit is in charge of the airport electricity section. Airport Electricity handles several parts, including transmission and distribution to ensure the smooth flow of electricity entering the units in the Dr. Ferdinand

Lumbantobing Airport Management Unit. A generator is a backup power source device that must be within the scope of the airport, which functions to maintain the availability of electric power in aviation safety and security services in accordance with aviation regulations.

In the generator fuel tank at UPBU, Dr. Ferdinand Lumbantobing uses a fuel level gauge using an indicator hose. Using an indicator hose gauge causes the operator not to know how much fuel is left in the tank. So it is not optimal to know the amount of fuel left in the tank that will be used by the generator to operate and there is no alarm / sign when the generator fuel has begun to run out.

The condition of the fuel in the tank changes due to the operation of the generator which must be monitored regularly so that operators must always monitor fuel through the indicator hose, this is not optimal for monitoring. From the above problems, the author wants to make an innovative development in the form of an ultrasonic sensor-based fuel level measuring device that can measure fuel level and has an alarm when the fuel in the tank has begun to run out.

Data related to the problem were taken by conducting field studies, by conducting surveys in the generator room and generator fuel tank located in the UPBU Electricity Unit Dr. F.L. Tobing, and supported by theory from the Literature Study that had been carried out by the author. The data in question are as follows:

- Genset fuel tank
- Generator set fuel level gauge

3.1 Settlement

Table 1 Comparison of fuel height gauges

No.	Tank height gauge current fuel	Tank height gauge Desired
1.		
2.	At this time, the generator fuel level gauge still uses an indicator hose. There was no word on how many litres of fuel were left in the tank and there was no alarm as to when fuel should be carried recharge.	The current prototype that is desired as a generator fuel level gauge is based on ultrasonic sensors programmed through Arduino, this prototype can produce the amount of fuel in liters. And also provides an alarm for charging refuel.

To make it easier to monitor generator fuel, the author is interested in developing innovations such as the design of generator fuel level measuring devices and has an alarm if the fuel has begun to run out. The ultrasonic sensor will read how much fuel is left in the tank and will give an alarm when the fuel reaches the height that has been adjusted according to the programming.

3.2 Prototype Planning

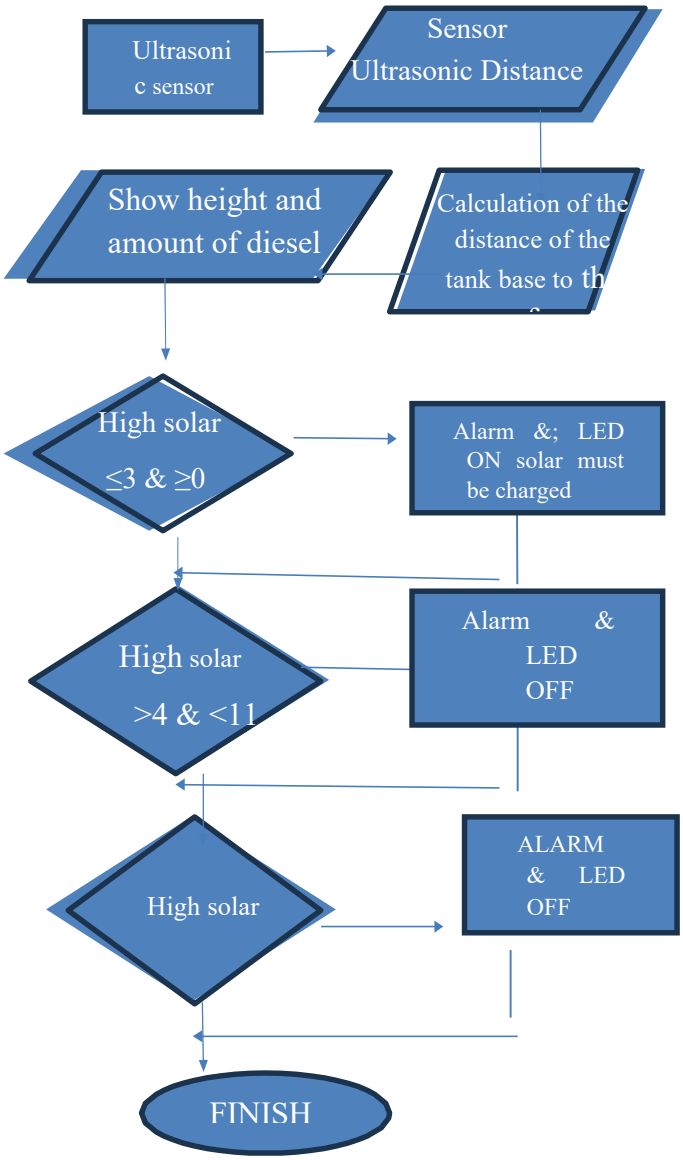

Figure 1 Flowchart

To prototype a tool requires a plan. This planning is useful to find out how later this tool can work optimally. The planning of this prototype is explained in the flowchart above.

Flowchart explanation:

This monitoring system will work on the basis of commands from Arduino Uno, when the tool is turned on, the system will start operating. The ultrasonic sensor HC-SR04 will start measuring the distance from the bottom of the tank to the fuel surface. After the distance is measured, the Arduino Uno will calculate how much fuel (liters) are left in the tank and then the altitude and amount of fuel will be displayed on the LCD screen. When the fuel shows the lowest altitude (adjust to the size of the tank) then the alarm and LED ON, this is a sign that the amount of fuel in the tank must be refilled. And when the height has been adjusted the alarm and the LED will be OFF again.

Arduino Uno is a system that will be programmed to command all components in the circuit or also known as the control center. This Arduino will later control the ultrasonic sensor HC-SR04 and LCD 16x2. Do programming on Arduino Uno R3, adjust programming to your needs. To do programming, connect the Arduino Uno USB cable to a computer or PC.

3.3 Prototyping

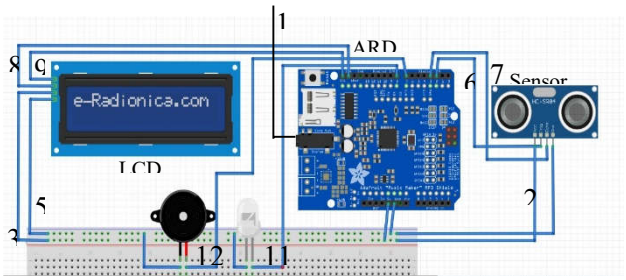

Figure 2 Monitoring System Diagram

The picture above is a wiring diagram of the prototype. The Arduino will get input from the breadboard power supply with output from the 5 V power supply to the input from the Arduino (1). The 5 V output pin from Arduino is connected to the VCC pin on the ultrasonic sensor HC-SR04 (2) and the VCC LCD pin (3). Arduino ground pins are connected to the HC-SR04 ultrasonic sensor ground pin (4) and LCD ground pin (5). Pins 2 and 3 of the Arduino output are connected to the Trig pins (6) and Echo (7) of the HC-SR04 ultrasonic sensor. For SDA (8) and SCL LCD (9) pins, the LCD is connected to the SDL and SDA outputs of Arduino. And continued by pairing the alarm, the LED is connected to the 8 pins of the Arduino output which are adjusted to the programming (10) and ground on the Arduino (11). Then the buzzer is connected to pin 7 which is adjusted to the programming (12) and ground on the Arduino (13). Then connect the adapter using a male DC jack to supply the breadboard power supply (14).

3.4 Prototype experiments

Figure 3 First Attempt

The fuel level gauge measured by the ultrasonic sensor HC-SR04, which currently reads with a height of 12 cm (full). And indicates the amount of fuel remaining in the tank which is 2.12 liters.

Figure 4 Second Attempt

At a height of 3 cm, the alarm and LED will be ON indicating that the fuel will start to run out. And at this time the operator will have to refuel.

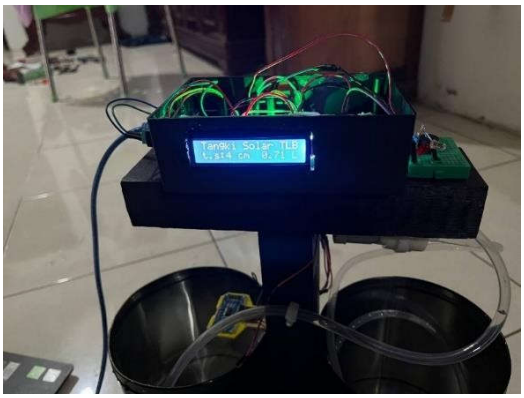

Figure 5 Third Attempt

When the fuel is above 4 cm, the alarm and LED OFF return. The alarm function and LED indicate that the fuel is running low and must be replenished. At each fuel surface height, the prototype also displays how much fuel (liters) is left in the tank. The program is organized inside the Arduino programmer and the fuel volume calculation formula is adjusted to the shape of the tank used to operate.

The following is a comparison table of the amount of fuel in the tank based on theory and monitoring system experiments:

Table 2 Fuel quantity comparison

Fuel level	Amount of fuel (litres)	
	Theory	Experiment tool (mock up)
1 cm	0.17	0.18
2 cm	0.35	0.35
3 cm	0.52	0.53
4 cm	0.7	0.71
5 cm	0.88	0.88
6 cm	1	1.06
7 cm	1.2	1.24
8 cm	1.4	1.41
9 cm	1.5	1.59
10 cm	1.7	1.77
11 cm	1.9	1.94
12 cm	2.1	2.12

4. CONCLUSION

The conclusions that can be drawn from this research are as follows:

1. Make it easy for operators to monitor the amount of fuel (liters) in the generator tank.
2. The operator can receive an alarm from the device to refuel.

ACKNOWLEDGEMENT

Praise to be almighty God who always provides health and aboundant sustenance so that this reasearch can be completed. The authors would like to express their acknowledgment for the support and encouragement received from colleagues and mentors.

REFERENCES

[1] Book of Standard Operating Procedure (SOP) for Electrical Engineering, Airport Operator Unit Dr. Ferdinand Lumbantobing.

[2] Cyntia Widiasari, S.ST.T., Putri Insani, A.Md, and Muhammad Diono, S.ST, M.T., Jurnal Elementer, Sistem Monitoring Tank, (Caltex Polytechnic | Riau).2019.

[3] Rina Mardiati, Ferlin Ashadi, Geusan Farid Sugihara, Design a Prototype of a Safe Distance Warning System on a Four-Wheeled Vehicle Based
on Microcontroller ATMEGA32, (Sunan Gunung Djati State Islamic University). 2016.

[4] Putra Stevano Frima Yudha and Ridwan Abdullah Sani, Journal of einstain, Implementation of Ultrasonic Sensor Hc-SR04 as an Arduino-Based Car Parking Sensor, (Medan State University). 2017.

[5] Andi Adriansyah Oka Hidyatama, 2013, JurnalTelka, Design an Elevator Prototype Using Arduino Atmega 328P Microcontroller, (Sunan Gunung Djati State Islamic University.). 2013,

[6] Mutmainnah, Imam Rofii, Misto, Dewi Ulul Azmi, 2020, Jurnla theory and application of physics, Electrical and Optical Characteristics in LEDs and , (Jember University).2020.

[7] Gani, Danial, 12 Volt circuit and its functions. (Gorontalo State University). 2013.

[8] Didik Aribowo, Desmira, Danan Ahlan Fauzan,, Genset Engine Maintenance System at Pt (Persero) Pelabuhan Indonesia II (Sultan Ageng Tirtayasa University). 2020.

[9] Lucky Aggazi Subagyo, 3-phase unbalanced current monitoring system based on Arduino Uno (Surabaya State University). 2017.

[10] Budi Saputro, Generator Set Reliability An alysis "as an emergency power supply if the power supply from PLN suddenly goes out at Morodadi Poultry Shop Blitar, (Balitar Islamic University). 2017.

[11] Tianur, Fauzi Ramdan, Hendriko, Jajang Jaenudin, Measurement of Fuel Soaking Tank Volume Using Circle and Tembereng Area Method, (Riau Caltex Polytechnic). 2022.