Indonesian Journal of Electrical Engineering and Computer Science
Vol. 5, No. 2, February 2017, pp. 433 ~ 440
DOI: 10.11591/ijeecs.v5.i2.pp433-440

Between Two Line Follower Stand Before the Barrier Mobile Robot-Design and Implementation

Abdülkadir Cakir*[1], Amal Ali Sreawi[2]
[1]Department of Electrical and Electronics Engineering, Faculty of Technology, Suleyman Demirel University, Isparta, Turkey.
[2]Department of Computer Engineering, Faculty of Engineering, Suleyman Demirel University, Isparta, Turkey.
Corresponding author, e-mail: abdulkadircakir@sdu.edu.tr*[1], akeel.bahaa.3@gmail.com[2]

Abstract

A Between two line follower stand before the barrier mobile robot is a mobile machine that can detect and follow between two line drawn on the floor. Generally, the path can be white lines on a black surface or it can be black lines on a white surface. Today robot is very important in our life because it can do everything without human intervention, especially for difficult or danger works. And the second cause is that robots able to work for a long time without feeling tired. Therefore in this research we will going to design robot that able to walk between two lines, and at the same time, this robot can pass the barriers that facing it. We conclude from this that this robot can help in many areas, such as to be a helper in hazardous work or in the transport of materials that are dangerous to human life, Or that this robot be helpful for people with disabilities where carts industry able to navigate seamlessly, also can use this robot in military actions. In this study robots should sense the line with its Infrared Ray (IR) sensors, and the objects sensors should sense the objects in front of the robot to be able to pass it easily. The work of the robot depends on the receipt information from sensors and sent this information to the main memory (arduino) and then to the motors as the Android based movement According to the information received from sensors.

Keywords*: Barrier, Mobile Robot, Line Follower*

1. Introduction

Between two line follower stand before the barrier mobile robot is a mobile machine that can detect and follow between two line drawn on the floor. Generally, the path can be a white lines on a black surface or it can be a black lines on a white surface. Today robot is very important in our life because it can do everything without human intervention, especially for difficult or danger works. And the second cause is that robots able to work for a long time without feeling tired [1].

The basic operations of the Between two line follower stand before the barrier mobile robot is capturing the two line and walk between it with two optical sensors mounted at the bottom of the robot body. At the same time there is IR Sensor in the front section of the robot to distinguish objects facing robot. Two motor are used to control and guide the movement of robot.

This type of robot can be used in many applications in our daily lives such as: It can be used in the transport of goods and purposes in the giant factories, as well as it can be used in the transport of hazardous materials that are dangerous for human

life. It also can be used in a very important area, it can be used in the disabled and older vehicles to be helping them in their movement easily, And a lot of everyday applications where the robot can work for long hours without having to feel tired, unlike man, so the robot is Assistant friend of humans.

In this study we will share our experience to benefit in the future. Between two lines follower stand before the barrier mobile robot will be discuss the structure and mechanism of action in Section 2. Clarify the algorithms and a line follow and stand in front of the obstacles and pass it in Section 3. The programming of Between two line follower stand before the barrier mobile robot will be explained in section 4. Conclusions will be explained in section 5.

Received Octeber 16, 2016; Revised January 15, 2017; Accepted January 30, 2017

We ended up designing, building and programming the robot and it has been successfully tested. Between two line follower stand before the barrier mobile robot can be seen as described above in Figure 1.

2. Structure of between Two Line Follower Stand before the Barrier Mobile Robot

The pieces used in the manufacture of robots as shown in the following Table 1.

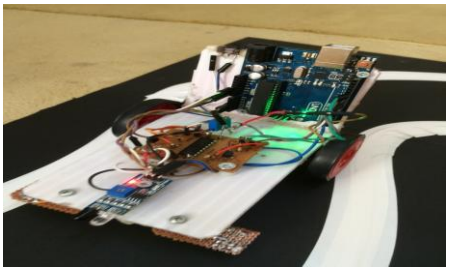

Figure 1. The designed between two line follower stand before the barrier mobile robot

Table 1. The used parts in the project

No	Part name	Amount
1	-+ArduinoUno(Atmega328)	1
2	IR sensor	1
3	CNY70 sensor	2
4	motor (DC servo)	2
5	motor Driver	1
6	Power source	1
7	Body	1
8	Power switch	1
9	Power Cable	1
10	Connecting Cables	As needed
11	Front Support Wheel	1
12	Motor Wheel	2

The electrical circuit of some line follower robots can compare the analog signal received form sensors and then transmit the result to the processor in digit '0' or '1' and some of them send the analog signal to the processor directly. Anyway, the analog signal must be converted to the digital form and then the processor can process it according to that digit [2].

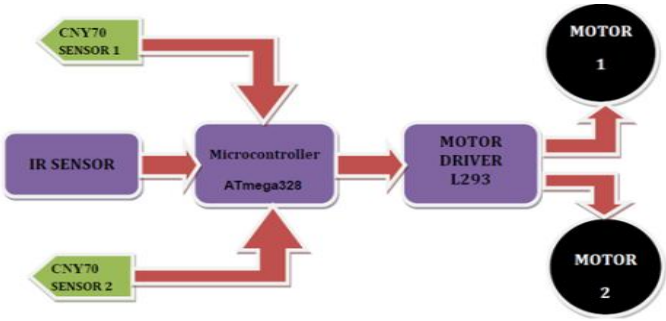

Figure 2. Between two line followers stand before the barrier mobile robot block diagram

All the pieces in the robot is supplied with power from the sources of energy. The robot's block diagram in Figure 2.

2.1. The Processor

In our project we have used arduino uno microcontroller board based on ATmega328 microcontroller. This type of microcontroller can be programmed by using C language. Because Atmel's AVR microcontrollers have a RISC core running single cycle instructions and a well-defined I/O structure that limits the needs for external components [2].

Atmel's ATMega328 8-Bit Processor in 28 pin DIP package. It's like the ATmega168, with double the flash space. 32K of program space. 23 I/O lines, 6 of which are channels for the 10-bit ADC. Runs up to 20MHz with external crystal. Package can be programmed in circuit. 1.8V to 5V operating voltage [3].

2.2. IR Sensor

In this project we used one IR sensor (Figure 3) placed at the front of the body for the purpose of detecting objects and obstacles faced by robot.

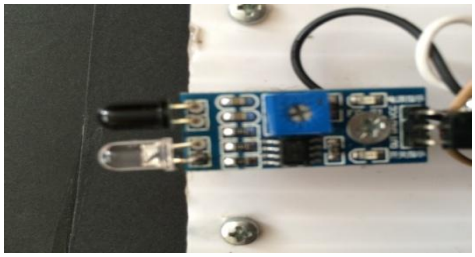

Figure 3. IR sensor used in the project

IR Sensors work by using a specific light sensor to detect a select light wave length in the Infra-Red (IR) spectrum.

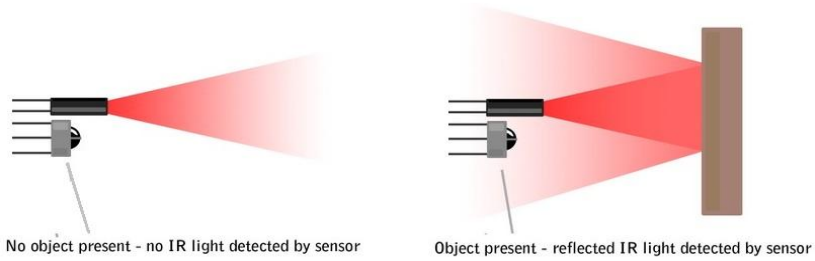

Figure 4. Depiction of the operation of an IR Sensor

By using an LED which produces light at the same wavelength as what the sensor is looking for, you can look at the intensity of the received light. When an object is close to the sensor, the light from the LED bounces off the object and into the light sensor. This results in a large jump in the intensity, which we already know can be detected using a threshold (Figure 4) [4]. You can see the schematic diagram of IR sensor in Figure 5.

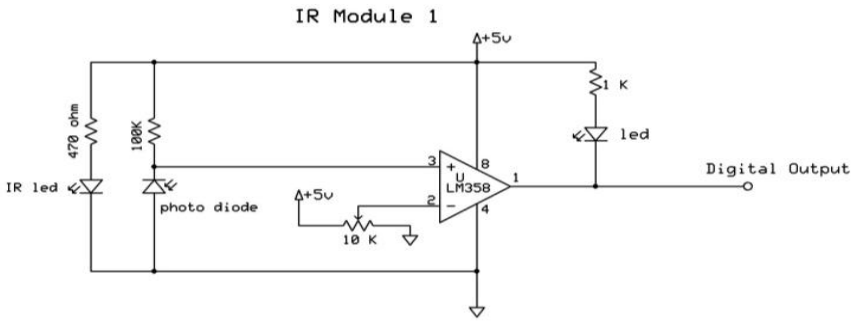

Figure 5. Schematic Diagram of IR sensor

2.3. CNY70 Sensor

In our project you can see that we used two CNY70 sensors (Figure 6). It was placed in the lower part of the body in order to monitor the lines and walk between them and not to deviate from the specified path.

We can see from Figure 6 above that this type of Sensor contains a diode and a transistor, since the diode is sending rays and the transistor receive it.

CNY70 sensors are often used to detect white and black surfaces. White surfaces generally reflect well, but black surfaces reflect poorly. Hence, the distance between sensors and ground surface is important and it is more important that how we put sensors near to each other. The distance between sensors and ground surface must be 2 to 10 mm [5].

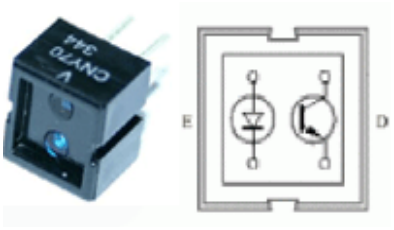

Figure 6. CNY70 sensor

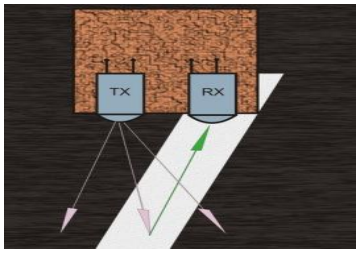

Figure 7. Work principles of CNY70 sensor

From Figure 7, we see that the reflected radiation from the white lines are much stronger than that reflected from the black. Therefore, in this project we used two sensor to control the robot movement between the white lines on a black ground.

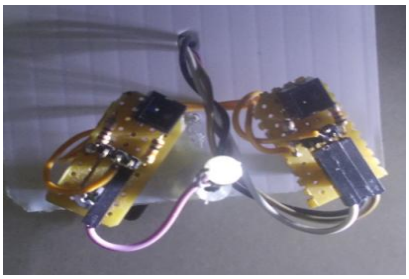

Figure 8. CNY70 sensor in project

You can see the schematic diagram of CNY70 sensor in Figure 9 shown below

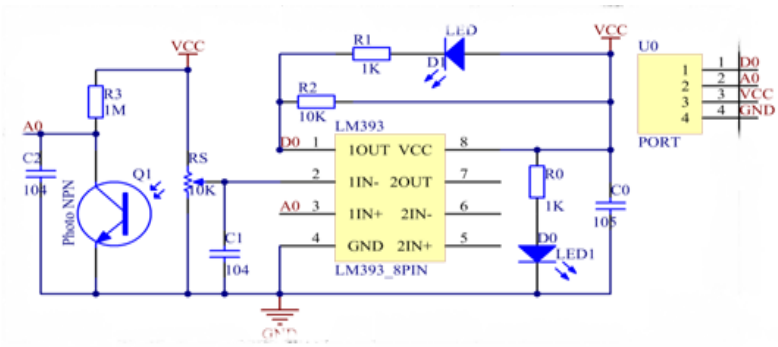

Figure 9. Schematic diagram of CNY70 sensor

2.4. Motors and Wheels

The movement system is very important part of a robot. And its objective is how to move robot from one point to another one. This system has some details shown us how we should use motors and wheels. We use motors to convert electrical energy to the mechanical energy. There are a lot of kinds of motors and we must choice the best one that we need. Our choice is depended on the robot function, power and precision. Undoubtedly, one of the agents of success of our robot is to choose good motors. [2]

In this project we have used two 5v servo DC motor as shown in Figure 10 below. We used this type of motors for several reasons

1. Low power consumption.
2. High ability to control the direction.
3. Can increase susceptibility to movement.

Figure 10. 5v servo DC motor

For our project we used three wheels, Two of them were placed in the back of the robot, And one was placed in the front part of the robot to facilitate the movement of the robot to the fullest extent.

2.5. The Driver

A DC servo Motor can't be driven directly with a Microcontroller, as DC Motors requires high current and high voltage than a Microcontroller can provide. Microcontrollers usually operates at +5 or +3.3V supply and it I/O pin can provide only up to 25mA current. Commonly used DC Motors requires 12V supply and 300mA current. Moreover, the back EMF of motor can affect the working of MCU. Hence, H-bridge motor controller named L293D was used for the robot. The benefit of this H-bridge is the direction of motor and speed can be changed by controlling 4 switches by means of coding [6].

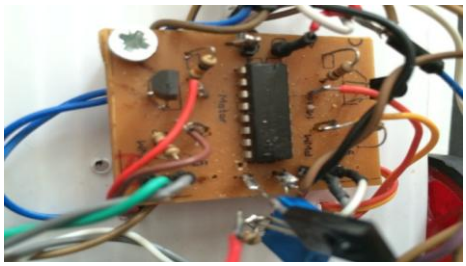

Figure 11. Motor Driver

To control the movement and speed of the DC motor in robot we have H-Bridge in L293D. H-bridge shown in Figure 12.

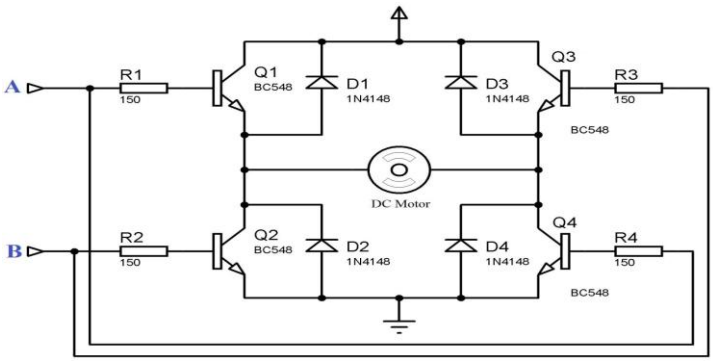

Figure 12. H-bridge

Two fuzzy commands are used to control the left wheel and right wheel respectively. Combined these commands, the robot movement can be described by the following five fuzzy sets: (Forward, Backward, Right, Left, Stop), as presented in Table 2 [7]. From the data in Table, the decision of the robot movement is depends on the line following.

Table 2. Robot movement.

Motor 1		Motor 2		Direction
A	B	A	B	
0	1	0	1	Forward
1	0	1	0	Backward
0	1	1	0	Right
1	0	0	1	Left
0	0	0	0	stop

2.6. The Body

We were in this project choose plastic material to design the body of our robot because it's have a light weight, Easily installation pieces above it, and for its flexibility.

Figure 13. The Body

3. The Working Principle and Algorithms

In our project of the most important things is sensor arrangement. We were put CNY70 Sensor on the bottom of the body, the gap between Sensor and the earth is 1 cm to get the best results and not to get a mistake in the work of Sensor and going out of the specified path. Also the distance between the Sensor and the ground it must be no more than 2 cm to get the best work. Line width also can cause problems if it is small, so in this project the line width is 2 cm. Each of two sensors will give a digital output either line is present or not.

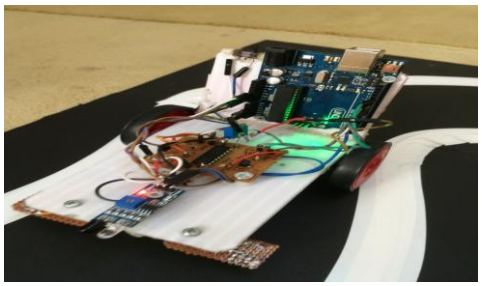

Figure 14. Lines and sensor arrangement

As shown in the Figure 14 above we were put IR Sensor in the front part of the body. This Sensor detects objects facing robot and send information to motors to stop for 2 sec, and after that the robot going to pass the barrier from the left. After this explanation drawing of the circuit in the project will be as follows in Figure 15.

An Efficient between two line follower stand before or pass the barrier algorithm plays a crucial role in between two line follower stand before the barrier robot. We have in our project two algorithms.

1. The first Algorithm of our project is between two line follower pass the barrier robot and its algorithm shown in Figure 16 below.

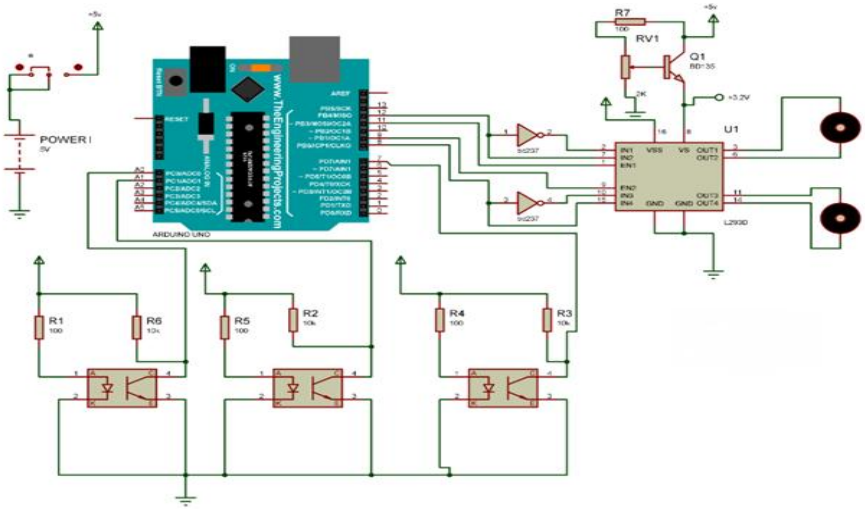

Figure 15. Project Circuit diagram

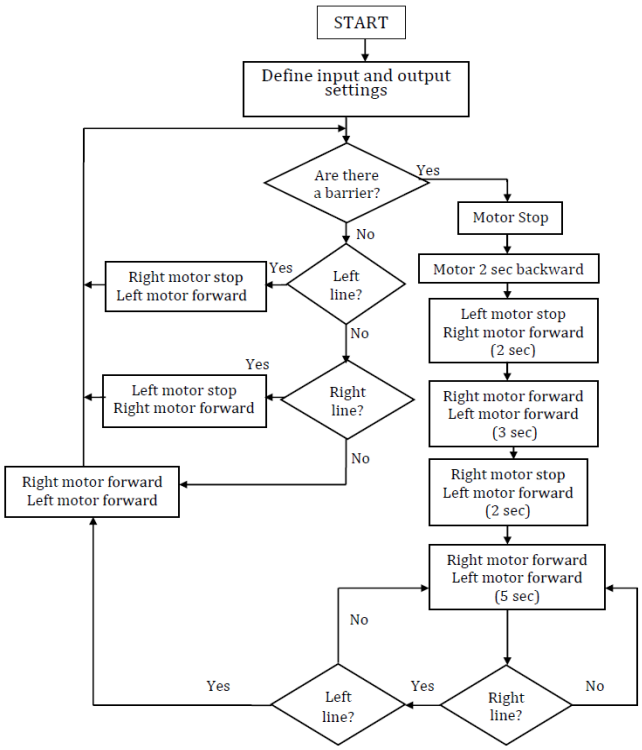

Figure 16. Between two line followers pass the barrier algorithm

2. The second algorithm is between two line follower stand before the barrier and its algorithm shown in Figure 17.

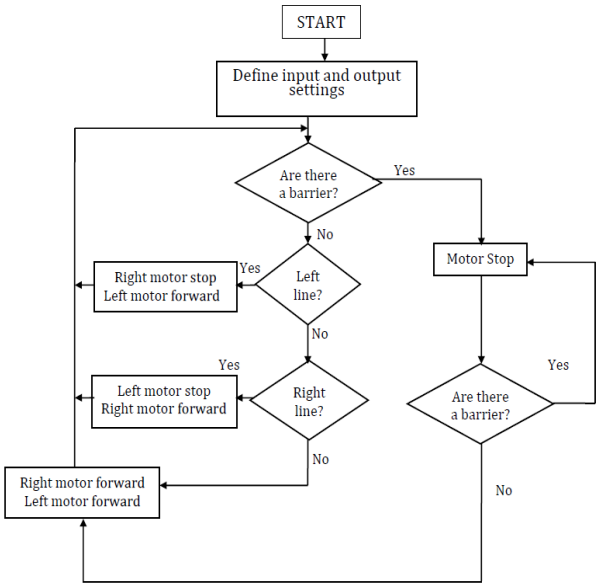

Figure 17. Between two line followers stand before the barrier algorithm

5. Conclusion

Between two line follower stand before the barrier mobile robot is able to walk between two lines without any mistake, When the robot face any obstacle, the robot stops, Then pass the barrier from the left and back to complete his way between two lines.

The designed between two line follower stand before the barrier mobile robot has two CNY70 Sensor putted on the bottom of the body to exploring the existing lines on each side and walk between them. Also the designed robot has IR sensor putted in front part of the body. This Sensor detects objects facing robot and send information to motors to stop for 2 sec, and after that the robot going to pass the barrier from the left. The controller board include ATmega328 microcontroller. And we used the motor driver L293D which were used to control the direction and the speed of motors. So that the designed robot will be able to follow a two line and having the ability to avoid barrier with a very simple algorithms.

References

[1] Dan N, Wang J. Two Wheeled Robot Self Balancing Control Research. *TELKOMNIKA*. 2016; 2(3): 617-624.
[2] Pakdaman M, Sanaatiyan MM. *Design and Implementation of Line Follower Robot*. Second International Conference on Computer and Electrical Engineering. Singapore. 2009; 2: 585-590.
[3] Sparkfun: https://www.sparkfun.com/products/10524. Date: 17.03.2016.
[4] Education: http://education.rec.ri.cmu.edu/content/electronics/boe/ir_sensor/1.html. Date: 01.05.2016.
[5] Engin M, Engin D. *Path Planning Of Line Follower Robot*. Proceedings of the 5th European DSP Education and Research Conference. Amsterdam. 2012: 1-5.
[6] Kaiser F, Islam S, Imran W, Khan KH, Islam KMA. *Line follower robot: Fabrication and accuracy measurement by data acquisition*. In Electrical Engineering and Information & Communication Technology (ICEEICT). Bangladesh. 2014: 1-6.
[7] Sahib M, Kadom L, Abdullah D. Robust Method for Robotic Guidance Using Line Following Method. *International Journal of Engineering and Innovative Technology (IJEIT)*. 2014; 4(3): 6-15.