BEST
Journal of Applied Electrical & Science Technology - University of PGRI Adi Buana
p-ISSN 2715-2871
e-ISSN 2714-5247

EXPLOSIVE DETECTOR DESIGN TO KNOW THE EXISTENCE OF EXPLOSIVE MATERIALS BY COMPARING THE LARGE VALUE OF MEDNET MAGNET USING ARDUINO IN JUANDA AIRPORT AREA

Atmiasri*, Gesang Fajar Rahmawan
Department of Electrical Engineering
University of PGRI Adi Buana Surabaya
*Corresponding email address: atmi.asri@yahoo.com

Abstract — The design of this explosive detector is an alternative low-cost explosive detector device that can detect the presence of explosives by comparing the value of the magnetic field so that an object will be known to be an explosive or not. This tool can provide additional assistance in the Juanda airport area which still rarely uses conventional explosive detector equipment because the price is still expensive. This design uses a magnetometer sensor that can calculate the magnitude of the magnetic field in the explosives and will send analog inputs in the form of voltage values to the Arduino displayed with LCD media and sound from the buzzer so that the category of explosives can be detected.

***Keywords: explosive detector, arduino, magnetic field, magnetometer*.**

I. INTRODUCTION

Based on the International Air Transport Association (IATA) in the Dangerous Goods Regulation and Annex 18 concerning The Safe Transport of Dangerous Goods by Air, it is explained that there are some goods or materials which are not allowed to be transported by airplane. Goods or materials that allow danger to the health, safety or property of passengers when transported by airplane. Therefore, it is necessary to check passenger luggage before being put on the plane, one of which is using the Explosive Detector [1], [2], [3].

Explosive Detector is a device designed to detect the presence of explosives in aircraft passengers and goods to be transported on aircraft [4]. Explosive detector is able to detect the presence of vapor and explosive particles. When explosives are detected, the equipment will automatically give an alarm in the form of sound, graphics and text [5]. However, this equipment is still rarely used in Indonesian airports because the price is still expensive.

Based on the above problems, then an idea arises to make an explosive detector design at a more affordable cost by using a magnetometer sensor to compare the magnitude of the magnetic field in the explosives [6], [7]. This design is connected with a power supply of 5 Vdc that comes from a 220 Vac PLN voltage that has been changed by the power supply circuit. magnetometer as a sensor calculating the magnetic field on explosives sends analog inputs in the form of voltage values to Arduino [8] [9]. While the Arduino output is connected to the LCD and buzzer to display the magnitude of the magnetic field, the category of explosives that are detected and the output in the form of sound.

II. RESEARCH METHODS

The trick is to connect Arduino to the power supply that comes from a 220 Vac PLN voltage which will be converted to 5 Vdc by the power supply failure. The magnetometer as a sensor calculating the magnetic field on an explosive sends analog input in the form of a voltage value to the Arduino. Arduino will compare the magnitude of the magnetic field received from the magnetometer sensor with a program that has been made to determine the classification of explosives. Output of Arduino connected with the LCD and buzzer to show the results of a large magnetic field and category of explosives were detected and sound output.

III. RESULTS AND DISCUSSION

In this section, the test data was collected at the time of testing on the explosive detector using

p-ISSN 2715-2871
e-ISSN 2714-5247

3 types of explosives. The data is presented in tabular form. Among the test results are:

3.1. Power Supply Testing

Supply voltage obtained from a voltage of 220 Volt AC obtained from source PLN. Power supply circuit can change the 220 Vac Input voltage to Output 5 Vdc. Output 5 Vdc will be an Arduino voltage input of 5 Vdc. To find out the magnitude of the power supply voltage in accordance with the provisions it is necessary to test it before it is used on research equipment. Tests carried out using a multimeter.

Table 1. Power Supply Test Result

Calculation	Measurement	Explanation
5 Volt	4,9 Volt	Near

3.2. LCD testing (Liquid Crystal Display)

LCD testing is done to find out the work of the LCD in displayingcharacters or data in accordance with the planned program. The LCD is mounted on the PORT DIG 2, 3, 9, 10, 11, 12 on the I2C 1602 serial module which is later connected to arduino.Testing is done using a multimeter by connecting the red multimeter probe with the LCD 2 pin or Vdd pin and the black probe with pin 1 or ground pin. If the voltage value indicated by AVO is 5 volts, the device is in normal condition.

Table 2. LCD Test Result

Calculation	Measurement	Explanation
5 Volt	4,9 Volt	Near

3.3. Testing I2C 1602 Serial module

This test is I2C 1602 Serial Module to find out the performance of the module itself instead of serial data from the LCD into digital data that will be connected with Arduino. The voltage on the I2C 1602 Serial Module can be measured on vcc and ground using a multimeter. Measure the voltage generated by connecting the red multimeter probe with the vcc module and the black probe with ground. If it shows a 5-volt voltage, the module is in normal condition.

Table 3. I2C Serial Module Test Result

Calculation	Measurement	Explanation
5 Volt	4,9 Volt	Near

3.4. Buzzer Testing

Buzzer testing is conducted to determine the performance of Buzzer in producing sound output in accordance with the planned program. In designing this tool, Buzzer is installed on PORT DIG 5. Testing is done by inserting a microcontroller program with the Buzzer measurement program using the Arduino application first, then connect Buzzer with Arduino via PORT DIG 5 on the design of the tool in accordance with the program and connect the power supply. Here are the results of table-shaped tests, namely:

Table 4. Buzzer Test Result

Input	Buzzer Output	Explanation
Low	OFF	Correct
High	ON	Correct

3.5. Testing the value of ADC (Analog to Digital Converter)

ADC value testing is carried out in order to find out the voltage conversion results using the ADC (Analog to Digital Converter) program on the Arduino application. In designing this tool, using ADC with a resolution of 10 bits.

In the ADC measurement in the design of this tool the resolution used is 10 bits, so the quantity level is as follows:

Quantity Level = 2^n, where n = Resolution (bit)
N = 10-bit, Quantity Level = 2^{10}=1024

To convert the ADC (Analog to Digital) form to voltage using the following formula:

$$\text{ADC Value} = \frac{\text{Voltage generate (Volt)}}{\text{Quantity Value 1024}} \times \text{V reference}$$

In this ADC measurement using a 5-volt reference V, the calculation results from the LCD display (Arduino program) will be compared with the measurement results using an Avometer/multimeter.

Table 5. ADC Arduino Test Result

Magnetic Field value	ADC Calculation value	ADC Calc. in Serial Monitor	Explanation
0 Gauss	474	475	Near
0,27 Gauss	476	476	Near
0,53 Gauss	478	477	Near
1,06 Gauss	480	479	Near

p-ISSN 2715-2871
e-ISSN 2714-5247

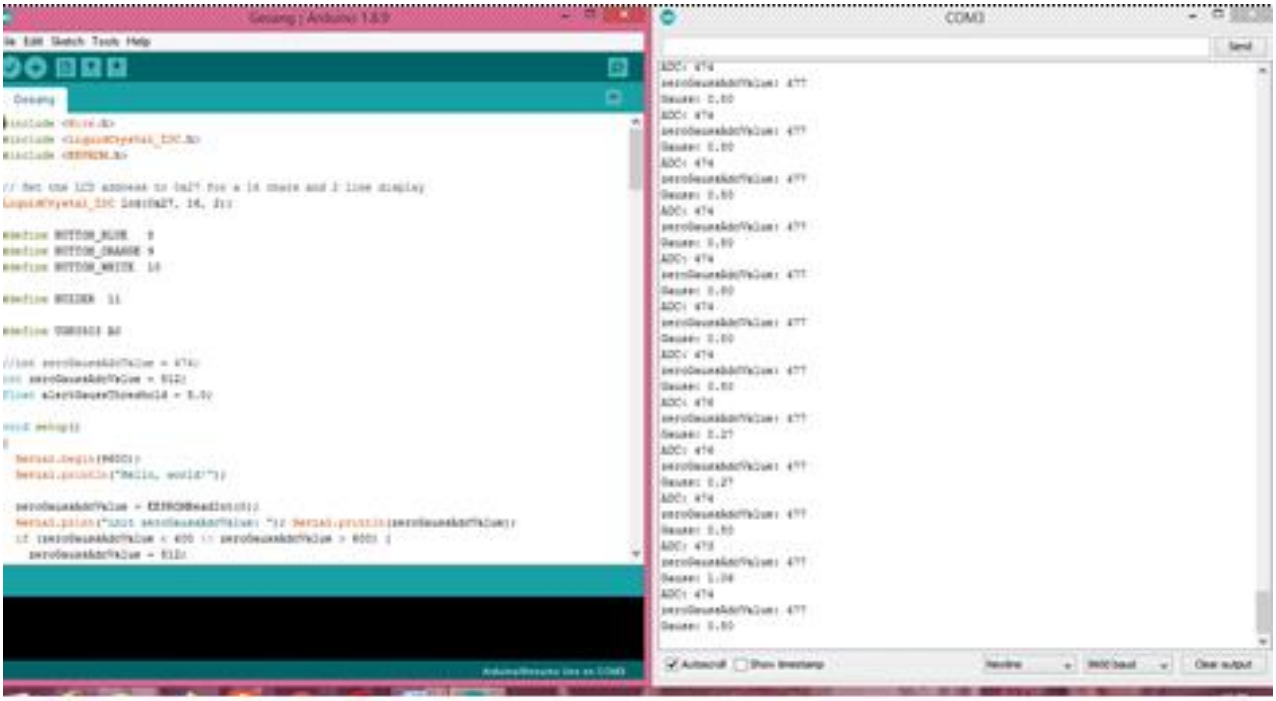

Figure 1. Sensor voltage value, fluk density value, and ADC value serial monitor software Arduino

3.6. Testing Magnetometer UGN3503

Sensor testing was conducted to determine the ability of the UGN3503 magnetometer sensor to detect the magnitude of the magnetic field on the explosive test material used in the Explosive Detector. In the process of measuring sensors using test materials in the form of firecrackers that have different magnetic fields so that explosives will be categorized as A, B or C. The output from the detection process by the sensor in the form of ADC values will be compared based on the database that has been programmed. With the existing ADC value classification will be based on the amount of ADC value. Then the ADC value will be sampled to determine the category of explosives, where the magnitude program of the magnetic field category Low 0 - 0.53 Gauss, Medium 0.54 - 0.80 Gauss and High is more than 0.81 Gauss.

Table 6. Sensor Test Result

Test Materials	Display LCD	Explanation
A	0,53 Gauss	Low
B	0,80 Gauss	Medium
C	1,06 Gauss	High

3.7. Data Analysis

From the results of the 6 tests above, the writer can do the analysis as follows:

1. Power Supply Analysis

Testing on the power supply circuit aims to measure the amount of voltage needed by Arduino as a place of data processing. The required voltage is 5 Vdc. After measuring the power supply circuit, the output voltage for power supply ranges from 4.88 Vdc to 5.04 Vdc.

2. LCD Analysis (Liquid Cristal Display)

On the 16x2 LCD datasheet the Input Voltage value on pin 2 or VDD pin is 5 Vdc while the measurement on the LCD uses AVO meter by connecting the red AVO meter probe to pin 2 or LCD VDD pin and the black probe with pin 1 or GND pin shows a large voltage 4.9 Vdc. This shows that the value on the datasheet with the measurement value on the AVO meter is approaching.

3. Analysis of I2C 1602 Serial module

In the I2C 1602 Serial Module Operating Voltage datasheet of 5Vdc while the measurement on the LCD uses an AVO meter by connecting the red AVO meter probe to the VCC pin and the black pin GND probe shows a voltage of 4.9 Vdc. This shows that the value on the datasheet with the measurement value on the AVO meter is approaching.

p-ISSN 2715-2871
e-ISSN 2714-5247

4. Buzzer Analysis

Based on the results of the Buzzer test, when Input is low, the Buzzer does not sound while when Input is High, the Buzzer will sound. This means Buzzer works normally.

5. Analysis of ADC (Analog to Digital Converter) values

Comparison between the results of the voltage calculation approaches the measurement results using a multimeter/Avometer as well as reading the ADC value and LCD display. This shows that the ADC program found in Arduino works in accordance with the planned program.

6. Analysis of UGN3503 Magnetometer Sensor

The data in table 4.6 is the measurement data on the test material which in the table shows the magnitude of the magnetic field of each test material and its category. Where material A 0.53 Gauss is the Low category, material B 0.80 Gauss is the Medium category and C material 1.06 Gauss is the High category. This shows that the UGN3503 Magnetometer Sensor operates well because it is able to censor large magnetic fields of a ferromagnetic material or magnetic material with a small difference and is able to be transformed into a voltage with a small difference so that it can be said the UGN3503 Magnetometer sensor has good sensitivity. For the maximum distance measurement from the UGN3503 magnetometer sensor is 10 mm.

IV. CONCLUSION

Based on the results of planning design explosive detector to know the existence of explosives by comparing large magnetic field values using Arduino in Juanda airport area:

1. Explosive Detector design can detect the presence of low explosive types of explosives (firecrackers) and can distinguish types of explosive test materials A (Low 0.1-0.53 gauss), B (Medium 0.54-0.80 gauss) and C (High 0.81> gauss).
2. UGN3503 magnetometer sensor can be used as a detection of Dangerous Goods in the form of explosive heating
3. The detection system of alatin uses a UGN3503 magnetometer sensor wherein to detect the material, it needs a large amount of magnetism and magnetism from the edible material.

ACKNOWLEDGMENT

Acknowledgments and awards need to be conveyed to PGRI Adi Buana University Surabaya Faculty of Industrial Technology especially the Electrical Engineering study program, which has provided laboratory facilities for the completion of writing this article.

REFERENCE

[1] Carver, Kraus 1973 *Electromagnetics*. Tokyo Japan, Kosaido Printing CO.LTD.

[2] Coey, J.M.D 2009 *Magnetism and Magnetic Materials*, Cambridge University Press.

[3] Djuandi, Feri 2010 *Pengenalan Arduino,* Free Book Online.

[4] Fordham, S. 1980 *High Explosive and Propellants.* Pergamon Press.

[5] Gardner, Julian W. 2003 *Electronic Noses and Sensors for the Detection of Explosives.* Springer-Science+Business Media.

[6] Hall Effect Sensing and Application. Honeywell

[7] Meyer, Herbert W. 1972 History of Electricity and Magnetism. Burndy Library.

[8] Wohlfarth, E.P. 1980 *Handbook of Ferromagnetic Materials.* North Holland.

[9] Rochman, Sagita, and Budi Prijo Sembodo. "Rancang Bangun Alat Kontrol Pengisian Aki Untuk Mobil Listrik Menggunakan Energi Sel Surya Dengan Metode Sequensial." WAKTU 12.2 (2014): 61-66