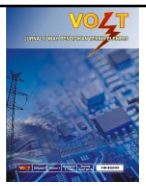
VOLT
Jurnal Ilmiah Pendidikan Teknik Elektro
P-ISSN: 2528-5688
E-ISSN: 2528-5696
Journal homepage: jurnal.untirta.ac.id/index.php/VOLT
Vol. 2, No. 2, October 2017, 101–108



ANALYSIS OF THE SENSOR LINE ON LINE FOLLOWER ROBOT AS AN ALTERNATIVE TRANSPORT THE TUB TRASH IN THE SHOPPING CENTER

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Received: 05 July 2017. *Received in revised form*: 03 October 2017. *Accepted*: 05 October 2017

Abstract

This is a line follower robot is a robot designed to assist humans in activities such as throw away trash in the shopping center. On robot sensors added a line that consists of photodioda and LED. The robot will walk follows the path which has been given a different color (black and white) to be detected by the sensor lines at the location of the junk-filled tubs and tubs of the empty trash. The research aims to know the performance of the sensor lines and the movement of the robot with the research method using PID. The results of this study when the distance between the sensor and the surface of 5 cm – 7 cm then the performance of the sensor surface in distinguishing the line of black and white still work fine, while at a distance of 8 cm – 10 cm sensor line performance diminished. Untuk pengaturan PID, P = 10 akan menghasilkan rata –rata nilai error yang lebih besar yaitu 9,9 sehingga robot akan bergerak cepat tetapi tidak stabil, sedangkan P = 5 rata – rata nilai error yaitu 8 sehingga robot akan bergerak stabil (sesuai jalur hitam). For setting the PID, P = 10 will result averaged a greater error value i.e. 9.9 so the robot will move fast but unstable, while P = 5 align the median value error – i.e. 8 so the robot will move stable (as black).

Kata kunci: photodioda, *line follower*, LED, robot, trush, sensor.

INTRODUCTION

Trash is the unwanted materials remaining after the end of a process. The definition of waste according to UU No. 18/2008 on waste management are the everyday activities of humans and the natural processes that shape or solid.

The shopping center as one of public facilities that could potentially generate a lot of garbage every day and therefore requires a system of waste management which are more op-

timal in this regard is the process of transporting a tub of trash.

In general, the activity of the visitors and the seller as well as the increase in the number of visitors that are not coupled with optimal management of waste in the shopping center is one of the factors of the increase in the number of heaps trash that is is generated every day. To that end, handle waste matter thoroughly needs to be done – alternative transportation alternatives a more optimal waste crankcase, so that an increasing number of middens can be suppressed.

The robot has been made at this time to resolve the issue as it has been done by Maulana (2014) in the study entitled "design and analysis of the comparison of the position of the Sensor on the Robot line of Waste Management", in the robot research, using 2 microcontroller. The use of 2 such troublesome microcontroller in combining components to the microcontroller. So in making this robot used a microcontroller, Arduino Mega 2560 so that all components can be incorporated in 1 microcontroller only. Arduino Mega 2560 also has a pin that more and bigger storage memory.

On this research created a robot that served to transport garbage in tubs of building a shopping center. A robot transports the tub this garbage is one of the alternative solutions are expected to anticipate the garbage buildup at shopping. This robot application is placed on the shopping center because the shopping centre has a flat floor surface so that it can facilitate the movement of the robot when it runs.

The purpose of this research is to know the performance of the sensor line in distinguishing black and white lines and know the movement of the robot using the PID.

Line Sensor

Line sensor serves to detect the color of the surface under the robot line tracking with the intention of enabling the sensor line can generate the logic of the position of the robot. The logic of the position sensor produced by this line would then be used as input to a microcontroller on a robot. On the sensor line, the components used are photodioda as detector line or lines, and LEDs as a transmitter and received by photodioda.

Photodioda is a type of diode that can detect the presence of light. Photodioda transform the light into a current, meaning that photodioda will drain off current if there is a light that hits it. So in other words, photodioda will be sent if exposed to light

Figure 1. Photodioda

The magnitude of the conductivity of photodioda depends on the strong light that enters. As is the case on the surface of black and white. On the black surface, photodioda will receive a little reflected light because the light from the LED is more absorbed by the black surface due to the nature of the black color that is absorbing light. So photodioda will be even greater resistance and can not send currents. While on the surface of white, photodioda will receive the reflected light from the LED of the transmitter so that the resistance will be getting smaller and is conducting current.

Photodioda way of working also depends not only from the color of the surface, but also based on the distance between the sensors to the surface. In the distance is the farther away, the harder it will be photodioda

receive reflected light from the LED of the transmitter so it gets big and small voltage. When the distance is close, photodioda more easily receive the reflected light from the LED so that the voltage is small and gets bigger.

Light Emitting Diode (LED) is an electronic component that can emit light when it is given the voltage going forward. The LED is a diode made of semiconductor material.

Figure 2. Light Emitting Diode (LED)

In the sensor line, the LED serves as a transmitter of light will be reflected to the photodiode (Arifianto, 2011: 123). The workings of the LED when the LED emits light, that has two of the same pole that is the positive pole (P) and the negative pole (N). But the LED will only light when attached to a forward voltage (forward bias) from the anode to the cathode toward. When the LED forward voltage is irrigated or biased forward of the anode (P) towards the cathode (K), the excess electrons on the N-Type region will move to an excess of holes that is positively charged region (P-Type material). When an electron meets a hole will release the photon and emits light of a monochromatic (single color).

Arduino Mega 2560 is 2560 ATMEGA microcontroller on an which has 54 digital input/output which is 16 pin used as PWM outputs, 16 inputs analog, and it included a 16 MHz crystal oscillator, a USB connection, power, ICSP, and the reset button. The performance of the arduino microcontroller this requires support by connecting on a computer with a USB cable to turn it on using AC or DC and can also using batteries. For the resolution of the ADC on board Arduino Mega 2560 is 10 bits, which means able to map up to 1024

Figure 3. Arduino Mega 2560

L298 driver has the capability of moving motor DC current up to 2A and maximum 40 Volt DC voltage for one used channel. The enable pin A and B to control motor speed or road, the pin input 1 to 4 to control the direction of rotation. The enable PIN given VCC 5 Volts for full speed and PWM (Pulse With Modulation) for rotational speeds that vary depending on the high level.

Figure 4. Motor *Driver* L298

The DC motor is a type of motor that uses voltage DC (direct voltage) as an energy source. By providing different voltages at both terminals, the motor will rotate in one direction, and when the voltage polarity is reversed then the direction of the motor rotation will be reversed as well.

As for DC motor consists of two main parts, namely: 1) the stator, is the part that fixed/stationary. Stator generates magnetic fields, either generated from a spindle (electro magnet) or permanent magnet; 2) rotors, is rotating. The rotor in the form of coil (coils) where there is an electric current.

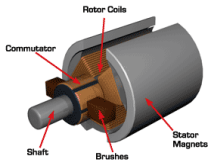

Figure 5. DC Motor

Servo motor is a motor with a closed feedback system in which the position of the motor will be communicated back to the control circuit of the servo motor. The motor consists of a motor, a series of gear, and a potentiometer circuit control. There are two types of servo motor, i.e. standard servo motor and servo motor continuous. Standard servo motor is only capable of moving both directions with each angle reaches 90 degrees. While the continuous servo motor capable of moving both directions without limitation angle swivel

Figure 6. Servo Motor

ADC (Analog to Digital Converter) there were converters that analog input into a digital code – code. ADC is widely used as an industrial process control, communication and digital circuit measurement/testing. Generally used as an intermediary between the ADC sensor (such as temperature sensors, light, pressure, weight, and so on) that is most analogous to the computer system is then measured using a digital system (computer). Converting analogue to digital can use the following formula:

$$\text{Nilai ADC} = \frac{Vin}{Vref} \text{x} \, (2^n - 1) \qquad (1)$$

Vin : the voltage is measured
Vref : the maximum voltage that goes on the microcontroller
2^n-1 : value of bit (n is a bit of a microcontroller)

METHOD

The methods used in this method robot PID. PID (Proportional, Integral, Derivative) Controller is the controller to determine the accuracy of a system with the characteristics of the existence of feedback/feedback on the system. PID component consists of 3 types, namely Proportional, Integrative, and derivatives

Proportional Control

The controller is an input amplifier so that the results in the output is not getting into small on a system. Changes that occur at the input signal will cause the system to directly modify the output of the constant multiplier. The P value obtained by way of trial and error/define for themselves the value of P to get a stable robot motion. The value of P will this affect DC motor PWM.

Integrative Control

The Integral controller function generates a response system that has zero state error (Error Steady State = 0). If a controller does not have an element of proportional controller, integrators are not able to guarantee the output system with error state of zero.

Derivative Control

If the movement of the robot is still visible air-waves, can be added to control derivatives (D). Control D used to measure how fast the robot moves from left to right or from right to left. The faster moving from one side to the other, then the larger the value of d. same as the value of P, the value of D is also obtained by way of trial and error. Usually great value D is half of the value of P.

The system of transport of waste is a tub of manner or under-water process started from a place of garbage containers (source middens) come to TPS. This scheme can be seen in Figure 7.

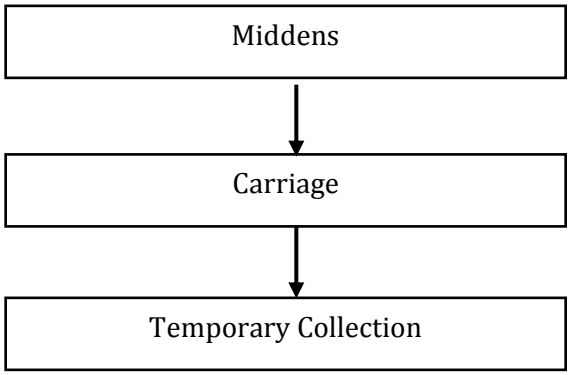

Figure 7. Operational Techniques of Transport Schemes Tub Trash

Flowchart robot can be see in Figure 8.

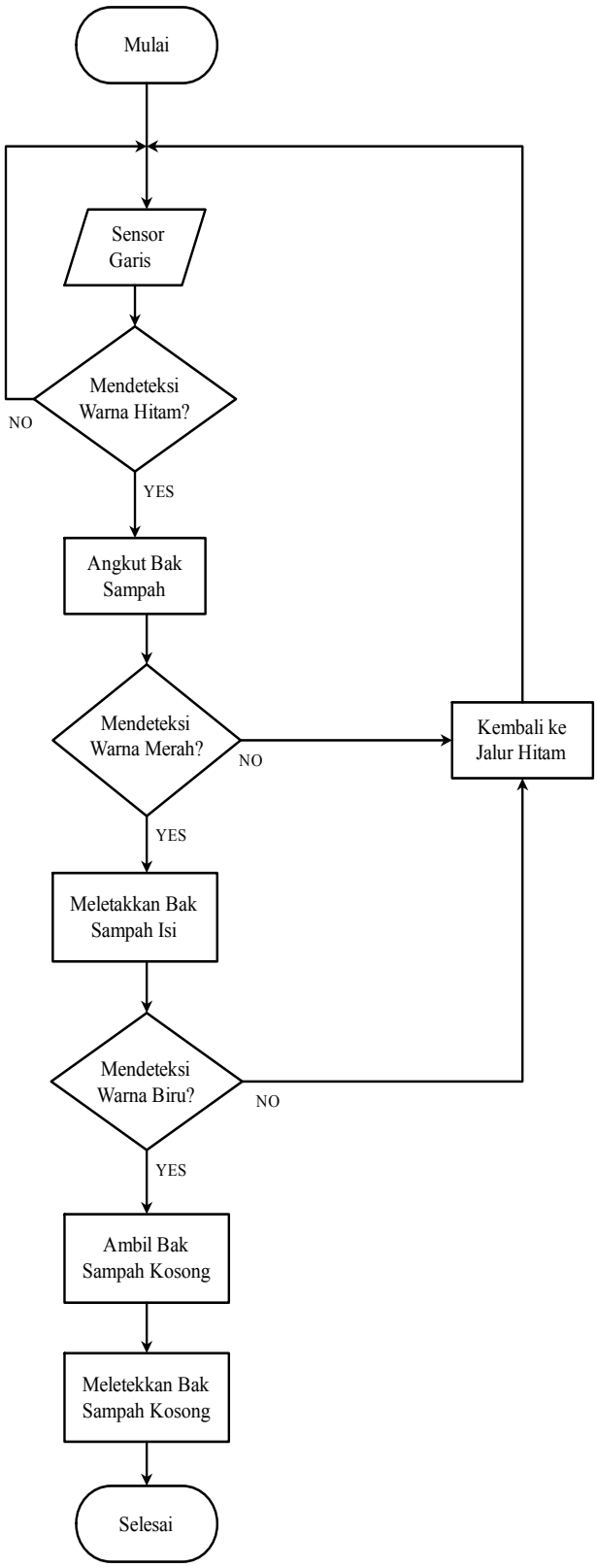

Figure 8. Robot Flowchart

The process of hauling waste crankcase starts from detecting black line by line sensor. If not detected, the sensor will return to detect the black line. If it is already detected, the robot will take bak bak raised the way garbage bins that use servo motor, Then the robot to walk again by detecting the collection while the red line. If it does not detect the color red, the robot back to the black line up again to find the red line. If detected, the robot will degrade bak garbage, then walk again until the blue line. When the blue line is not detected, the robot back to the black lines. When detected, the robot will take empty bins to put the tub in place. This process is shown in Figure 8

RESULT AND DISCUSSION

The resulting data is data the measurement value of the difference between the ADC is black and white. ADC is the analog to digital converter, i.e. change the analog data into digital data. The modified data is data the results of the measurement of the voltage. The value of the voltage ranges from 0 volt – 5 volt, or in the digital value that is 0-1023. ADC is needed so that a computer system can recognize the value of the voltage range 0 volt – 5 volt by means of converting to a digital value.

Table 1 is a result of the difference in the value of the ADC data line black and white based on the distance between the sensor surface lines with line

Table 1. The value of the difference in the ADC on the black and white

Sensor	ADC Value					
	5cm	6cm	7cm	8cm	9cm	10cm
1	176	144	130	91	70	61
2	183	160	150	112	94	83
3	151	133	111	98	81	71
4	158	134	109	104	83	72
5	171	150	125	114	90	78
6	133	93	73	66	51	45
7	168	133	107	96	82	70
8	168	142	118	108	96	84
9	171	141	114	100	89	76
10	212	172	138	116	99	82
11	153	127	111	93	79	66
12	149	117	102	73	63	49
∑	166	137	116	97	81	70

From the data in table 1, the value of the mean difference – align the sensor line that generated the ADC at a distance of 10 cm value smaller than at a distance of 5 cm. it is in accordance with the workings of photodioda, i.e. the LED will give light to the surface then reflected to the photodioda. If the distance of the sensor lines withblack and white surface further and further, then cause the reflected light from the surface will be increasingly far away anyway and generate the value of the ADC (value of voltage which is already converted to digital) surface of the smaller black and white anyway. Table 2 is the data the results of setting the PID. The PID is used on robots so that a robot walking fit right on top of the line and to regulate the movement of the robot.

Table 2. The results of the sensor when P = 10 and D = 5

No.	Error Value	The Results of Readings of the Sensors
1.	27	0000000000000001
2.	20	0000000000110000
3.	10	0000000011111110
4.	5	0000001111111110
5.	2	0000011111111111
6.	-5	0000111111111110
7.	0	0000111111111111
∑	9.9	

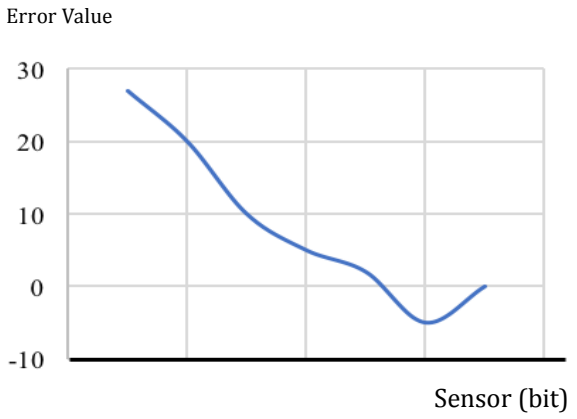

Figure 9. Graphic Sensor When P = 10 and D = 5

Tabel 3. The results of the sensor when P=5 and D=3

No	Error Value	The Results of Readings of the Sensors
1.	15	0000000001111100
2.	13	0000000000111111
3.	10	0000000011111110
4.	8	0000000011111111
5.	7	0000000111111110
6.	4	0000001111111111
7.	0	0000111111111111
Σ	8	

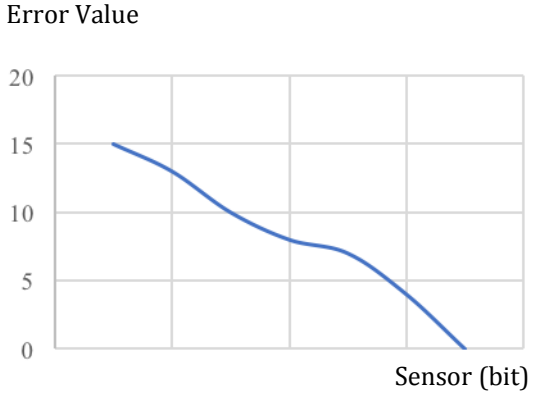

Figure 10. Sensor graphic when P=5 and D=3

In table 2 and table 3, note the results of the readings of the sensors i.e. 12 binary value which represents the number of 12 sensor used in robot error when the value is determined from the results of setting the P and D. On the results of the binary value of the sensor, the reading of 1 indicates the sensor is located directly above the line (black), while the binary value 0 indicates that the sensor is not on the line (white color).

Based on the graph in Figure 9, that the existence of invisible waves. This shows the movement of the robot is getting fast and unstable/not just above the line (black color). Based on the graph in Figure 10, to see that the presence of waves that are almost straight. This means the movement of the robot stabilized above the line (black color).

When P = 10, the value of the error value is great and it is also affecting the speed of a DC motor into a fast but the sooner the DC motor, the movement is also unstable. When P = 5, error value is worth little and affect the speed of a DC motor being slow so that the movement of the motor becomes more stable.

CONCLUSION

Out of 12 sensor, note that for each 5 cm-10 cm increments the value decreased by ADC 57.83%. From these data shows that the distance results in the performance of the sensor line in distinguishing black and white surface will be reduced.

For P = 10, the mean value of the average error i.e. 9.9, then what happens is the robot moves fast but unstable (moving outside the lines). While the moment P = 5, flat median value error i.e. 8, then the robot is moving more stable (subject line). So the larger the value of P, the movement of the robot is getting fast and

unstable. Conversely, the smaller the value of P, the movement of the robot is getting stable.

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