Design And Development Of A Portable Alcohol Testing Device For Motorists

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Abstract.

This research aims to design and develop a portable alcohol testing device that can be used to check whether prospective drivers have consumed alcohol before driving. The device is designed with the goal of improving road safety by reducing the risk of accidents caused by intoxicated drivers.In this study, we used the Figaro TGS 2620 alcohol sensor. The device is also equipped with a 16x2 LCD that displays test results directly and accurately. Additionally, we added indicators in the form of LEDs and a buzzer for signaling. The device we designed utilizes an Arduino UNO microcontroller.The test results and evaluations indicate that the portable alcohol testing device can respond to changes in alcohol levels around the sensor. When subjected to a non-alcohol condition, the device shows an average voltage reading of 0.69 V, whereas when subjected to the presence of alcohol, the device exhibits an average voltage reading of 3.97 V.

Keywords: *Alcohol, alcohol sensor, arduino uno, buzzer and voltage.*

I. INTRODUCTION

Intoxicated drivers, who seriously and persistently jeopardize road safety [1]. Research results indicate that around 20 to 30 percent of drivers who have previously driven under the influence commit repeat offenses. Due to their repeated violations and high blood alcohol levels, their contribution to traffic accidents is significantly more substantial than it should be [2]. Although awareness of the dangers of driving under the influence of alcohol has increased over the last few decades, tragic incidents that still occur emphasize the need for further measures to prevent this practice. When addressing cases of drunk driving behavior, detecting the level of alcohol in a driver's body is the primary method to determine whether the driver is driving under the influence or not [3]. In the effort to enhance road safety, there is a need for innovation in designing and developing a portable alcohol testing device that can be used by prospective drivers before they commence their journey.The use of this portable alcohol testing device will assist prospective drivers in measuring the alcohol content in their bodies before they embark on driving. This can reduce the risk of traffic accidents caused by alcohol-consumed drivers. Furthermore, the portable alcohol testing device can also serve as an effective tool in enforcing laws related to driving under the influence of alcohol.Previous related research has been conducted, such as the design of an alcohol breath detector using Arduino Nano [4]. This study utilized an MQ-3 alcohol sensor in the design of a similar device. Another similar study also employed an MQ-3 alcohol sensor and integrated its system with a smartphone [5].In this research, different types of alcohol sensors will be utilized, specifically the Figaro TGS 2620 sensor.

In previous studies, the Figaro TGS 2620 sensor has been employed for monitoring alcohol gas in the rice fermentation process [6], detecting alcohol in urine [7], supporting the purification of bioethanol [8], and more. Based on one of the studies, the sensor's performance is closely related to the temperature and humidity conditions in the testing environment [8]; hence, a special enclosure is necessary to ensure that the sensor operates at an optimal level. This research also uses the Arduino Uno microcontroller. The Arduino Uno microcontroller can be utilized to control various electronic devices and perform various tasks with sensors that can sense physical phenomena [9], [10]. In this study, Arduino Uno is used as an integral part of the portable alcohol testing device that can be applied for motor vehicle drivers.The Figaro TGS 2620 sensor will be used to detect alcohol from human breath in this research. The testing conditions for the constructed device are tailored based on previous studies. Additionally, the device will be equipped with a 16x2 LCD,

LED, and buzzer to provide users with more interactive and clear test results. The use of the Arduino UNO microcontroller will also facilitate the integration and development of software that supports this testing device.This research aims to create a more holistic and effective solution in preventing intoxicated drivers from being on the road and to raise awareness of the dangers of drunk driving. This research is expected to contribute to larger efforts to ensure road safety and reduce the negative impacts of alcohol in driving.

II. METHODS

The tools and materials

The design and construction of a portable alcohol testing device for motorcyclists require various tools and materials, including Arduino, jumper cables, a breadboard, a 16x2 LCD with a 16062 Blue Backpack, LED, alarm buzzer, voltage sensor, TGS2620 sensor, a 1K resistor, a battery, and alcohol-containing beverage samples. The steps in designing an alcohol level detector for motorcyclists are as follows: conceptualizing the detection of alcohol levels in breath using the TGS2620 sensor, designing the hardware and software components, conducting experiments to measure the detected alcohol levels, and calculating the average sensor readings before and after subjecting it to alcohol exposure.

The hardware design

Arduino UNO

The design of the alcohol detection system with Arduino functions as a data processor. The system can be seen in Figure 1. The circuit utilizes the TGS2620 sensor, where its resistance value is read by a voltage sensor, then processed using a microcontroller, and the value is displayed on the 16x2 LCD. It also includes alarm indicators and LEDs that operate based on certain parameters.

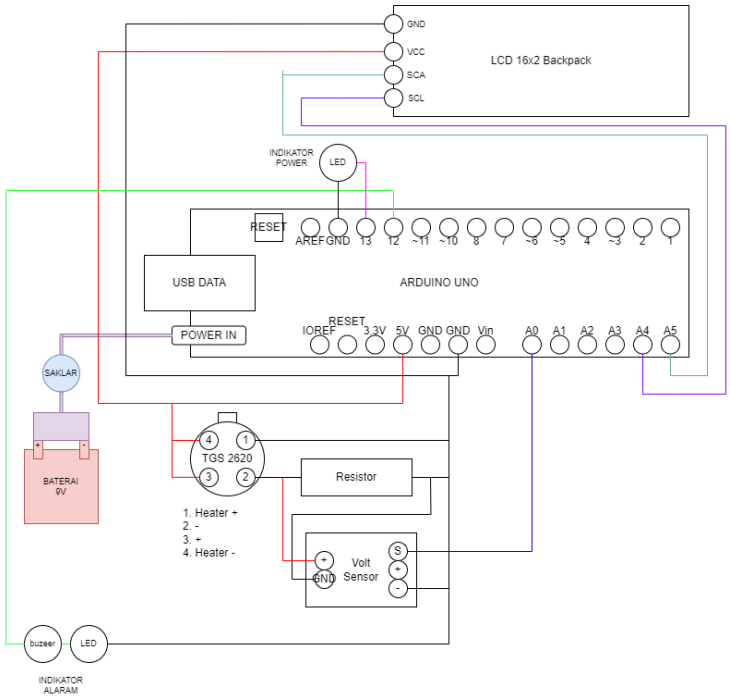

Fig 1. The diagram design of the system

Connection of the TGS2620 Sensor with the Voltage Sensor

The TGS2520 sensor has 4-pin legs, with the (-) pin connected to a resistor before being connected to the ground. The input of the voltage sensor is connected to both ends of the resistor to monitor the voltage passing through the resistor. The other leg (+) of the TGS 2520 sensor is connected to the 5V pin of the Arduino, and the heater is connected to the 5V pin and GND pin.

Connection of the Voltage Sensor with Arduino

The Voltage Sensor has 3 pins: S, (+), and GND. The S pin is connected to the analog A0 pin, and the GND is connected to the GND pin. The (+) pin on the voltage sensor is not used because the circuit does not require additional power.

Connection of the 16x2 LCD Backpack IC with Arduino

The 16x2 LCD Backpack IC has 4 pins: VCC, GND, SDA, and SCL. VCC and GND are the pins to operate the display, while SDA and SCL are the data pins to visualize data, and they are connected to the A5 and A6 pins on the Arduino.

Connection of the Buzzer and LED with Arduino

The buzzer and LED are used to facilitate the measurement of alcohol levels. When the levels reach a predefined threshold, the buzzer and LED will operate. The buzzer and LED are placed on pin 12 simultaneously.In this study, the first step is that the flow of breath will be detected by the TGS2620 sensor. If alcohol gas is detected, there will be a change in resistance, which will be read by the voltage sensor and then transmitted through the Arduino. The Arduino will process and visualize this value on the 16x2 LCD.Data management on the Arduino involves filtering the resistance values and performing operations if the resistance value exceeds or falls below the specified parameters.

III. RESULT AND DISCUSSION

The design process involves experimentation to determine the upper and lower limits for detecting the alcohol content in breath. The TGS 2620 sensor can detect various types of gases other than alcohol, such as methane and others. The variety of gases results in different resistance values compared to alcohol. Parameter measurements are carried out in two stages: measurement before the sensor is exposed to breath and after being exposed to breath. In the first measurement, the resistance of the TGS2620 sensor is measured before exposure to alcohol breath. In the second measurement, medical alcohol with a 70% alcohol content is used, and the sensor's resistance is measured after exposure to alcohol gas blown onto cotton. The results of both measurements are displayed in Table 1.

Table 1. Resistance Measurement of TGS 2620 Sensor Before and After Exposure to Alcohol Gas

Measurement	Sensor measuring before exposure to alcohol (V)	Sensor measuring after exposure to alcohol (V)
1	0.71	3.69
2	0.71	3.86
3	0.71	3.93
4	0.66	3.96
5	0.71	4.08
6	0.68	4.15
7	0.68	4.2
8	0.68	4.15
9	0.68	4.1
10	0.68	4.08
11	0.68	4
12	0.68	3.91
13	0.68	3.86
14	0.68	3.81
15	0.68	3.71

Based on Table 1, data was collected a total of fifteen times. From these fifteen data points, it is evident that before the presence of alcohol gas around the sensor, the average voltage reading was 0.69 V. However, after exposure to alcohol gas, the average voltage reading of the sensor is 3.97 V.

IV. CONCLUSION AND RECOMMENDATION

Based on the conducted tests, it can be concluded that the portable alcohol testing device using the TGS 2620 sensor is capable of detecting changes in alcohol levels in the surrounding air quite effectively. Before exposure to alcohol gas, the average sensor voltage reading is 0.69 V, while after exposure to alcohol gas, the average sensor voltage reading increases to 3.97 V. This indicates that the device is effective in detecting the presence of alcohol in the surrounding air.Further testing is required to calibrate this device to provide more accurate readings in terms of alcohol content measured in percentage, rather than voltage readings. Continued research and development of the portable alcohol testing device are also needed to ensure its reliability and accuracy in various real-world environmental conditions.

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REFERENCES

[1] A. Khalil, K. Aljanaideh, and M. Janaideh, "On Detecting Drunk Drivers in Mixed Autonomous Platoons Using Vehicles Velocity Measurements," *IEEE/ASME Trans. Mechatronics*, vol. PP, 2022, doi: 10.1109/TMECH.2022.3187658.

[2] ILO, *Financing Small Businesses in Indonesia: Challenges and Opportunities*. 2019. [Online]. Available: www.ilo.org/publns

[3] Y. Feng and M. Wang, "Study on the Application of Drunk Driving Detection Device Design in Traffic Safety," 2020, pp. 134–139. doi: 10.1061/9780784482902.016.

[4] M. Alparizi Pebers, Bayu wahyudi, P. Kusi Olla, and D. Ningtias, "Rancang Bangun Alat Pendeteksi Alkohol Portabel Pada Pernafasan Manusia Menggunakan Arduino Nano," ***Elkom J. Elektron. dan Komput.,*** vol. 15, no. 2, pp. 393–402, 2022, doi: 10.51903/elkom.v15i2.914.

[5] M. Haris, I. M. B. Suksmadana, and S. Ch, "Perancangan alat pendeteksi kadar alkohol dan asap rokok pada nafas manusia," *Dielektrika*, vol. 4, no. 1, pp. 39–44, 2017, [Online]. Available: http://dielektrika.unram.ac.id/index.php/dielektrika/article/view/31%0Ahttp://dielektrika.unram.ac.id/index.php/dielektrika/article/download/31/19

[6] Harahap, Arman. 2020. Species Composition & Ecology Index Of The Family Gobiidae At The Mangrove Belawan Of Sicanang Island ***International Journal of Scientific & Technology Research*** Volume 9, Issue 04, April 2020.

[7] Harahap, A., et all (2021), Monitoring Of Macroinvertebrates Along Streams Of Bilah River ***International Journal of Conservation Sciencethis*** link is disabled, 12(1), pp. 247–258.

[8] Mamangkey, J., Suryanto, D., et all (2021). Isolation and enzyme bioprospection of bacteria associated to Bruguiera cylindrica, a mangrove plant of North Sumatra, Indonesia, Biotechnology Reports, 2021, 30, e00617.

[9] A. P. U. Siahaan *et al.*, "Arduino Uno-based water turbidity meter using LDR and LED sensors," ***Int. J. Eng. Technol.***, vol. 7, no. 4, pp. 2113–2117, 2018, doi: 10.14419/ijet.v7i4.14020.

[10] M. Negara, R. Wirawan, and N. Qomariyah, "RANCANG BANGUN SISTEM MONITORING GAS ALKOHOL PADA FERMENTASI KETAN BERBASIS SENSOR TGS 2620," ***ORBITA J. Kajian, Inov. dan Apl. Pendidik. Fis.***, vol. 6, p. 235, 2020, doi: 10.31764/orbita.v6i2.3166.

[11] H. Sutanto, A. D. Haryowati, and Z. Arifin, "Rancang bangun deteksi alkohol pada urine dengan sensor TGS 2620 berbasis mikrokontroler AT89S51," *Berk. Fis.*, vol. 13, no. 3, pp. 97–100, 2010.

[12] E. Antika and Y. Susmiati, "Perancangan dan Implementasi Sensor MQ3 dan Sensor TGS2620 Berbasis Mikrokontroler Penunjang Alat Pemurnian Bioetanol," *Semin. Nas. Has. Penelit. 2017*, pp. 978–602, 2017.

[13] F. R. Saputri and N. Pranata, "GP2Y0A21YK0 INFRARED SENSOR AND," vol. 7, no. 2, pp. 142–149, 2023.

[14] Harahap, Arman ,2018, Macrozoobenthos diversity as bioindicator of water quality in the Bilah river, Rantauprapat, ***Medan. J. Phys***.: Conf. Ser. 1116 052026.

[15] A.Harahap,P.Hrp,N.K.A.R.Dewi,Macrozoobenthos diversity as anbioindicator of the water quality in the River Kualuh Labuhanbatu Utara, ***International Journal of Scientific & Technology Research***, 9(4),2020,pp.179-183.

[16] Harahap, et, all, Macrozoobenthos diversity as anbioindicator of the water quality in the Sungai Kualuh Labuhanbatu Utara, AACL Bioflux, 2022, Vol 15, Issue 6.