Prototype *Engine Fire Protection System* berbasis *Microcontroller Arduino Uno*

M. Ade Lucky Saputra*, Suseno, Gunawan Sakti

Politeknik Penerbangan Surabaya, Jemur Andayani I/73 Wonocolo Surabaya, East Java, Indonesia, 60236
**Corresponding Author. Email: madeluckysaputra@poltekbangsby.ac.id*

Abstract
The engine is part of the aircraft as a generator of thrust and a source of power for systems on the aircraft such as electricity and pneumatics. Seeing the density of components and systems installed on the engine, this makes the engine a zone that is considered a potential fire. In the hangar of the Surabaya Aviation Polytechnic, there are several shortcomings of props to support the learning of aircraft system material, one of which is about engine fire protection, from previous research there are learning tools but they are still incomplete in their perceptions. Complementing previous research that is still not suitable, especially in the extinguisher system section, and to help improve the quality of learning in the Surabaya Aviation Polytechnic hangar with data analysis carried out by giving a questionnaire form sheet to cadets who participate in prop testing techniques. It is hoped that the design of this tool can facilitate understanding in learning about fire protection, and can complement the shortcomings of previous research. The research of the arduino uno microcontroller-based engine fire protection system props was obtained from comparing the data obtained in the test results related to the effect of using props as a learning tool. For quantitative data calculation using the formula mean / average value given between learning that uses teaching aids and those that do not use teaching aids. The comparison results used are the absorption of understanding of aircraft system material, especially on engine fire protection system material when using props or practie doing is more effective by getting an average value of 8.21 compared to learning by not using props or only visually getting an average value of 7.1.

Keywords: Fire protection, Arduino Uno, Learning pyramid, Surabaya Aviation Polytechnic.

INTRODUCTION

Engine is part of an airplane as a thrust generator and a power source for system systems in airplanes such as electrical and pneumatic. The fire detector on the engine is installed in the fan case compartment in the upper fan case, lower fan case, left core section and right core section with fire detection temperature characteristics of 304^0 C on Boeing 737NG aircraft.

There are several shortcomings of props to support learning in the Surabaya Aviation Polytechnic hangar, one of which is about fire protection, especially in the engine section, The possibility of a fire on an aircraft, especially in the lower fan case engine compartment which can damage the main engine control components, is the background for making this engine fire protection system practicum props and by completing previous research which is still not in accordance with what it should be, especially in the extinguishing section.

Saputra et al, (2019), Designing engine fire protection props, the research uses thermocouple sensing which is used to detect the temperature in the engine compartment, the basis of oxygen subtisution and or breaking the chain reaction, namely dry chemical flour or CO, therefore water proves less effective for extinguishing gas type fires, water is more effectively used to extinguish class A fires, namely solid material fires except metals, such as wood, textiles, paper, plastic, rubber and others Proceedings.

A simple prototype of a semi-automatic engine fire protection system. This system uses thermocouple type k temperature sensors installed on the upper fan case and lower fan case to determine the temperature and indicate overheating if the temperature on the upper fan case or lower fan case reaches ≥60.80°C, indicating a fire if the temperature on the upper fan case or lower fan case reaches ≥80.00°C.

METHODS

Tool Design

The creation of this design is expected to increase time efficiency, increase understanding, and can facilitate

learning, especially during practicum by providing a visual explanation of the engine fire protection system found on the aircraft.

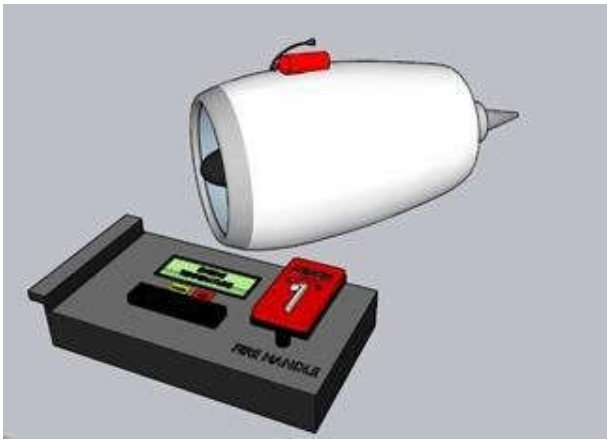

Figure 2. 1 3D Design

Tool Works

The condition of all circuits is in standby. Based on Figure 3.3 The source of the circuit comes from a DC 5 V 3 A power supply. Fire and overheating arise in the engine prototype which is assumed to be the engine room then one of or both sensors receive fire and heat input. the input is sent to the Arduino and processed then the data is sent to the light indicator lights up and the buzzer sounds. Use the fire handle to activate the fire extinguisher in the form of a halon which is a portable light fire extinguisher.

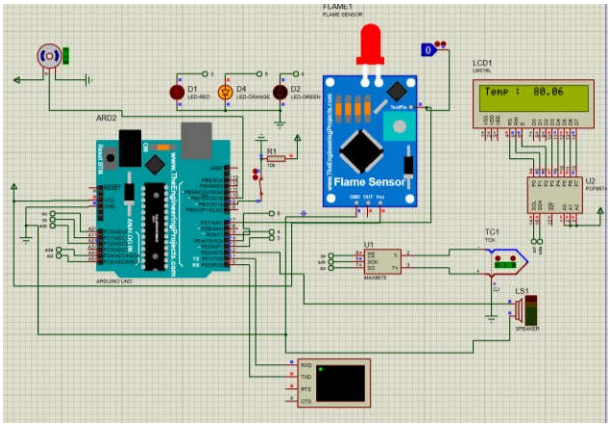

Figure 2. 2 Wiring Diagram

Data Analysis Technique

In the data analysis technique, the author states that engine fire protection with Arduino Uno microcontroller is successful if the tool functions perfectly and all components are connected perfectly without any obstacles. The engine fire protection tool with the Arduino Uno microcontroller is declared a failure if the discharge button is pressed without extinguishing the heat sensor of a room in the engine. The next method is with a questionnaire as a learning media in the form of questions in a questionnaire which will be the average percentage of learning success using props and without using props. The results of the final score will be processed and recapitulated in the form of a reporton the percentage of the average value of both learning using props or without using props.

RESULTS AND DISCUSSION

The results of the research on testing the arduino uno microcontroller-based engine fire protection system props were obtained from comparing the data obtained from the test results related to the effect of using props as a learning tool. The comparison used is the absorption of understanding of aircraft system material, especially on engine fire protection system material. when using props compared to not using props. For quantitative data calculation using the formula mean / average value given between learning using props and not using props.

Learning Data Without Tools

The data was taken on Sunday, April 2, 2023 with the following data:

Total sample size (all TPU cadets level 1 and 2) : 42

$$\text{Mean} = \frac{1(6+6+6+5+10+7+6+10+7+7+7+8+10+9+7+7+7+7+7+8+7+7+7+10+6+7+7+6+7+10+10+6+7+7+7+8+7+9+10+5+5)}{42}$$

$$= 7{,}1$$

The average score of cadets when learning the engine fire protection system without using props is 7.1

Learning Data Using Tools

The data was taken on Friday, Wednesday, April 4, 2023 with the following data:

Sample size (all level 2 TPU cadets): 42

$$\text{Mean} = \frac{1(6+6+6+5+10+7+6+10+7+7+7+8+10+9+7+7+7+7+7+7+8+7+7+7+10+6+7+7+6+7+10+10+6+7+7+7+7+8+7+9+10+8+7+5+5)}{42}$$

$$= 8{,}21$$

The average score of cadets when learning the engine fire protection system using props is 8.21.

Based on the results of the comparison of the value of cadets when using tools without usingprops is very influential. Where the average value ofcadets when learning the Engine Fire Protection System without using tools is 7.1 while the averagevalue of cadets when learning the engine fire protection system using tools is 8.21.

Data from Tool Testing

The results of the research on the testing of the Engine fire Protection System props areobtained from testing whether the Engine fire Protection System props have worked in accordancewith the instructions or not, and in their operation there are problems or not. obtained the following data:

Table 3. 1 Tool quiz table

NO	DESIGN	CONDITIONS	RESULTS	NOTE
1	Arduino powered by 5v 3a power supply	OK	ACCORDING	
2	Normal temperature LED green, which informs you that the engine temperature is normal.	OK	ACCORDING	Led Geen (normal temperature)
3	Arduino runs according to the program and doesnot error.	OK	ACCORDING	Led Geen
4	Temperature overheat indicator >34.8°C on, the orange (amber) led lights up indicating there is overheat in the engine area.	OK	ACCORDING (120 seconds)	Led orange ENG OVHT
5	The temperature overheat indicator is <34.8°Coff, in which case the orange (amber) led is not lit, indicating there is no overheat in the engine area.	OK	ACCORDING (20 seconds)	Led orange (Eng Fuel Cut off)
6	LCD that serves to display temperature details and inform what is happening.	OK	ACCORDING	Led Green (normal temperature)
7	The fire indicator at <60.8°C is off, the red led is not lit, indicating there is no fire in the engine area.	OK	ACCORDING (180 seconds)	Led Red (FIRE WARN)
8	The fire indicator at a temperature of >60.8 ° C is on, the red led lights up, indicating a fire in the engine area and the Buzzer/Speaker signals that a fire has occurred in the form of a warning bell sound.	OK	ACCORDING (quick time)	Led Red (FIRE WARN)
9	Switch discharge on by pulling out for engine fuel cut off, and switch turn left moves the servo to spray fire extinguishing on the area where the fire occurs.	OK	ACCORDING (10 seconds)	Engine Fuel Cut off
10	Fire extingushing extinguishes the fire which is assumed to be a temperature of> 60.8 ° C, when it is extinguished, the temperature will return to normal, namely < 60.8 ° C degna marked green led lights up.	OK	ACCORDING 20 seconds	Led Geen (normal temperature)

In step 2 when the arduino is given a 5v power supply, then the normal temperature is green, in this tool in the form of a green LED light. Which functions to inform that the temperature in the engine is normal.

In steps 4 and 5 the overheat indicator at temperatures >34.8 ° C will be on, in this case the orange (amber) led lights up which serves to indicate there is overheat in the engine area. The overheat indicator at a temperature of <34.8 ° C will be off, in this case the orange (amber) led does not light up, which serves to indicate there is no overheat in the engine area.

In steps 8 and 9 the fire indicator at temperatures >60.8 ° C will be on, in this case the red led lights up, which serves to indicate a fire in the area inside the engine and the Buzzer/Speaker on this prop is used to signal that there is a fire in the form of a warning bell sound. The discharge switch is on by pulling up for engine fuel cut off, and swipe left to move the servo and spray fire extingushing on the area where the fire occurred.

Emergency. During an emergency, the fuel shut-off valve switch is turned on to stop the fuel flow from running normally as desired.

In the 10th step, the servo moves the Fire extingushing to extinguish the fire which is assumed to be a temperature of> 60.8 ° C, when it is extinguished, the temperature will return to normal, namely < 34.8 ° C with a green led marked on.

Figure 3. 1 Tool Design

CONCLUSION

From all the tests and measurements of the design, the following conclusions can be drawn:

1. With this props, learning on engine fire protection sytem becomes easier to understand and practice.

2. This series of props is more effective than the use of learning only by imagining how a fire occurs in the engine then the sensor will send information to the cockpit which will then be extinguished through panels in the aircraft cokpit, because you can know how the sensor process receives temperature and is read by the Arduino which is displayed through the LCD so that it is easier to understand easily.

3. Engine Fire protection system is used to detect early in the event of a fire trigger by installing a k type thermocouple sensor which is placed in the lower section will detect a fire warning temperature of ≥60.8˚C which is connected to the LED and buzzer as an indicator.

4. In this system prototype, the fire extinguisher is a 0.5 kg light fire extinguisher manually using a servo to be able to reduce the temperature sensed by the sensor after detecting the fire warning temperature.

REFERENCES

[1] Mulyono joko, Djuanidi, Esa Apriaskar (2021) Simulation of fire alarm using Mq-2 sensor, Arduino Microcontroller Based Flame Sensor. Semarang State University, Scientific Journal of electronics and computers, vol 14. No 1, July 2021,pp.16-25.

[2] Bagas Dwi O.S, Rudi Fikus Prihanto, Sri Lestari (2019) Engine Fire Protection System Props Design Aviation Polytechnic Surabaya, Aviation Polytechnic Surabaya. ISSN: 2548-8090.

[3] Irkhamna Rizki Desi, (2021) Analysis of Fire Protection Systems using flame and Heat Detector in scada-based storage tanks in the construction of large bamboo production facilities at PT Pertamina EP BBS and ABG Development Project, Gadjah Mada University.

[4] Zain Abdul (2016), Design of Fire Protection System Using Smoke Detector and Heat Detector, Bontang College of Technology, Journal INTEK, Volume 3 (1): 36-42