A Self balancing Line follower Bike

BATCH: B1
GROUP: G

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INTRODUCTION:

Line follower robots and self-balancing vehicles are two exciting projects that demonstrate the capabilities of Arduino boards in robotics. A line follower robot is designed to autonomously navigate a path marked by a line on the ground. Using sensors to detect the line's contrast against its surroundings, the robot adjusts its movement to stay on track. Arduino serves as the control center, processing sensor data and implementing algorithms to steer the robot along the desired path. Self-balancing vehicles, on the other hand, are engineered to maintain an upright position on two wheels without tipping over. These vehicles rely on gyroscopic sensors to measure tilt angles and rates of rotation, allowing the Arduino to compute necessary adjustments to the vehicle's center of gravity in real-time. Both projects offer valuable learning experiences in sensor integration, control theory, programming, and mechanical design. Whether you're fascinated by precision navigation or intrigued by stability control, Arduino-based robotics provides an accessible platform for exploration and innovation in the world of robotics.

WHY SELF BALANCING LINE FOLLOWER ROBOT ?

This is an automated movement robot designed to operate seamlessly with rechargeable Li-ion batteries.

This straight forward and effective robot is suitable for extended distances as well.Its fundamental operations can be modified by adjusting the Arduino code.

The overall production cost of the robot is highly economical.

A self-balancing bike utilizes sensors and control algorithms to maintain stability without the need for a rider to manually balance it. Gyroscopic sensors detect the bike's tilt angle, while control algorithms adjust motor torque to keep it upright. This technology offers improved safety and ease of use, making it particularly appealing for electric bicycles and personal mobility devices. Self-balancing bikes are revolutionizing urban transportation by providing a stable and intuitive riding experience for users of all skill levels.A self-balancing bike with a reaction wheel utilizes gyroscopic principles to maintain stability. By spinning a reaction wheel in the opposite direction of any tilting motion, the bike counteracts imbalance and remains upright. This technology enhances rider safety and comfort by automatically stabilizing the bike without requiring manual input.

BASIC WORKING PRINCIPLE:

The working principles of both a line follower and a self-balancing vehicle with an Arduino board involve sensor feedback and control algorithms.

For a line follower:

1. *Sensor Input*: Infrared or reflective sensors detect the contrast between a line on the ground and its surroundings.
2. *Arduino Processing*: The Arduino board receives sensor data and analyzes it to determine the position of the line relative to the robot.
3. *Control Algorithms*: Based on the sensor inputs, control algorithms determine the direction and speed adjustments needed to keep the robot on the line.
4. *Motor Control*: The Arduino sends commands to motor controllers, which adjust the speed and direction of the robot's motors accordingly.
5. *Iterative Process*: The robot continuously adjusts its movement based on real-time sensor feedback, creating a closed-loop control system.

For a self-balancing vehicle:

1. *Sensor Input*: Gyroscopic sensors, such as accelerometers and gyroscopes, measure the vehicle's tilt angle and rate of rotation.
2. *Arduino Processing*: The Arduino board receives sensor data and computes the vehicle's orientation and stability status.
3. *Control Algorithms*: Using control algorithms, the Arduino calculates the necessary corrective actions to maintain balance, such as adjusting motor torque.
4. *Motor Control*: The Arduino sends commands to motor controllers, which adjust the torque applied to the wheels or reaction wheel to counteract any tilting motion.
5. *Feedback Loop*: The vehicle continuously monitors its balance and makes rapid adjustments in real-time to remain upright, creating a closed-loop feedback system

In both cases, the Arduino board serves as the central control unit, processing sensor data and executing control algorithms to achieve the desired behavior of the robot or vehicle.

COMPONENETS USED:

- Arduino Board (UNO)
- Jumper Wires
- L298 motor driver module
- IR sensor module
- Rechargeable Li-ion Battery
- Connecting wires
- HC-06 Bluetooth Module
- Soldering iron
- Solder wire
- 2208 80KV Gimbal Brushless Motor
- Readytosky Simonk 12A Electronic Speed Controller (ESC)
- Ultrasonic Sensor
- Servo Motor

ABOUT THE COMPONENTS:

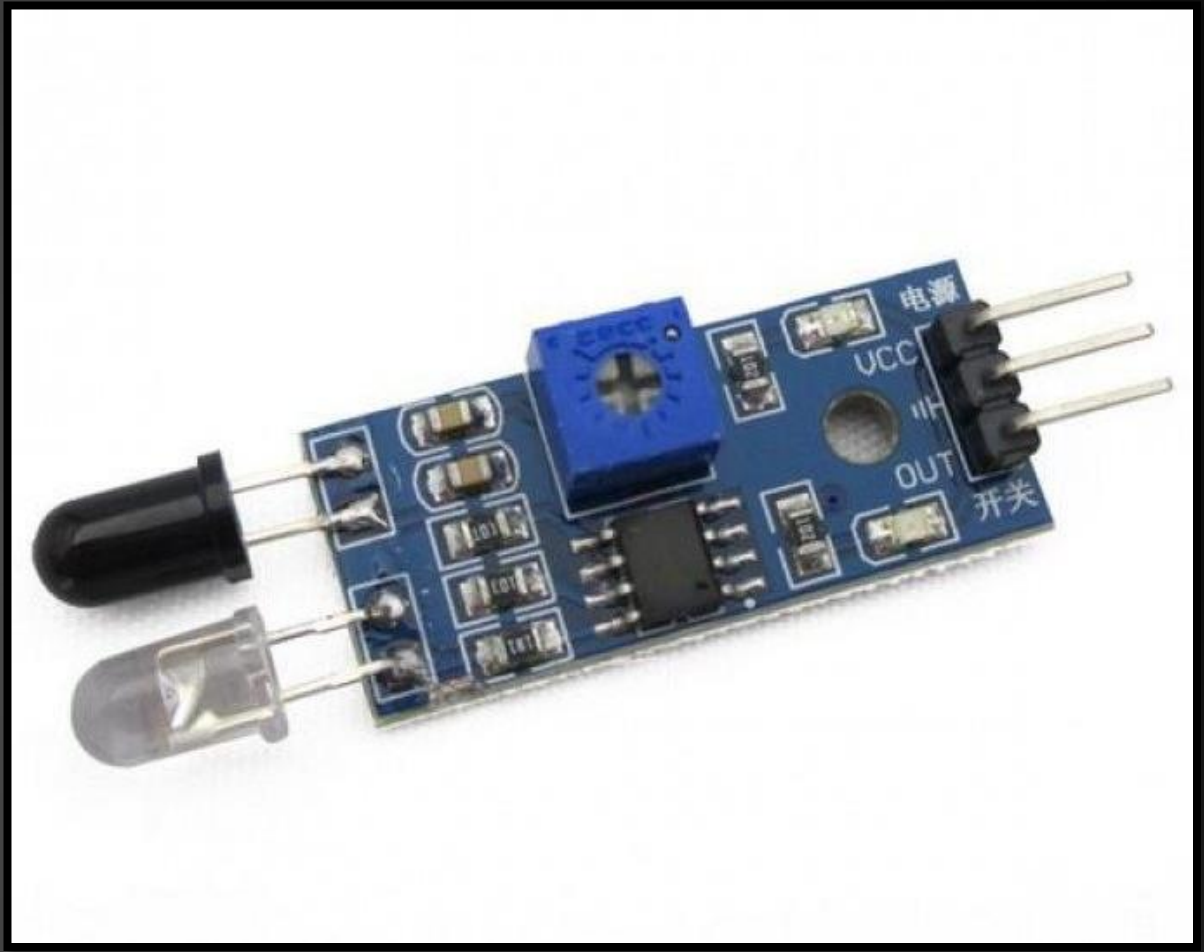
1)ARDUINO UNO:

Arduino Uno is an 8-bit ATmega328P microcontroller. To support the microcontroller, it uses components such as a crystal oscillator, serial communication, voltage regulator, etc. It has 14 digital I/O pins(6 pins can be used as PWM pins). It has six separate analogue input pins, a USB connection, a power barrel jack, an ICSP header, and a reset button.
This board is programmable with the Arduino IDE (Integrated Development Environment) platform via a type B USB cable.
This board can be powered via a USB cable or an ext ernal voltage ranging from 7 to 20 volts.

2) INFRARED SENSORS:

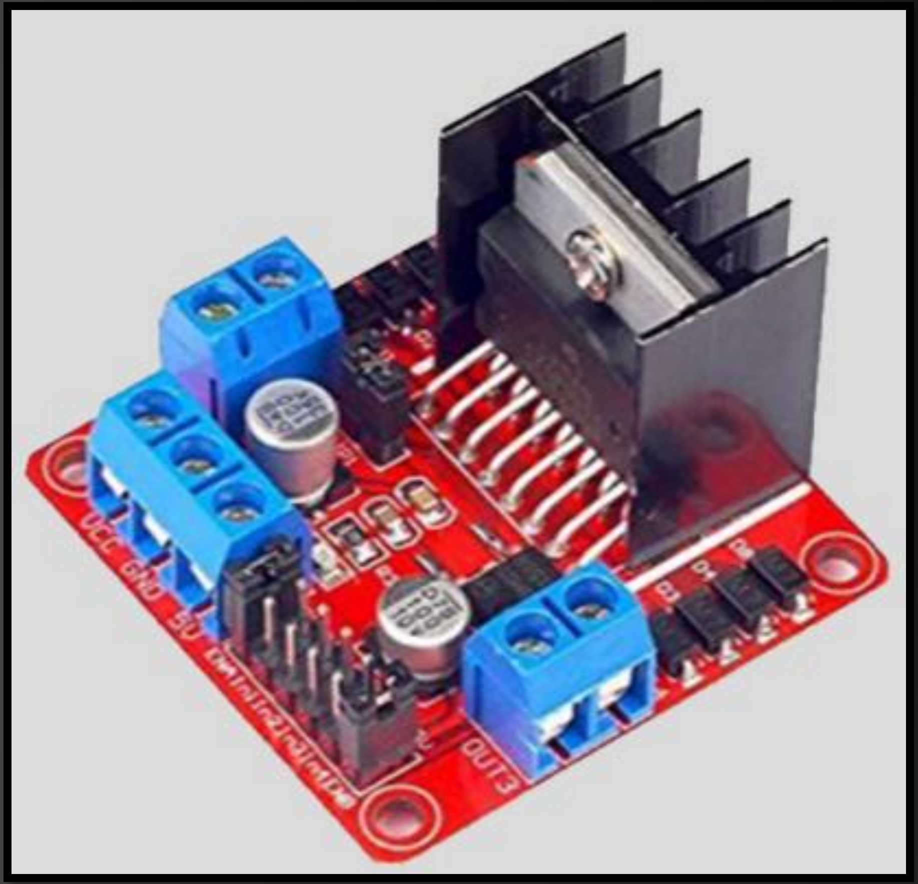
An infrared sensor utilizes light emission to perceive specific surroundings. Operating within the infrared spectrum, all objects emit thermal radiation invisible to the human eye. However, an infrared (IR) sensor can effectively capture and detect these radiations.

In this context, the IR light-emitting diode (LED) functions as the emitter, while the IR photodiode serves as the detector. The IR LED emits infrared light, and the photodiode is highly sensitive to this specific wavelength. As the IR light reaches the photodiode, both the output voltages and resistances undergo proportional changes corresponding to the intensity of the received IR light..



3)L289N MOTOR DRIVER:

L298N is one of the easiest and best ways to control DC motors. It is the two-channel motor driver that can control the speed and spinning direction of DC motors.
This L298N motor driver is a high-power motor driver module. It is used for driving DC and stepper motors. This motor driver consists of an L298N motor driver IC and a 78M05 5V voltage regulator, resistors, capacitor, power LED, and 5V jumper in an integrated circuit.
When the jumper is placed, it enables the 78M05 voltage regulator. When the power supply is less than or equal to 12 volts, the voltage regulator will power the internal circuitry. When the power supply is more than 12 volts, then the jumper should not be placed and should give a separate 5 volts to power the internal circuitry.
Here, the ENA and ENB pins are speed control pins for Motor A and Motor B. IN1 and IN2 and IN3 and IN4 are direction control pins for Motor A and Motor B.



4)BATTERY OPERATED MOTORS:

A BO motor is known as a battery-operated motor. These motors are commonly used in hobby-grade projects where the user requires a small DC motor as a simple actuator.

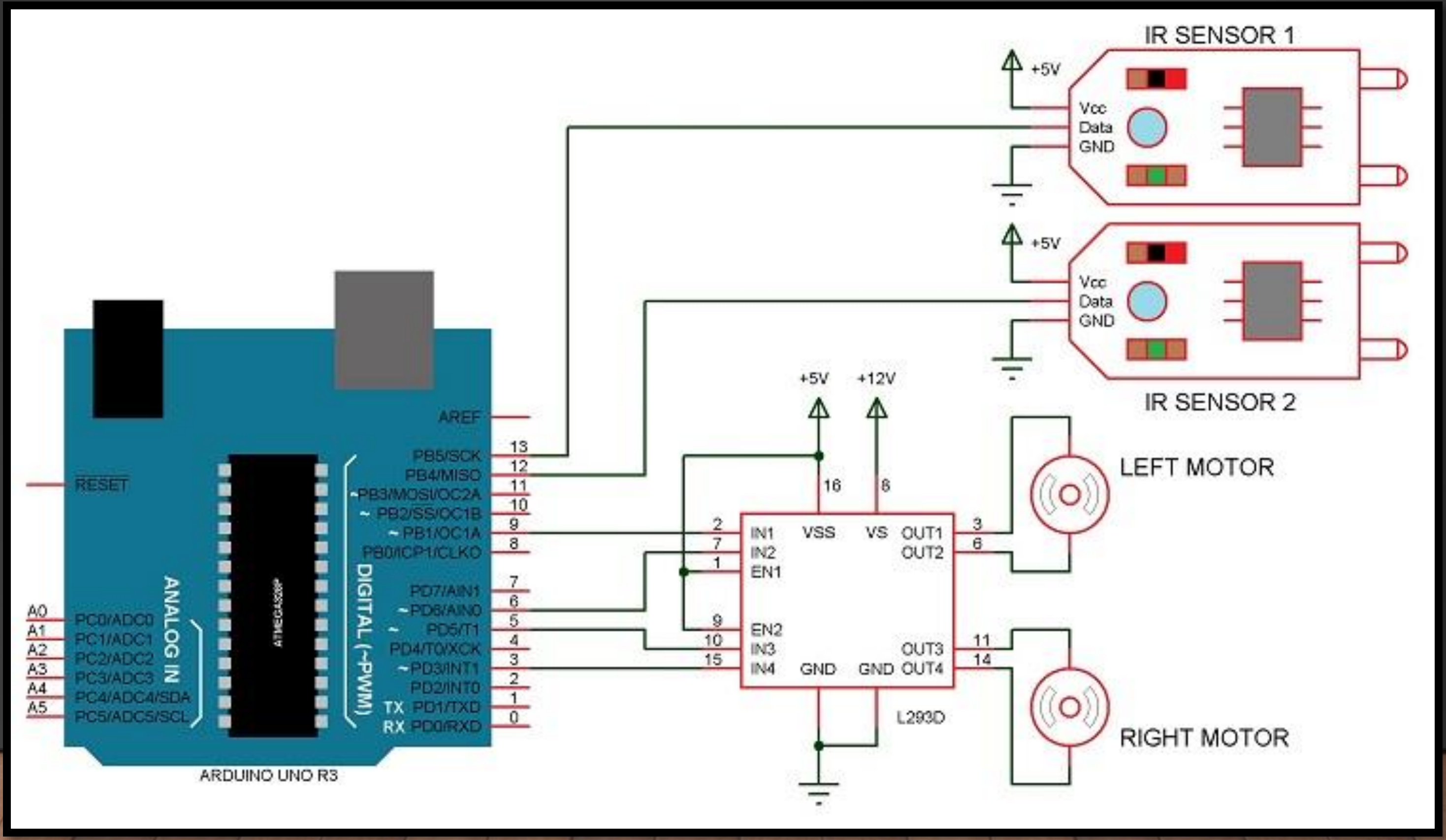
BO series linear motors provide good torque and rpm at lower operating voltages. The BO motors are available in single-shaft, dual-shaft, and DC plastic gear BO. These motors consume a low current. In this project, we have used four single-shaft BO motors.

5) LITHIUM-ION BATTERY:

A lithium-ion battery is a rechargeable battery. It is commonly used in portable devices such as mobiles, laptops, electronics, and electric vehicles. Also, they are growing in popularity for military and aerospace applications.

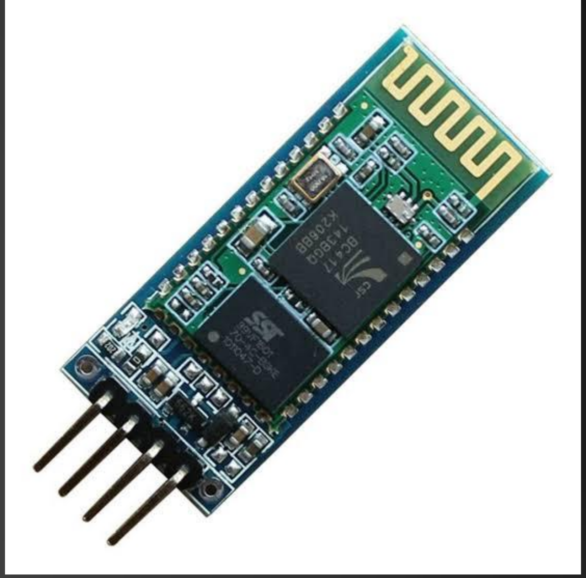
6)CONNECTIONS AND WIRING:

Here, we have used four BO motors. Motors 1 and 2 are connected to the first channel of L298N, whereas motors 3 and 4 are connected to the second channel of the motor driver.
IN1, IN2, IN3, and IN4 pins are connected to pins 9, 6, 5, and 3 of the Arduino Uno. Here, we have used the jumper between +5V and the enable pins (EN1 and EN2). You can remove it and make the external connection.



7) HC 06 BLUETOOTH MODULE:

In a self-balancing line follower project, the HC-06 Bluetooth module can be used to establish a wireless communication link between the robot and a smartphone or computer. This allows for remote control or monitoring of the robot's operation. The HC-06 module can receive commands from the master device, such as adjusting the robot's speed or direction, and send back status information like battery level or sensor readings. Its simplicity and ease of use make it a suitable choice for hobbyist projects like self-balancing line followers, providing a convenient way to interact with the robot without the need for physical connections.



8) SG 90 SERVO:

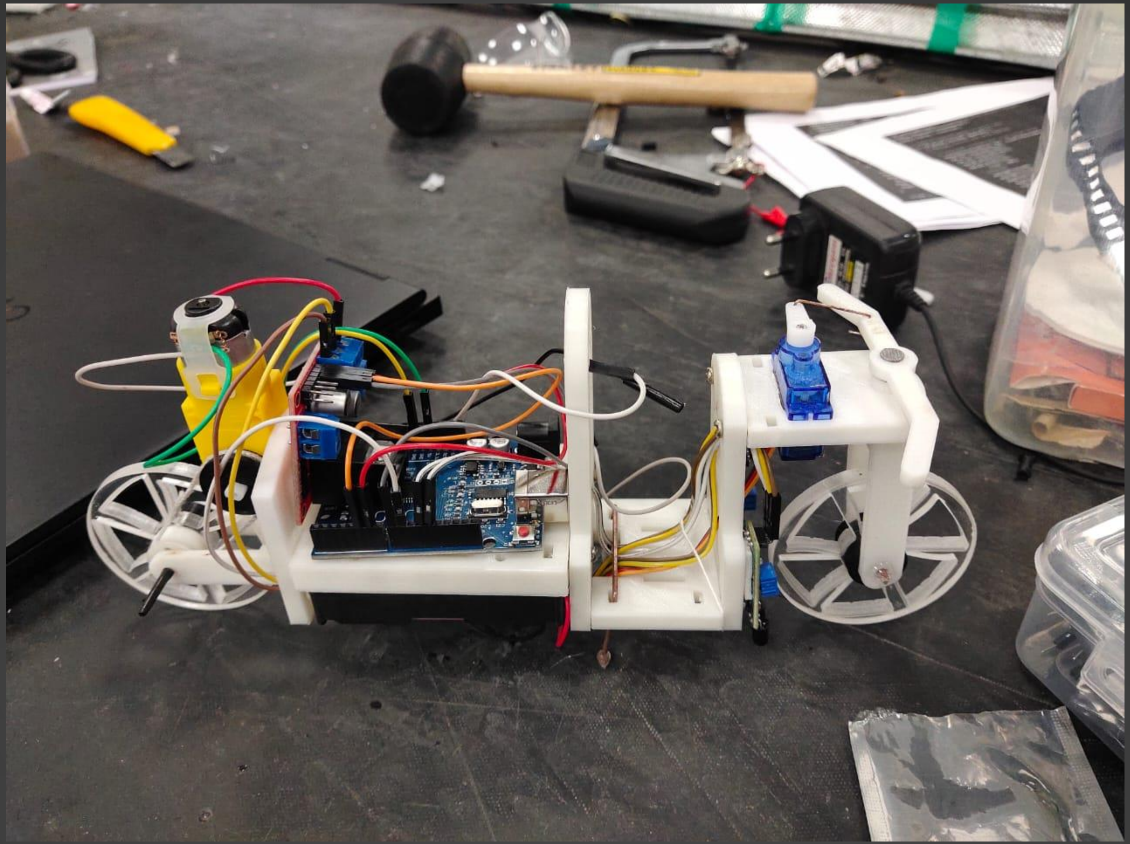
In line follower robots, SG90 servo motors are commonly used to control the direction of the robot's movement. The servo motor is typically attached to the front wheels of the robot, allowing it to steer left or right based on input from sensors detecting the line on the ground. By adjusting the angle of the servo motor, the robot can effectively follow the path marked by the line. The servo motor's precise control allows the robot to make small adjustments to its direction, ensuring it stays on course as it follows the line. This setup is popular in competitions and educational projects, as it demonstrates principles of robotics, control systems, and sensor integration in a simple and engaging way.

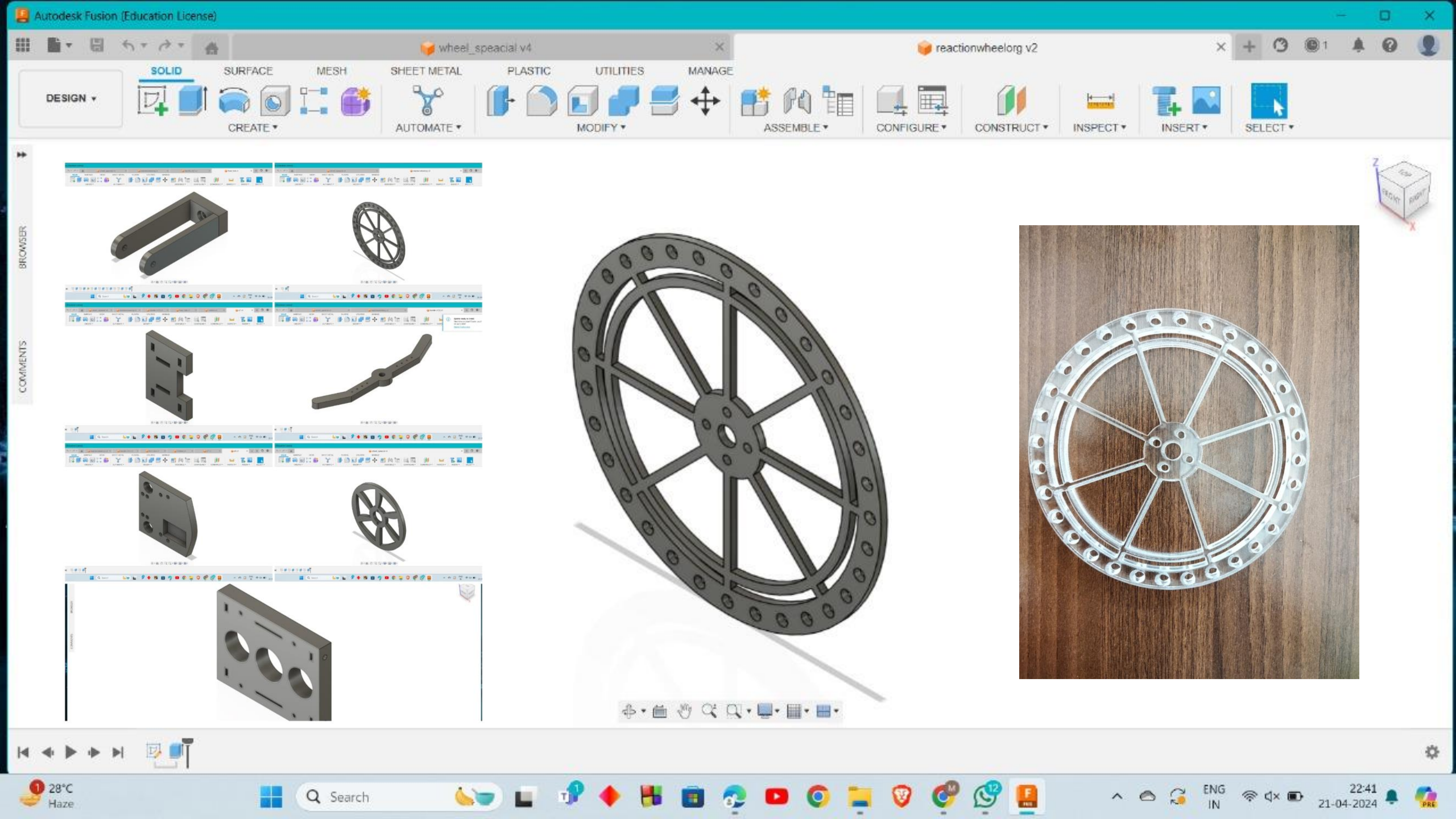
9) GIMBAL BRUSHLESS MOTOR:

The 2208 80KV gimbal brushless motor is a specific type of motor commonly used in gimbal stabilization systems, particularly in drone and camera stabilizers. The "2208" designation refers to the motor's size and dimensions, with the numbers representing the diameter and length of the motor's stator in millimeters. The "80KV" specification indicates the motor's speed constant, which signifies the motor's rotational speed per volt applied. In this case, an 80KV motor would rotate at 80 revolutions per minute (RPM) per volt applied, under no load conditions. These motors are known for their efficiency, reliability, and precise control, making them ideal for stabilizing camera and sensor systems in various applications.

10)CALIBERATION AND TESTING:

Calibration and testing are crucial phases in the development of a line follower robot, ensuring optimal performance and accuracy in following predefined paths. Calibration involves fine-tuning the robot's sensors, such as infrared sensors or cameras, to accurately detect and respond to the line on the surface. This process may include adjusting sensor sensitivity, threshold values, and ensuring proper alignment.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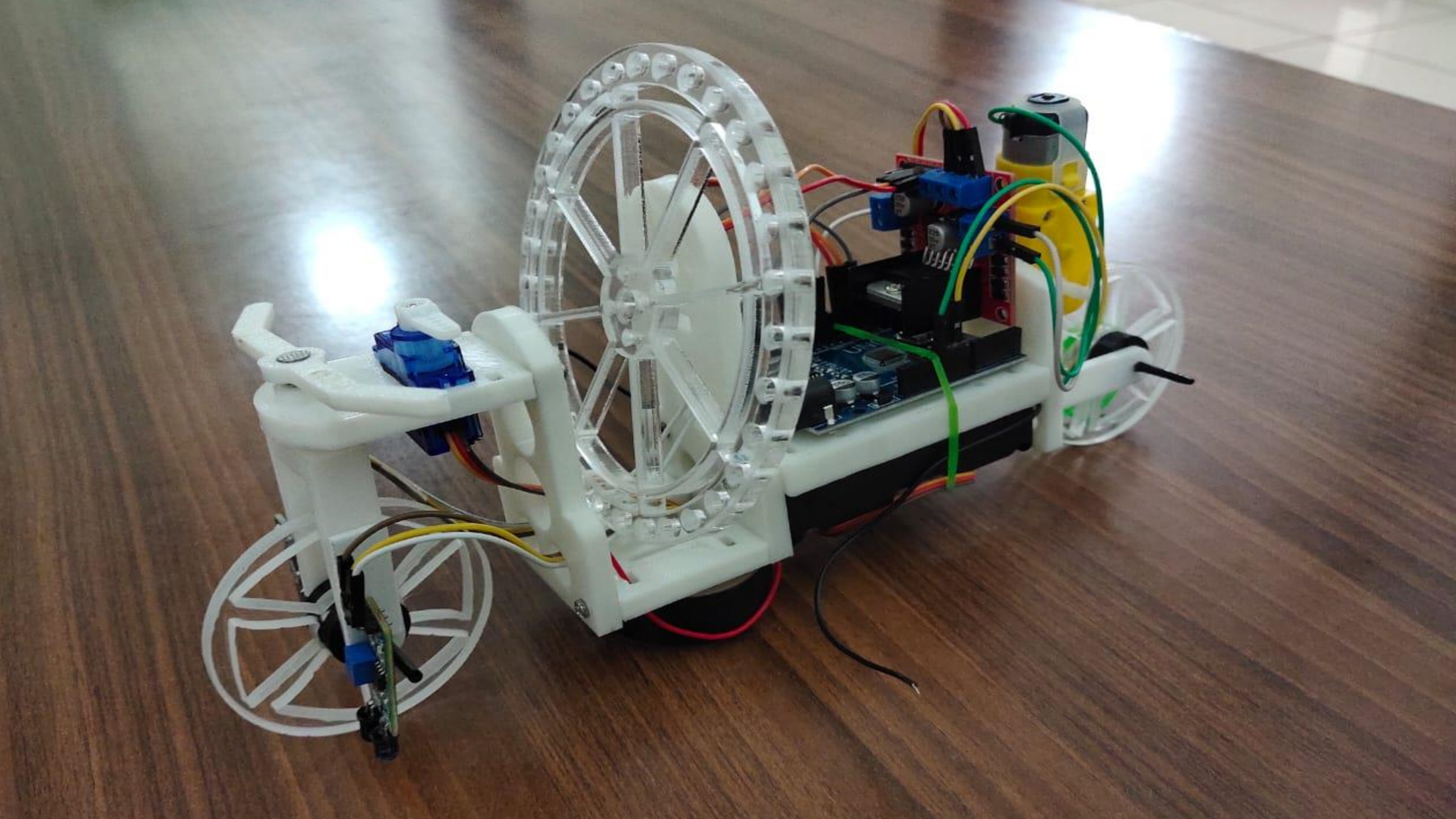

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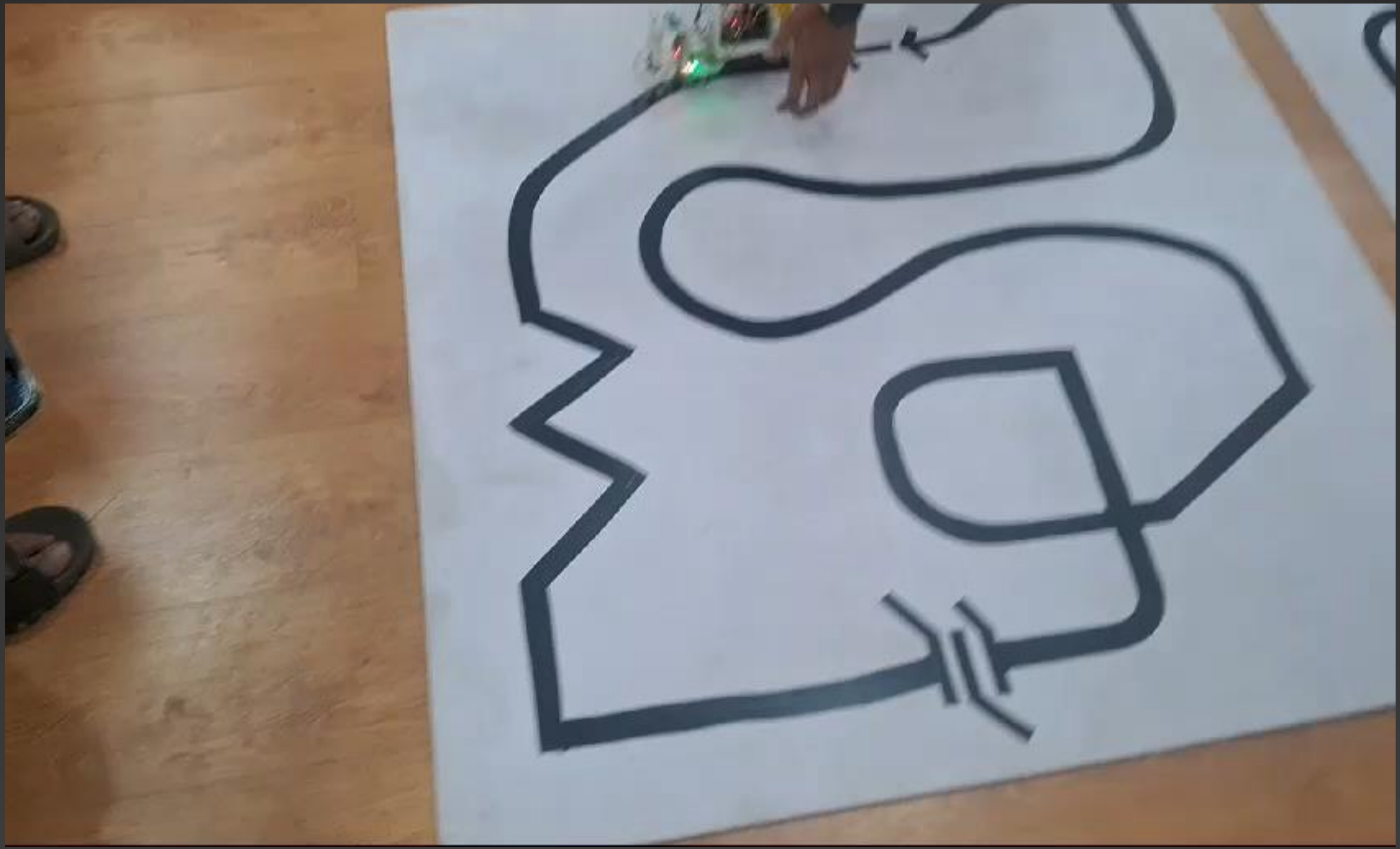

KEY LEARNINGS:

- Sensor Integration: Learnt to integrate and calibrate IR sensors.
- Algorithm Development:It provides hands-on experience in translating control theory into practical applications.
- Hardware Design:Designing the physical structure of the robot, including the chassis and motor configurations.
- Problem- Solving: Enhanced critical thinking.
- Programming Skills:Dealing with challenges such as sharp turns, intersections, and variations in line characteristics enhances problem-solving skills in robotics.
- Testing and Iteration : It involved patience and understanding for not repeating the same mistakes.
- Electronics and Wiring:Learning to connect and wire components such as motors, sensors, and microcontrollers provides practical experience in electronics and circuit design.

CONCLUSION:

In summary, the line follower robot stands at the impressive crossroads of technology and practical utility. Through its capacity to independently traverse a predetermined route via infrared sensors and advanced algorithms, it not only highlights the strides made in robotics but also introduces diverse possibilities for real-world applications. Whether applied in industrial automation or educational endeavors, the line follower robot proves to be a flexible instrument for improving efficiency and facilitating learning. As technology advances, we can expect ongoing enhancements in line follower robots, leading to heightened precision, adaptability, and seamless integration across various fields.

The purpose of our specialized feature is to investigate the possibility of designing a control system in order to stabilize the unstable nature of a bike. Furthermore, there will be an examination of system behaviour and stability in order to understand the boundaries of aforementioned design.
As a result, there will be a chance to draw a conclusion about the mechatronic design of the system and take note of strengths, weaknesses and potential improvements. In summary, the line follower robot stands at the impressive crossroads of technology and practical utility. Through its capacity to independently traverse a predetermined route via infrared sensors and advanced algorithms, it not only highlights the strides made in robotics but also introduces diverse possibilities for real-world applications. Whether applied in industrial automation or educational endeavors, the line follower robot proves to be a flexible instrument for improving efficiency and facilitating learning. As technology advances, we can expect ongoing enhancements in line follower robots, leading to heightened precision, adaptability, and seamless integration across various fields.

THANK YOU!