ROBOT CLEANER

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ABSTRACT

Creating a robot is an important aspect of engineering, yet it is essential not to lose sight of the primary purpose which is our projects aim—making people's lives easier. Robot Cleaner is an obstacle avoiding robot which features a mop attachment at its base. It has an ultrasonic sensor which is an instrument that measures the distance to an object using ultrasonic sound waves. The sensor enables it to navigate without collisions and, the mop at its base collects the dirt from the floor. Consequently, during its movement, the device completes the task of cleaning.

INTRODUCTION

The project's goal is to create a robot that cleans an area while avoiding hitting objects around it. The robot has an ultrasonic sensor in the front that makes it collision-free. Thanks to mop attachment at its bottom, it avoids collisions and cleans the area at the same time.

Among the various types, some sensors are expensive for everyday use. Automatic Vacuum Cleaners have these types of sensors and, they are pricey since these devices make some chores easier for people to do. The manner of work of these types of machines is variable: some of them vacuum and mop, while others are dedicated solely to vacuuming or mopping, like our machine. The ones that are used in home environment have more features like using control remotely with smart phone and longer runtime. Our project is a prototype of these types of devices. It has one ultrasonic sensor on the front which makes the robot collision-free. Prior to project development, considerations were given to factors such as cost-effectiveness, design simplicity and, low-profile construction. Our aim was to achieve something that is a luxury in a simple way.

If these devices were lower priced, like we aimed to do, they wouldn't only be in the home environments more, but they would also become a part of the streets. Since the population is too high, manpower in the service industry becomes insufficient every day. To solve this endless problem completely, imagine that there are Robot Cleaners on the streets all the time without getting tired, hungry, or sleepy. While it reduces the expenses in long term, it is also more efficient than a human worker. With this power, not only our streets, but also our world would become cleaner.

Hence, the Robot Cleaner is simple yet useful solution that benefits environmental considerations. By addressing significant problems, such as environmental pollution, with the simplest solutions, we not only save our recourses but also prepare a more sustainable future for the next generations.

METHODOLOGY

1) Experiment Set-Up

The hardware consists of Arduino Uno R3, L298N Dual Motor Driver Board with Voltage Regulator, HC-SR04 ultrasonic sensor, 6V 250 Rpm DC motor, 6 AA Battery Slot, jumper cables, batteries and, platform.

a) HC-SR04 Ultrasonic Sensor

A sensor is a device that detects a physical parameter and converts it into electrical signal that can be measured and used by an electronic system. The detected quantity is usually a form of energy that is analog and is converted into electrical energy using a transducer. For instance, microphone is a transducer which converts sound energy into electrical energy.

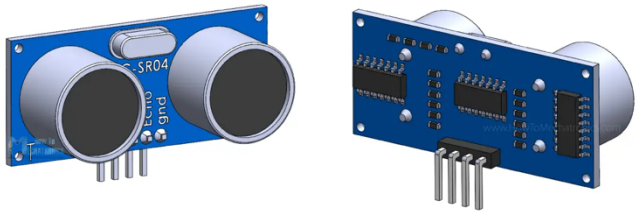

Figure 1- HC-SR04 Ultrasonic Sensor

An ultrasonic sensor measures the distance by using ultrasonic sound waves which are at a frequency above the range of human hearing. The sensor determines the distance to a target by measuring time lapses between the sending and receiving of the ultrasonic pulse.

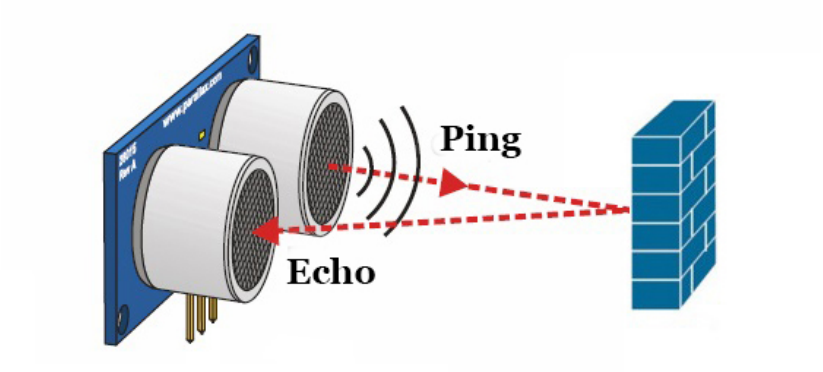

Figure 2- Working Manner of Ultrasonic Sensor

For presence detection, ultrasonic sensors detect objects regardless of color, surface, or material. However, they are insensitive to light, dust, smoke and vapor.

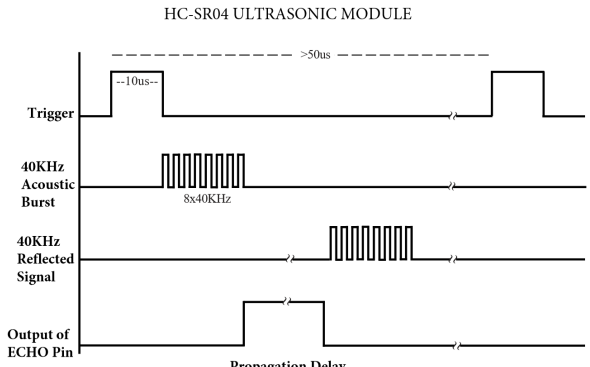

Figure 3-

To begin measuring the distance, the microcontroller sends a trigger signal to the ultrasonic sensor. The duty cycle of this trigger signal is 10μS for the HC-SR04 ultrasonic sensor. When triggered, the ultrasonic sensor generates eight acoustic (ultrasonic) wave bursts and initiates a time counter. As soon as the reflected (echo) signal is received, the timer stops. The output of the ultrasonic sensor is a high pulse with the same duration as the time difference between transmitted ultrasonic bursts and the received echo signal.

b) Arduino Uno R3

Arduino UNO is a microcontroller board based which has 14 digital input/output pins, 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button.

Figure 4- Arduino Uno R3

c) L298N Dual Motor Driver Board

Motor Driver Board controls motor speed and rotation direction of two DC motors. The L298N module can be used with motors that have a voltage between 5 and 35V DC.

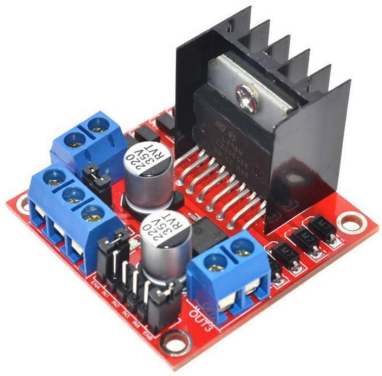

Figure 5 - L298N Dual Motor Driver Board

d)Power Supplies

A power supply is an electrical device that supplies electric power to an electrical load. The primary objective of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. Consequently, power supplies are occasionally referred to as electric power converters.

2) Building the robot

- Firstly, we fixed the 2 DC motors to the chassis with screws.
- Then, we attached the wheels to the motors and fixed the ball caster at the front side of the chassis.
- After that we attached the motor driver board on the chassis.
- We fixed the battery slot to the chassis.
- After that, we fixed the Arduino Uno R3 next to the battery slot.
- After making the necessary attachments with the jumper cables we fixed the ultrasonic sensor to the front side of the chassis.
- Then, we made the connections as follows (Figure 6):
- Finally, we made the final programme on Arduino an run the robot.

Connections of Ultrasonic sensor:

1. VCC – VCC terminal of Arduino."
2. GND – GND terminal of Arduino.
3. Trigpin – digital pin 9 on Arduino.
4. Echo pin – digital pin 10 on Arduino.

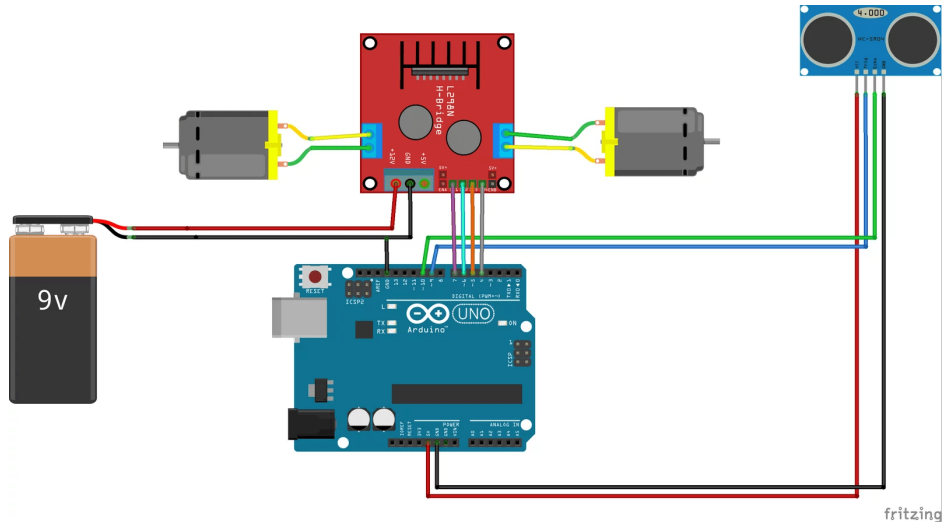

Figure 6-Connections for Obstacle avoiding robot

Connections of Motor Driver Board:

1. +12V – Positive terminal of the battery.
2. GND of Arduino -Negative terminal of battery.
3. Input terminal 1 – Pin 4
4. Input terminal 2 – Pin 5
5. Input terminal 3 – Pin 6
6. Input terminal 4 – Pin 7
7. Output terminal 1 – Positive of first motor.
8. Output terminal 2 – Negative of first motor.
9. Output terminal 3 – Positive of second motor.
10. Output terminal 4 – Negative of second motor.

RESULTS AND DISCUSSION

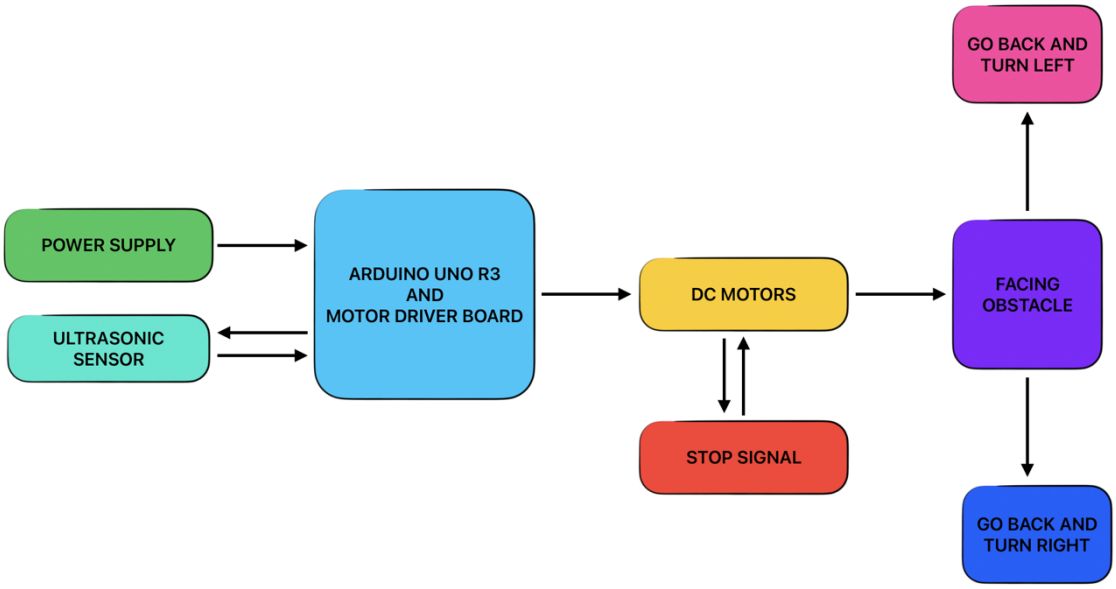

Figure 7- Obstacle avoiding robot diagram

As shown in the Figure 7, the ultrasonic sensor sends the data which it calculated as told in methodology, sends it to Arduino Uno R3 and Arduino manages it then sends a default data to motor driver board. After that, the motor driver board converts our input to a physical action and starts moving. To illustrate, while the robot moves it calculates its movements at every step. If it doesn't come across to any object, it doesn't change its direction. However, if the sensor detects any object near; robot changes its direction as shown in Figure 7.

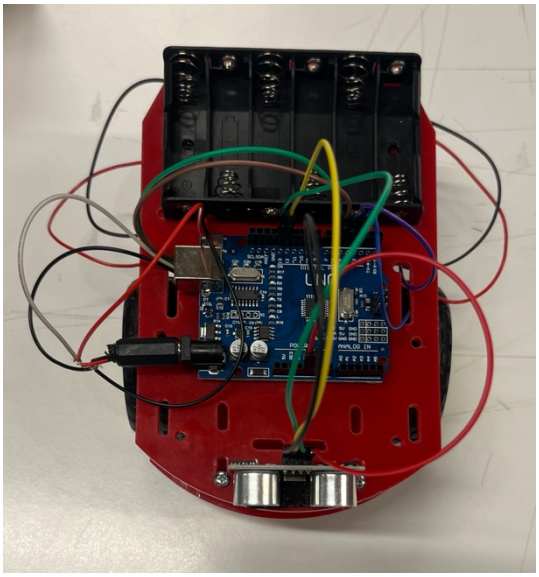

*Figure 9-The Obstacle Avoiding Robot Version*1*

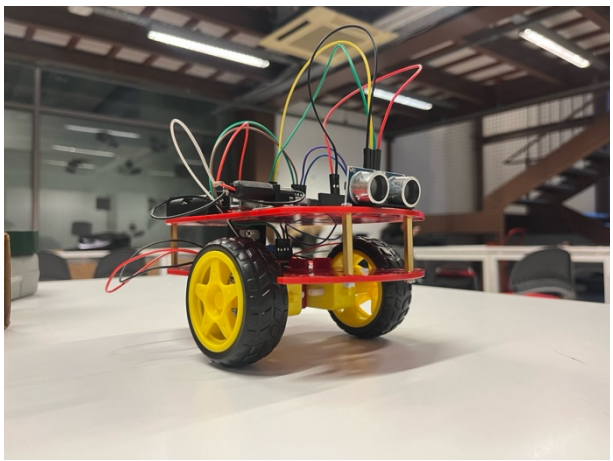

*Figure 8- The Obstacle Avoiding Robot Version*1*

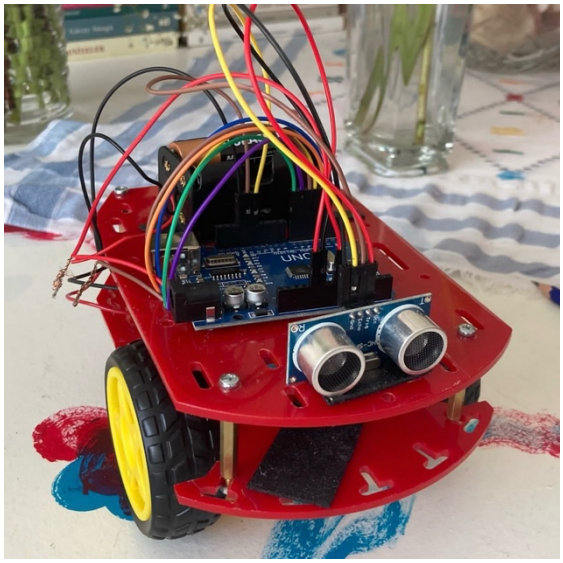

*Figure 12-Obstacle Avoiding Robot Version*2*

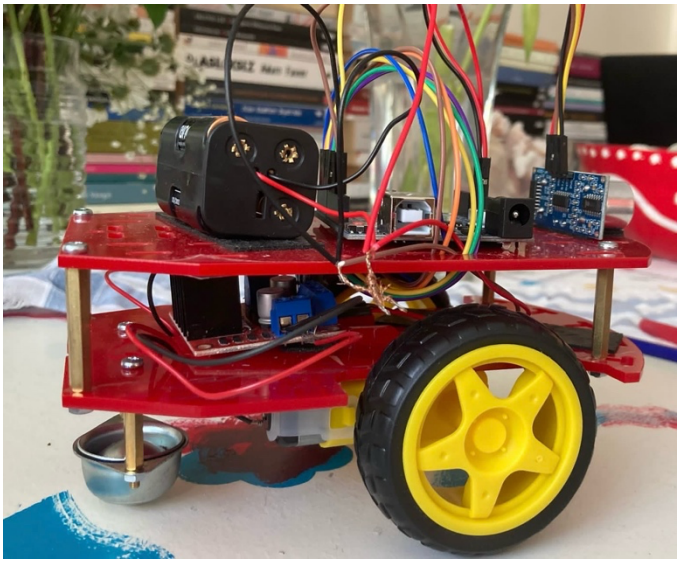

*Figure 10-Obstacle Avoiding Robot Version*2*

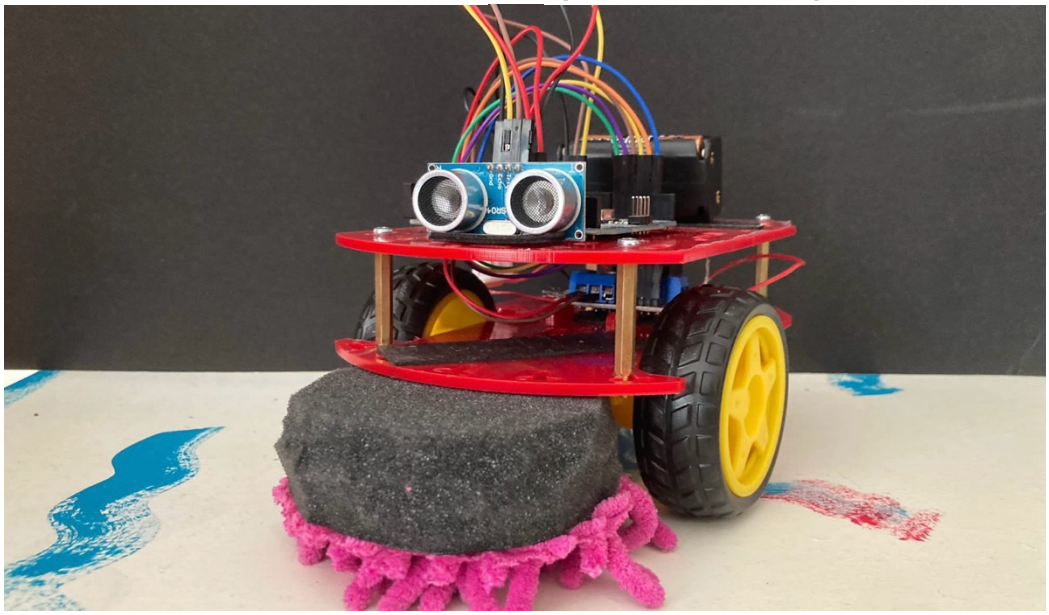

Figure 11-Robot Cleaner

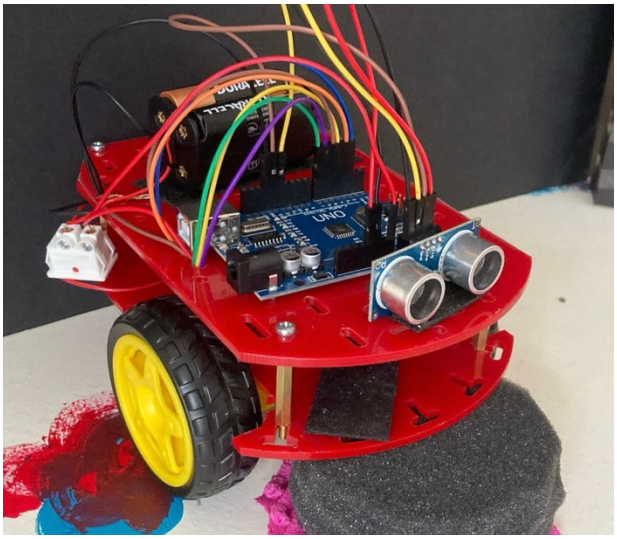

Figure 13-Robot Cleaner

CONCLUSION

In the beginning of this project, our aim was to achieve something complex that people use in daily life with a lot simpler yet still useful mechanism. We succeed and the final state of our robot is like a prototype of an actual robot cleaner.

This prototype could be improved with Bluetooth module to use our mobile phones as a remote control, better cleaning parts like adding vacuum to the system, adding more sensors for better movements, and updating code to catch up with these evaluated movements.

What makes this robot different than the actual ones is that it is more reachable because of its lack of features as mentioned. Since it is more reachable, that means that more people can use it. We can have them in streets, cleaning the endless roads and making our environment lot cleaner. The current product has insufficient battery space since the ones we have used has lower voltage than Lithium-Polymer batteries. Using that kind of batteries would lead the robot to have longer run time and have less ecological footprint.

The final product is parallel to the objectives that were set in the beginning. The robot cleaner cleans while it moves around, and the cost of this device couldn't be compared to the actual robot cleaners. It does have less features however our robot cleaner works and its simplicity doesn't lower its capacity. The outcome is what we were aiming to do in the first place.

APPENDIX

```
#include <stdio.h>
#include <stdlib.h>
#include <time.h>

#define echoPin 12 // Ultrasonik sensörün echo pin'i arduinonun 12. pinine tanımlandı.
#define trigPin 13 // Ultrasonik sensörün trigger pin'i 13. pine tanımlandı.
#define MotorR1 3  // R ve L harfleri motorun yönünü belirtir; sonrasında gelen sayı ise ileri ve geri hareket içindir.
#define MotorR2 4  // Burada R2 var, yani sağ motorun geri hareketi.
#define MotorRE 2  // Motorun yönünden sonra E harfi gelenler motorun gücünü tanımlayanlardır, rpm sayısını değiştirir.
#define MotorL1 5
#define MotorL2 6
#define MotorLE 7
long time, distance;
void setup() {
  pinMode(echoPin, INPUT);  // Echo pini ses dalgalarını alan pin olarak tanımlanır.
  pinMode(trigPin, OUTPUT); // Trigpin ise gönderendir.
  pinMode(MotorL1, OUTPUT);  // Geriye kalan bütün motorlar veri işlemi olacağından gönderime tanımlanır.
  pinMode(MotorL2, OUTPUT);
  pinMode(MotorLE, OUTPUT);
  pinMode(MotorR1, OUTPUT);
  pinMode(MotorR2, OUTPUT);
  pinMode(MotorRE, OUTPUT);
  Serial.begin(9600);
}
void loop() {

  int choice = random(2); // Bu komut [0,sayı) arasında bir tamsayı çıkarır, 2 koyduğumuz için 0 ya da 1.
  int randomized = random(421); // Bu sayı da 0 ile 420 arasında (ikisi de dahil).
  digitalWrite(trigPin, LOW);  // Gönderilen dalgalar arasındaki süre tanımlanır.
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  time = pulseIn(echoPin, HIGH); // Ses dalgalarının gelme süresi mikrosaniye olarak ölçülür.
  distance = time / 29 / 2; // Ses 29 mikro saniyede yaklaşık 1 cm yol kat eder, 29 a böldüğümüzde uzaklığı elde ederiz.
  Serial.println(uzaklik);
  if (distance < 10) { // Eğer ki engel 10 cm veya daha yakında ise.
    back(); // Geriye hareket et.
    delay(200); // Ve 200 mili saniye geriye hareket etmeye devam et (0.2 saniye).
    if (choice == 0) { // Engel tanımlanırsa geriye gidince rand(2) kodundan gelen sayıya göre sağa veya sola hareket eder.
      left();
    } else {
      right();
    }
    delay(700 + randomized); // Sağa ve sola dönüşü rastgele bir sürede olur, bu sayede zikzaklar çizmesi engellenir.
  }
  else {
    forward(); // Bir engel tanımlanamaz ise ileri git.
    delay(25); // Ve 0.025 saniye ileri gitmeye devam et
  }
```

```
}

void forward(){ // İleri gitmek için motorların ileri hareketlerini aktif geri hareketlerini pasif yapıyoruz, rpm ise 150 oluyor.
  digitalWrite(MotorR1, HIGH);
  digitalWrite(MotorR2, LOW);
  analogWrite(MotorRE, 150);
  digitalWrite(MotorL1, HIGH);
  digitalWrite(MotorL2, LOW);
  analogWrite(MotorLE, 150);

}
void left(){ // Sola gitmek için sol motorun hızı 0'a indirilirken sağ motor tam güçte çalışıyor.
  digitalWrite(MotorR1, HIGH);
  digitalWrite(MotorR2, LOW);
  analogWrite(MotorRE, 150);
  digitalWrite(MotorL1, HIGH);
  digitalWrite(MotorL2, LOW);
  analogWrite(MotorLE, 0);

}
void right(){ // Sağa gitmek içinse tam tersi.
  digitalWrite(MotorR1, HIGH);
  digitalWrite(MotorR2, LOW);
  analogWrite(MotorRE, 0);
  digitalWrite(MotorL1, HIGH);
  digitalWrite(MotorL2, LOW);
  analogWrite(MotorLE, 150);


}
void back(){ // Geri gitmek için ileri hareketleri pasif geri hareketleri aktif oluyor ve hızları maksimum değere çıkarılıyor.
  digitalWrite(MotorR1, LOW);
  digitalWrite(MotorR2, HIGH);
  analogWrite(MotorRE, 150);
  digitalWrite(MotorL1, LOW);
  digitalWrite(MotorL2, HIGH);
  analogWrite(MotorLE, 150);

}
```

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