Test Reports

## 1. Testing Procedures

**1.1. Sensor Calibration**

**Objective**: Ensure all sensors are calibrated correctly for accurate readings.

**Procedure**:

1. **Ultrasonic Sensor**:
   * Place the sensor in a controlled environment.
   * Measure distances to known objects and compare with sensor readings.
   * Adjust calibration settings in code if needed.
2. **Color Sensor**:
   * Test the sensor with known color samples (red and green).
   * Verify sensor outputs match expected color values.
   * Adjust sensitivity settings if necessary.
3. **IR Sensors**:
   * Place the vehicle on a track with marked lines.
   * Check the IR sensor readings as the vehicle passes over the lines.
   * Adjust thresholds in code to ensure accurate lane following.
4. **IMU Sensor**:
   * Place the vehicle on a stable surface.
   * Record orientation and acceleration data.
   * Verify data matches expected values and adjust calibration if required.

**Expected Outcome**: All sensors should provide accurate and reliable readings, allowing the vehicle to operate correctly in the competition.

**1.2. Motor and Steering Calibration**

**Objective**: Ensure that the motors and steering system are functioning correctly and responding to commands as expected.

**Procedure**:

1. **Motor Test**:
   * Run the vehicle forward and backward in a straight line.
   * Check for smooth operation and consistent speed.
   * Adjust motor driver settings in code if necessary.
2. **Steering Test**:
   * Test left and right turns to ensure the steering servo responds correctly.
   * Verify the vehicle makes sharp and controlled turns.
   * Fine-tune steering angles in code to improve accuracy.

**Expected Outcome**: Motors and steering should operate smoothly, with accurate control over movement and direction.

**1.3. Autonomous Driving Tests**

**Objective**: Verify that the vehicle can complete the autonomous driving challenges.

**Procedure**:

1. **Time Attack Race**:
   * Place the vehicle on a track and run it autonomously.
   * Record lap times and compare with expected performance.
   * Adjust driving algorithms if the vehicle is not meeting performance goals.
2. **Obstacle Challenge**:
   * Introduce random obstacles on the track.
   * Observe how the vehicle detects and avoids obstacles.
   * Refine obstacle avoidance algorithms if necessary.
3. **Traffic Sign Challenge**:
   * Place green and red traffic signs on the track.
   * Test the vehicle’s ability to follow green signs and respond to red signs.
   * Verify correct lane changes and direction reversals.

**Expected Outcome**: The vehicle should complete all challenges autonomously with accurate performance.

**2. Test Results**

**2.1. Sensor Calibration Results**

* **Ultrasonic Sensor**:
  + *Test Result*: Accurate within ±2 cm.
  + *Adjustments*: Calibration settings adjusted for optimal performance.
* **Color Sensor**:
  + *Test Result*: Correctly identified red and green samples.
  + *Adjustments*: Sensitivity settings fine-tuned for different lighting conditions.
* **IR Sensors**:
  + *Test Result*: Successfully followed track lines with minimal deviation.
  + *Adjustments*: Thresholds adjusted for better line detection.
* **IMU Sensor**:
  + *Test Result*: Orientation and acceleration data were consistent with expected values.
  + *Adjustments*: Calibration adjusted for accurate readings.

**2.2. Motor and Steering Results**

* **Motors**:
  + *Test Result*: Smooth operation with consistent speed.
  + *Adjustments*: Motor driver settings optimized for performance.
* **Steering**:
  + *Test Result*: Accurate turns with minimal overshoot.
  + *Adjustments*: Steering angles fine-tuned for better control.

**2.3. Autonomous Driving Results**

* **Time Attack Race**:
  + *Lap Times*: Achieved a lap time of X seconds.
  + *Adjustments*: Driving algorithms refined for better performance.
* **Obstacle Challenge**:
  + *Result*: Successfully avoided all obstacles.
  + *Adjustments*: Improved obstacle avoidance algorithms.
* **Traffic Sign Challenge**:
  + *Result*: Correctly followed green signs and responded to red signs.
  + *Adjustments*: Improved lane-following and direction change algorithms.

**3. Issues and Resolutions**

**3.1. Sensor Issues**

* **Issue**: Inconsistent readings from the ultrasonic sensor.
  + *Resolution*: Adjusted calibration and added delay between readings.
* **Issue**: Color sensor misidentifying traffic signs in varying light conditions.
  + *Resolution*: Implemented dynamic thresholding and calibration routine.

**3.2. Motor Issues**

* **Issue**: Power fluctuations affecting motor performance.
  + *Resolution*: Added a capacitor and used a voltage regulator.

**3.3. Steering Issues**

* **Issue**: Over-steering during sharp turns.
  + *Resolution*: Implemented proportional control algorithm for smoother turns.