20-20 Drag Racing Car

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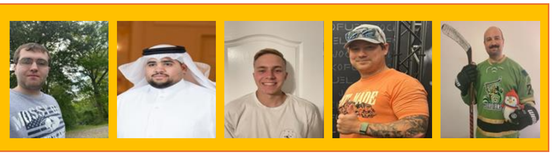


Introduction/Statement

The project's topic will be designing a small low-cost car (20cm X 20cm) which can drive 20m in a straight line fast in the shortest amount of time possible.

For some of the project objectives.

- First objective will be using cheap, efficient, and easy to use devices.
- Next is implementing the POC and programming within the car.
- Last is the overall test runs for demo day prep.
- These objectives relate back to the scope of the project.

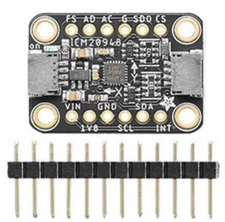
Problems Encountered

We got multiple issues that affected the performance and reliability of our previous project:

- **Motor Malfunction:** The motor failed to start or function consistently.
- **Camera Failure:** The onboard camera was not working, so we couldn't get visual feedback.
- **Gyroscope Errors:** The gyro gave us wrong orientation data, causing unstable movement.
- **Steering & Reverse Issues:** The project had trouble turning right and going in reverse.
- **Cable Problems:** We had issues with the wiring — the cables were not bundled or organized properly, making it hard to connect components together.

Requirements

- A car capable of moving in a straight line for 20 meters
- A gyroscope sensor (gyro) to help the car maintain a straight path
- An Arduino board to control the system and run the code
- A battery to power the motor and other electronic components

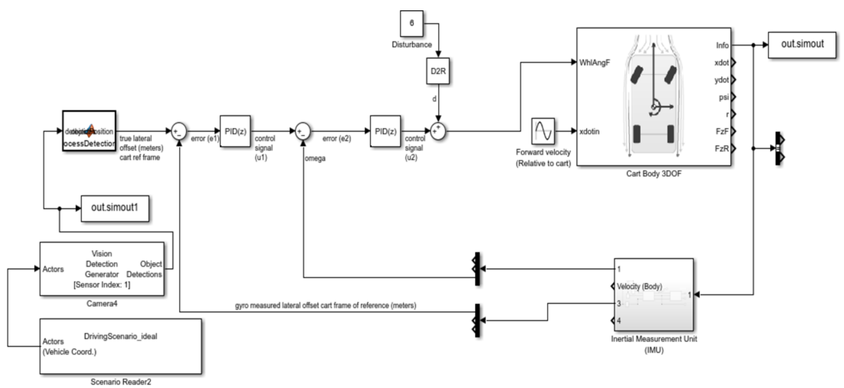


gyro

Arduino board

Simulation

- Control system designed to exploit the governing equations:
  - $u(t) = k_p\, e(t) + k_i \int e(t) + k_d \frac{de(t)}{dt}$
  - $Transfer\ Function\ C = k_p + \frac{k_i}{s} + k_d s$
- Controller testing programmed in MATLAB.
  - Actual controller design will be programmed in Arduino IDE



Testing

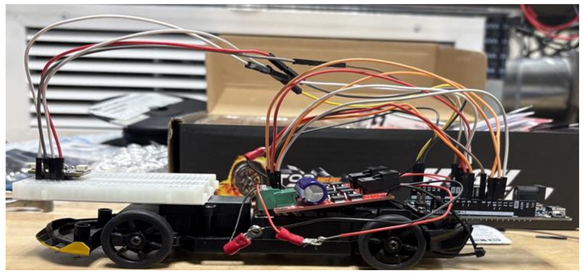
We used this code while testing the motor and the gyroscope to ensure everything was working properly. The code helped us check the motor's response and how well the gyro could help the car stay on a straight path. Below is a picture of the car during our testing phase, along with a picture of the code we used, which shows the basic setup and control logic for the motor and gyro

```
//Setup
void setup() {

  // Set all the motor control inputs to OUTPUT
  pinMode(MOTOR1_IN1, OUTPUT);
  pinMode(MOTOR1_IN2, OUTPUT);
  //pinMode(MOTOR1_PWM, OUTPUT);

  pinMode(MOTOR2_IN1, OUTPUT);
  pinMode(MOTOR2_IN2, OUTPUT);
  //pinMode(MOTOR2_PWM, OUTPUT);

  // Turn off motors - Initial state
  digitalWrite(MOTOR1_IN1, LOW);
  digitalWrite(MOTOR1_IN2, LOW);
  digitalWrite(MOTOR2_IN1, LOW);
  digitalWrite(MOTOR2_IN2, LOW);
```

Motor Setup

```
  float aX = imu.accX(); // Get acceleration in X direction (m/s²)
  float aY = imu.accY(); // Get acceleration in Y direction (m/s²)
  float aZ = imu.accZ(); // Get acceleration in Z direction (m/s²)
  float gX = imu.gyrX(); // Get position in X direction (m)
  float gY = imu.gyrY(); // Get position in Y direction (m)
  float gZ = imu.gyrZ(); // Get position in Z direction (m)
  float mX = imu.magX(); // Get compass in X direction (T)
  float mY = imu.magY(); // Get compass in Y direction (T)
  float mZ = imu.magZ(); // Get compass in Z direction (T)

  // Update velocity and distance
  velocityX += aX * deltaTime;
  distanceX += velocityX * deltaTime;
  velocityY += aY * deltaTime;
  distanceY += velocityY * deltaTime;
```

Gyro Variables



Conclusion

- The team successfully designed, built, and tested a working prototype that meets all project requirements.
- Valuable experience was gained in design, mechanical layout, and software engineering.
- The project demonstrated effective integration of hardware components such as the motor, gyroscope, Arduino, and battery system.
- Testing confirmed that the car could move in a straight line for 20 meters with the aid of the gyro sensor.
- This prototype lays the groundwork for future improvements, such as automated path correction, speed control, and remote monitoring.