OTW (On The Way)
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Mobility Management Discussion

Focus: Efficient actuator-sensor coordination for safe, autonomous navigation within power-limited environments.

I. Motor and Actuator Selection:

Component	Role	Reason for Selection	Power Capability
12V, 188 RPM SGM25-370 DC Gear Motor	Main drive motor (2x rear wheels)	High-torque motor for precise movement; low revolutions per minute allow smooth speed control.	Powered by a 12V Li-Ion battery (12.8Ah), well within safe current range.
43A BTS 7960 Motor Driver	Motor control	A dual H-Bridge has high-current capacity, incorporates PWM and direction control, and withstands safe stall current.	12V input (motor side), logic-compatible with 5V Arduino signals.
FS90 Micro Servo (x2)	1. Obstacle Detection Sweep (front sensor) 2. Steering	The first FS90 sweeps sideways across the front-mounted ultrasonic sensor to identify obstacles in the blind areas (side-scan sweep logic). The second FS90 is utilized for the steering of the front wheels of the car.	It operates on 5V; it has a very low idle current, with brief load spikes during movement. Sourced from a power bank or Arduino 5V rail.
Popsicle sticks, screws, jumper wires	Mechanical mounts and support for sensor arms or linkages	A rapid prototype that is lightweight, configurable, and modular.	Passive elements — reduce stress on motors.

II. Sensor Selection:

Component	Role	Reason for Selection	Power Capability
HC-SR04 Ultrasonic Sensor (x3)	Obstacle detection	- The two of them are confined by the sensors that probe proximity from left to right. - One is attached with an FS90 servo that sweeps from the front dynamically and detects the objects hidden deep into blind spots.	5V powered via Arduino or USB power bank; minimal current (~15 mA each).

DFRobot Huskylens AI Camera	Vision system	It employs visual processing tech called AI for specific actions such as object detection, face recognition, and line tracking. It operates as an autonomous mechanism for lane following or visual target acquisition.	Powered via 5V USB power bank; onboard processing offloads Arduino load.
Arduino UNO R3	Central controller	Coordination is between the motor drivers, sensors, and logic. It was selected based on reliable integration with BTS 7960 and compatibility with Huskylens and the servo Library.	It runs on a 5V USB, is logic-safe, and provides 5V for sensors/servos.

III. Power Strategy:

Power Source	Role	Reason for Selection
12V 12.8Ah Li-Ion Battery	Motors + Motor Driver	It provides a massive, stable voltage output at the levels of DC gear motors under load.
USB Power Bank (5V)	Arduino + Sensors + Servos	This isolates logic power to limit brownout conditions, caused by motor actuation, which is vital for Huskylens and servos.

IV. Mobility Management Benefits:

1. Precise Obstacle Detection Using Sweeping Sensor - The ultrasonic sensor on a servo motor actively scans the front field of view, sensing objects from various angles and cutting out blind spots.
2. Multiple Sensor Coverage for Enhanced Safety - Two stationary ultrasonic sensors (left and right) and one dynamically scanning sensor combine to create wide detection fields, minimizing the chance of undetected obstacles.
3. Efficient Power Allocation Through Split Power Systems - Motors and logic/sensors tap into distinct power sources (12V battery and USB bank), providing uninterrupted sensor feedback even under heavy motor load.
4. Low Power Consumption Components for Longer Operation - FS90 servos and ultrasonic sensors were selected for low power consumption, maximizing battery life, and extending running time throughout competition periods.
5. Compact, Lightweight Chassis Improves Acceleration and Responsiveness. A frame made with 3D printed PLA material and strategically positioned weight enables motors to move with the least amount of resistance, making maneuverability and energy efficiency optimal.
6. Vision + Proximity Sensor Fusion Enhances Navigation Accuracy. The integration of Huskylens AI camera input with ultrasonic input allows for smarter motion choices, such as halting for obstacles while following visual lines or targets.

7. Competition-Ready Reliability and Repairability - All servos, motors, and sensors are attached by accessible fasteners and modular brackets and can be quickly repaired, adjusted, or replaced during high-pressure event rounds.