Gravity: Jurnal Ilmiah Penelitian dan Pembelajaran Fisika

http://jurnal.untirta.ac.id/index.php/Gravity

ISSN: 244-515x; e-ISSN: 2528-1976

Vol. 6, No. 2, September 2020, Page 138-143

Development of distance glove for blind people as an alternative tool

Nugroho Prasetya Adi*, Rahayu Agustin

Department of Physics Education, Universitas Sains Al-Qur'an, Indonesia

E-mail: nugrohoprasetyaadi@gmail.com

(Received: 13 July 2020; Revised: 12 September 2020; Accepted: 21 September 2020)

ABSTRACT

The eye was one of the senses that functions to record a state or condition so that humans could know the object they see. However, not all humans were created with normal eye conditions; some had visual disturbances from birth. Blind people generally use a walking aid in the form of a cane or a trained dog to help with movement and increase safety and independence during activities. This research aimed to produce gloves as a tool for blind people who had a distance accuracy from the ultrasonic sensor. This research was a research development (R&D). The results showed that the average error percentage was 1.75% for the ultrasonic sensor one and the average error percentage was 2.13% for the ultrasonic sensor 2. So it can be concluded that the research data obtained has a research accuracy of 98.25% for the ultrasonic sensor 1 and 97.87% for the sensor. Ultrasonic 2. The maximum distance that the two ultrasonic sensors can read is 55 cm; at that distance, the two ultrasonic sensors will work properly. For distances above the maximum distance, the ultrasonic sensor cannot do.

Keywords: Proximity gloves, ultrasonic sensors, visually impaired

DOI: 10.30870/gravity.v6i2.8558

INTRODUCTION

Humans have five senses that function to feel the changes in the environment outside their bodies. These five senses consist of sight, hearing, touch, smell, and taste, which work as a human sensory system. (Melinda et al., 2018). The five senses have their respective functions, the eyes are to see, the ears to hear, the tongue to feel, the hands to handle, and the nose to smell. The watch is one of the senses that functions to record a state or condition so that humans can know the object they see (Hermawan, 2014). However, not all humans are created with normal eye conditions; some have visual disturbances from birth. People who have visual problems are called blind people.

Data from the Ministry of Health in 2014 states that the number of blind people is 1.5% of Indonesia's total population of 3.6 million people. Wonosobo Regency has some blind people, as many as 510 people or 10.8% of the real people with disabilities in Wonosobo Regency and 77 people, or 1.6% of Wonosobo residents have visual impairments (blind) and disabilities (Dispermadesdukcapil Jateng, 2019)

Blind people generally use a walking aid in the form of a cane or a trained dog to help with movement and increase safety and independence during activities. The adequacy of information that a blind person has regarding the surrounding environment can make it easier for him to do activities in a new environment. A stick is usually used by a person with visual impairments when doing activities outside the room. However, this stick's use is still an obstacle to determining the distance of objects around him. (Purnomo et al., 2015).

Very rapid technological advances can be a solution to help blind people to do activities outside the room. One of them is by using a microcontroller and sensor system as tools. A microcontroller is a semiconductor chip-shaped device consisting of a CPU, memory, and I/O (Sumarsono dan Saptaningtyas, 2018). Hamid (2017) explained that the microcontroller is a complete computer system in one chip (chip). A microcontroller is more than just a microprocessor, because it already contains ROM (read only memory) and RAM (random access memory), several input/output ports, and some peripherals such as; a counter or timer, ADC (analog to digital converter), DAC (digital to analog converter) and serial communication. The microcontroller is an interconnected program that requires mathematical and logical operations in digital input. The microcontroller form is a single-chip that includes an input/output operating area and a data section that functions to communicate both of them. (tal convertGuven et al., 2017)

A sensor system is a tool that has a function as an identifier, similar to the human senses. Sensors that can be used for blind people are proximity sensors / ultrasonic sensors, where this sensor can detect objects around the sensor with a predetermined minimum / maximum distance. Ultrasonic sensors are generally used to anticipate collisions by measuring nearby objects (Latha et al., 2016). Ultrasonic sensors are usually used in the automatic operation to measure distance, change in position, measurement level, as a detector in select applications to measure the purity of transparent materials. The ultrasonic sensor is operated on the principle of measuring the time of high-speed signal transmission and signal retrieval in the form of waves (Koval, 2016). Ultrasonic sensors can detect objects around 100 cm (Latha et al., 2016).

Based on the above problems, we need a solution related to assistive devices for blind people. Several studies related to the use of proximity sensors and microcontrollers: a) Setiawan (2017) about prototype a tool for the blind in the form of a stick using an arduino and an ultrasonic sensor; b) Arminda et al. (2011) about proximity sensor design with sound output as a walking aid for visually impaired persons; c) Koval, Vanus, and Bilik (2016) about distance measuring by ultrasonic sensor; d) Latha et al. (2016) about distance sensing with ultrasonic sensor and arduino; and Purnomo et al. (2015) about hindsight: hand mounted device to assist the blind with ultrasonic and arduino based. So that the solution given from this research is to develop a tool for blind people, the form of the tool developed is a glove. Gloves were chosen because they have ease of use, making it easier for blind people to be more comfortable. These gloves were developed as an alternative tool that can be used by blind people for daily activities. This research aims to produce gloves as a tool for blind people who have an accurate level of distance from the ultrasonic sensor.

RESEARCH METHODS

This research is a research development (R&D), which is research that produces a product (Sugiyono, 2011). The development model used is the Borg and Gall model, where nine steps must be followed to achieve the final result. This research was conducted in the Physics Education laboratory of the Al Qur'an Science University, with a research time of 2 months. The tools needed to develop the product include Arduino, ultrasonic sensor, servo motor, and buzzer. The design tools developed are as Figure 1.

There are 2 types of data analysis techniques used in this study, 1) iterative measurement data analysis technique is a data analysis technique by comparing the actual distance of

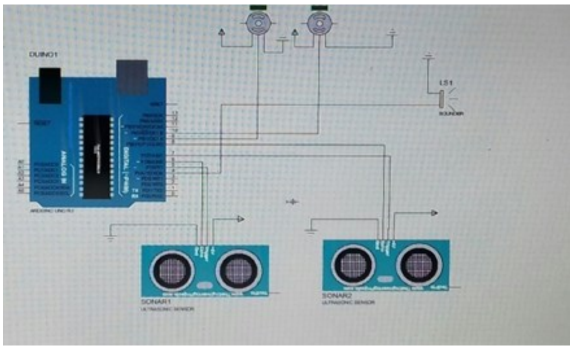

Figure 1. Tool Design

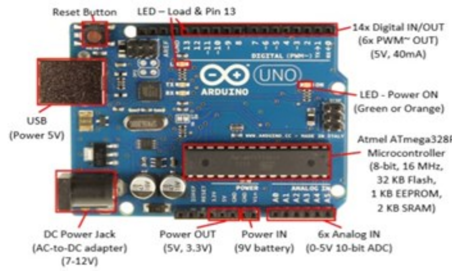

Figure 2. Arduino

the object measured with a ruler with the object's distance measured by the ultrasonic sensor to determine the mean error rate in the distance reading at the ultrasonic sensor. There is a way to calculate the error rate on the ultrasonic sensor with equations 1 and 2.

$$\text{Error}\,(\%) = \frac{\text{Actual distance - Reading distance}}{\text{Actual distance}} \times 100\% \qquad (1)$$

$$\text{Average Error} = \frac{\sum \text{Error value}}{\text{The number of trials}} \qquad (2)$$

2) test the level of responsibility buzzer and servo motor to the reading on the ultrasonic sensor by detecting objects in front of the sensor and observing the buzzer and servo motor when an item is detected.

RESULTS AND DISCUSSION

Distance Gloves

A distance glove is a glove in which it has been modified so that it can be used by blind people to detect objects around it. These distance gloves are arranged using an Arduino, breadboard, ultrasonic sensor, servo motor, and buzzer. Arduino is hardware and software that can allow anyone to prototype an electronic circuit based on a microcontroller. The Arduino Uno board works on an input voltage of 7-12V. This board contains 14 digital pins, and 6 of them act as Pulse Width Modulation (PWM) pins, which work when getting analog requirements on digital pins (Kadir, 2006). The picture of Arduino can be seen in Figure 2.

Arduino can be programmed using the Arduino software; Arduino sketch is an IDE (Integrated Development Environment) developed using the Java language and is used to program microcontrollers. Arduino sketch is used to compile and upload programs to the Arduino board (Setiawan, 2017). A breadboard is a small board designed to make it easier to arrange electronic circuits without soldering (Kadir, 2006). An ultrasonic sensor is a sensor that works using ultrasonic waves to detect objects around it and can be used to measure the distance from the sensor to the object. The ultrasonic sensor can measure objects at a distance of 3 cm to 3 m around the sensor (Kadir, 2006). The ultrasonic sensor works because ultrasonic waves are emitted into the air, and the ultrasonic wave reflection will occur when there are certain objects around the sensor. The ultrasonic wave reflection will be received back by the receiving sensor unit (Briggita, 2017).

The servo motor is a device with a closed feedback system where the engine's position will be informed back to the controller circuit on the servo motor. This motor consists of a motor, gear, potentiometer, and control circuit (Nasution et al., 2015). Servo motor is a motor capable of working in two directions (CW and CCW) where the direction and angle of the rotor's movement can be controlled by varying the pulse width (duty cycle) of the PWM signal on the control pin (Purnomo, 2015).

Ultrasonic Sensor Testing 1

The results of ultrasonic sensor 1 testing are presented in Table 1.

It will be easier to read the HY-SRF05 ultrasonic sensor if the test data is written into a graphic. The graph of the results of the ultrasonic sensor test 1 is presented in Figure 3.

Table 1. Ultrasonic Sensor Test Results 1

No	Input	Output	*Error (%)*
	Real distance (cm)	Reading distance (cm)	
1	15	16	6,67
2	25	26	4
3	30	30	0
4	35	36	2,86
5	40	40	0
6	45	46	2,22
7	50	50	0
8	55	55	0
9	58	57	1,72
10	60	60	0
	Average error		1,75

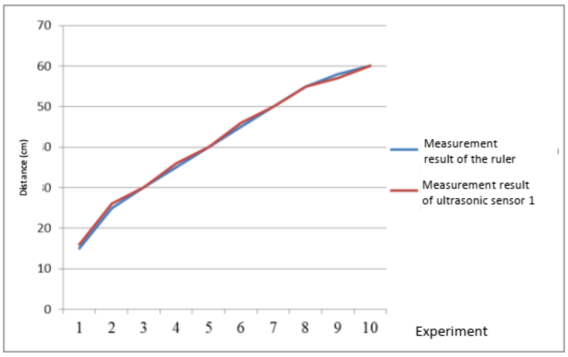

Figure 3. Ultrasonic Sensor Test Results 1

Based on the graph in Figure 3, it can be seen that the difference between measurements using the ultrasonic sensor is compared to the actual distance. The difference in the measurement results is the error data value. A total of 10 experiments obtained an average error percentage of 1.75%. The calculation result of the percentage error in the reading of the ultrasonic sensor can be concluded that the level of accuracy of the measurement results of the ultrasonic sensor 1 is close to the actual measurement results, so that the ultrasonic sensor can be used in a series of tools for blind people in detecting objects around the user.

Ultrasonic Sensor Testing 2

The results of the ultrasonic sensor 2 test are presented in Table 2. It will be easier to read the HY-SRF05 ultrasonic sensor if the test data is presented in graphical form. The results of the ultrasonic sensor 2 test in graphical form are presented in Figure 5 as follows

Table 2. Ultrasonic Sensor Test Results 2

No	Input	Output	*Error (%)*
	Real distance (cm)	Reading distance (cm)	
1	15	17	13,33
2	25	26	4
3	30	30	0
4	35	35	0
5	40	40	0
6	45	46	2,22
7	50	49	2
8	55	55	0
9	58	59	1,72
10	60	60	0
	Average error		2,13

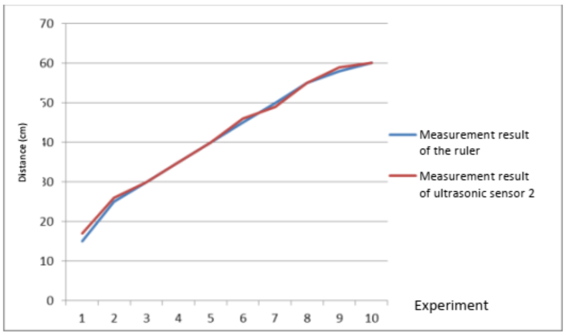

Figure 4. Graph of Ultrasonic Sensor Test Results 2

The graph in Figure 4 shows the difference between measurements using an ultrasonic sensor compared to the actual distance measured using a ruler. The difference in the measurement results is the error data value. A total of 10 experiments carried out obtained an average percentage error of 2.13%. Based on the calculation result, it can be concluded that the accuracy of the ultrasonic sensor 2 is close to the actual measurement results, so that the ultrasonic sensor 2 can be used in a series of assistive devices for blind people.

Whole System Testing

Testing the instrument system on the ultrasonic sensor 1 shows that when the object distance from the tool is 15 cm, the ultrasonic sensor 1 readings detect as far as 16 cm with the buzzer on and the axis of the servo motor 1 moving. When the distance between the object and tool is 25 cm, ultrasonic sensor 1 detects an object as far as 26 cm with the buzzer on, and the axis on the servo motor 1 is moving. When the object distance is changed to 30 cm, the ultrasonic sensor 1 detects an object as far as 30 cm with the buzzer on and the axis on the servo motor moving. When the object distance is 35 cm from the ultrasonic sensor reading, it detects 36 cm with the buzzer on and the axis on the servo motor 1 moving. 40 cm distance, the buzzer is on, and the servo motor axis moves. The object distance is 45 cm, the ultrasonic sensor readings detect an object as far as 46 cm with the buzzer on, and the axis on the servo motor 1 is moving. The object distance is 50 cm, the ultrasonic sensor readings detect an object as far as 50 cm with the buzzer off and the axis on the servo motor 1 at rest. The object distance is 55 cm, the ultrasonic sensor readings detect an object as far as 55 cm, with the buzzer off and the axis on the servo motor 1 at rest. The distance of the object as far as 58 cm from the ultrasonic sensor's reading detects an object as far as 57 cm with the buzzer off and the axis on the servo motor 1 at rest. The object distance is 60 cm when the buzzer is off, and the axis on the servo motor 1 is at rest.

Testing the instrument system on the ultrasonic sensor 2 shows that when the object is 15 cm away, the ultrasonic sensor 2 readings detect an object as far as 17 cm with the buzzer on and the axis of the servo motor 2 moving. The object distance is 25 cm, the results of the ultrasonic sensor 2 readings detect an object as far as 26 cm with the buzzer on, and the axis on the servo motor 2 is moving. The object distance is as far as 30 cm when the buzzer turns on and the axis on the servo motor 2 moves. The distance of the object is 35 cm, the reading of the sensor ultrasonic 2 detects an object as far as 35 cm with the buzzer on and the axis of the servo motor 2 moving. The object distance is 40 cm, the results of the ultrasonic sensor 2 readings detect objects as far as 40 cm with the buzzer on and the axis of the servo motor 2 moving. The object distance of 45 cm from the ultrasonic sensor's reading detects an object as far as 46 cm with the buzzer on and the axis on the servo motor 2 moving. The object distance is 50 cm, the ultrasonic sensor readings detect an object as far as 49 cm, the buzzer lights up, and the axis on the servo motor 2 moves. An object distance of 55 cm from the ultrasonic sensor's reading detects an object as far as 55 cm, with the buzzer off and the axis on the servo motor 2 at rest. The object distance of 58 cm from the reading of the ultrasonic sensor detects an object as far as 59 cm, the buzzer is off, and the axis on the servo motor 2 is still. The object distance as far as 60 cm from the reading of the ultrasonic sensor detects an object as far as 60 cm with the buzzer off and the axis on the servo motor 2 at rest.

The results of testing the tools obtained are by the existing theory that to find the distance is obtained by the equation (3).

$$\text{Distance} = \text{speed of sound} \times \frac{t}{2} \qquad (3)$$

Where, t is the travel time required by the ultrasonic signal when it is transmitted until it returns (Briggita, 2017).

It can be concluded that the test results of the whole system were successful because in accordance with the program written on the Arduino, when the ultrasonic sensor detects the object distance is less than 50 cm the buzzer will sound and the axis on the servo motor will move as information to the user that there is an object. in front of him.

CONCLUSION

The conclusions of this study are as follows The resulting distance gloves for blind people with an error percentage of 1.75% or 98.25% accuracy of distance accuracy for ultrasonic sensor 1 and 2.13% for ultrasonic sensor error percentage 2 or 97.87% of distance accuracy.

REFERENCES

Melinda, C. L. et all. (2018). Implementasi Pengalaman Panca Indra pada Interior Restoran Shao Kao Surabaya. *Jurnal Intra*, 6(2), 786-791

Hermawan, A.P. (2014). Intensitas Pencahayaan dan Kelainan Refraksi Mata Terhadap Kelelahan Mata. *Jurnal Kesehatan Masyarakat*, 9(2), 131-136.

Kementrian Kesehatan RI. (2014). *Buletin Jendela Data dan Informasi Kesehatan: Situasi Penyandang Disabilitas*. Jakarta: Kemenkes RI.

DISPERMADESDUKCAPIL Provinsi Jawa Tengah. (2019). Kependudukan Kabupaten Wonosobo. Diakses Desember 2019. https://sidesa.jatengprov.go.id/kabupaten/33.07

Purnomo, E.S. *et al*. (2015)..*Handsight: Hand Mounted Device untuk Membantu Tunanetra Berbasis Ultrasonik dan Arduino. Jurnal Teknologi dan Sistem Komputer*, 3 (1). 51-57.

Sumarsono dan Saptaningtyas, D.W. (2018). Pengembangan Mikrokontroler Sebagai Remote Control Berbasis Android. *Jurnal Teknik Informatika*, 11(1), 67-75. DOI:10.15408/jti.v11i1.6293

Hamid, R. (2017). Rancang Bangun Robot Pengangkat Box Berbasis Mikrokontroler ATmega 16. *Jurnal PROtek*, 4(2), 93-101.

Guven, Y. et al. (2017). Understanding the Concept of Microcontroller Based System to Choose the Best Hardware For Applications. *International Journal Of Engineering and Science*, 6(9), 38-44.

Latha N.A. *et al.* (2016). Distance Sensing With Ultrasonic Sensor and Arduino. *International Journal Of Advance Research, Ideas, and Inovation in Technology*, 2(5), 1-5.

Koval L., Vanus J., and Bilik P. (2016). Distance Measuring by Ultrasonic Sensor. *International Federation of Automatic Control (IFAC),* 153-158.

Setiawan, C. (2017). Prototype Alat Bantu Tuna Netra Berupa Tongkat Menggunakan Arduino dan Sensor Ultrasonik. *Journal of Information and Technology*, 5(2).

Gatra W, K. et al. (2011). *Desain Sensor Jarak dengan Output Suara Sebagai Alat Bantu Jalan Bagi Penyandang Tunanetra.* Surabaya: Politeknik Elektronika Negeri Surabaya.

Sugiyono. (2011). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta.

Kadir, A. (2016). *Simulasi Arduino*. Jakarta: PT Elex Media Komputindo.

Briggita M.K. (2017). *Alat Ukur Tinggi Badan Otomatis dengan Sensor Ultrasonik Berbasis Mikrokontroler dengan Tampilan LCD Bergerak dan Suara*. Yogyakarta: Universitas Sanata Dharma.

Nasution, R. Y. *et al*. (2015). Perancang dan Implementasi Tune Gitar Otomatis dengan Penggerak Motor Servo Berbasis Arduino. *Jurnal Elektro Telekomunikasi Terapan.* 83-94