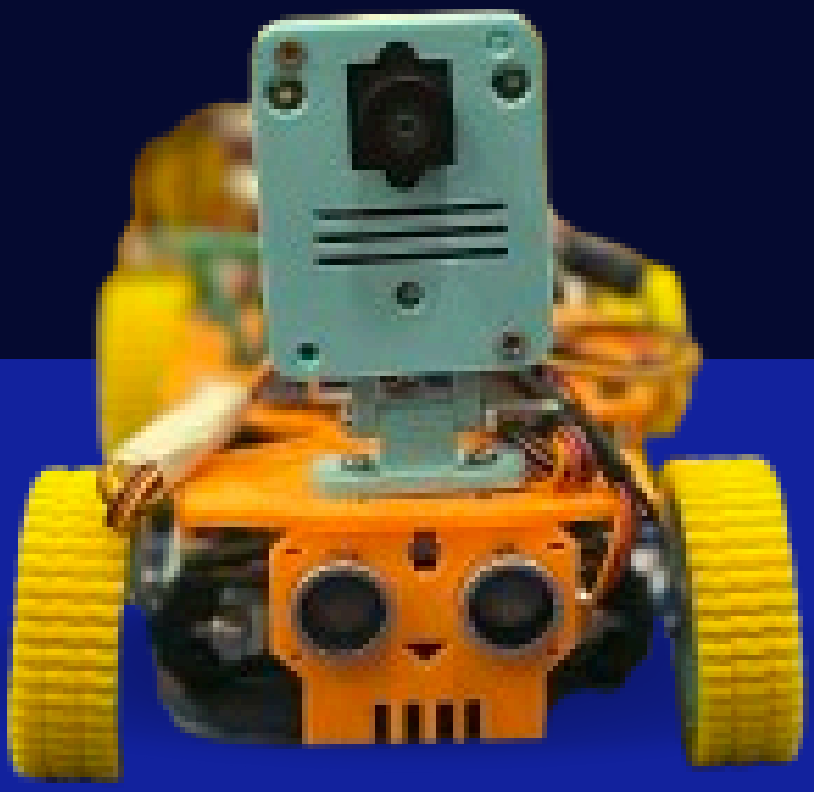
POWER AND SENSE MANAGEMENT



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POWER.

1.1 Power Source

The main power source for the bot is a 3S 11.1V LiPo battery. This battery provides the necessary power to all sensors and the Arduino Uno, which acts as the main controller for the system. LiPo batteries are known for their high energy density, providing ample power for mobile robotic systems.

- Battery specs:
  - Voltage: 11.1V
  - Current:800mAH
  - Configuration: 3 cells in series (3S)
  - Battery type: LiPo (Lithium Polymer)

1.2 Voltage Regulation

1.2.1 LM2596 Buck Converters

To manage and regulate the power delivered to different components, three LM2596 buck converters are employed. These converters step down the battery's voltage to the appropriate levels for the sensors and the Arduino Uno.

- LM2596 Specs:
  - Input Voltage: 4V to 40V
  - Output Voltage: 1.25V to 37V (adjustable)
  - Max output current: 3A (with heat sink)

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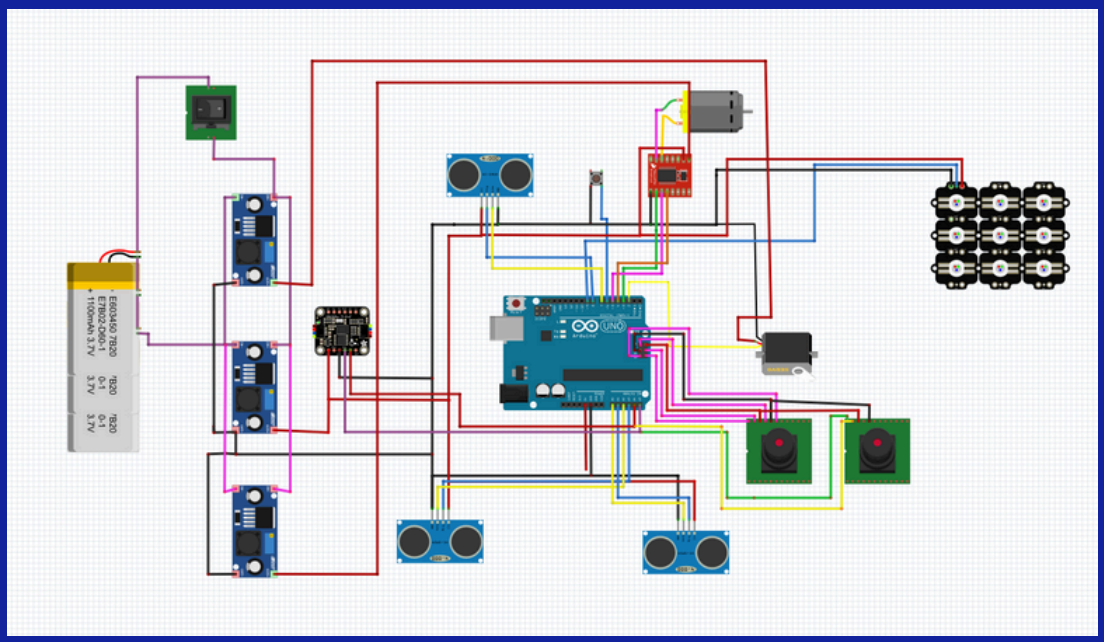
1.2.2 Voltage Management for Different Components

- Arduino Uno Rev 3: The Arduino Uno operates at 5V. One LM2596 buck converter is used to step down the battery's 11.1V to 5V to power the Arduino Uno.
- HC-SR04 Ultrasonic Sensors: Each ultrasonic sensor operates at 5V, so the same LM2596 buck converter used for the Arduino Uno also powers these sensors.
- BNO055 IMU: The BNO055 IMU operates at 5V as well. The second LM2596 buck converter is adjusted to step down the voltage to 6V to power the Servo motor shown below.
- Pixy Cam 2: Requires 5V; powered by the first LM2596 buck converter as well.
- Motor driver : Another converter adjusts voltage to 10 volts to power the motor driver
- Servo motor : the servo motor which works at 6 volts is powered by the third buck converter

By using LM2596 converters, the system ensures efficient power conversion, minimizing heat and power loss.



3. Motor Driver: TB6612FNG

The TB6612FNG motor driver is responsible for controlling the movement of the motors that power the wheels of the bot. It receives control signals from the Arduino Uno to manage forward, backward, left, and right movements.

Power specs:

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Operating Voltage (motor side): 4.5V to 13.5V
Operating Voltage (logic side): 2.7V to 5.5V
Continuous output current: 1.2A per channel

Motor Driver Role:

The motor driver is a dual-channel H-bridge used to control two DC motors (left and right motors) independently. It receives PWM (Pulse Width Modulation) signals from the Arduino to adjust motor speed and direction. The driver allows for bidirectional control of each motor, facilitating smooth turning, acceleration, and braking.

Integration with Pixy Cam 2:

When the Pixy Cam 2detects a red or green obstacle, the Arduino sends the appropriate signals to the motor driver:
Red obstacle: The bot's right motor slows down, and the left motor accelerates to execute a right turn.
Green obstacle: The bot's left motor slows down, and the right motor accelerates to execute a left turn.
This control ensures responsive and accurate obstacle avoidance based on the camera's real-time inputs.

SENSORS.

This section lists all sensors integrated into the 4-wheel bot, their respective roles, and power requirements.

2.1 Ultrasonic Sensors (HC-SR04)

There are three HC-SR04 Ultrasonic Sensors mounted on the bot. These sensors are used for obstacle detection and distance measurement.

- Power specs:
  - Operating Voltage: 5V DC
  - Operating Current: 15mA
  - Working Frequency: 40kHz
- Sensor roles:
  - Front Ultrasonic Sensor: Measures the distance to obstacles directly in front of the bot, preventing frontal collisions.
  - Left Ultrasonic Sensor: Measures the distance to obstacles on the left side, ensuring the bot does not veer too close to side barriers.
  - Right Ultrasonic Sensor: Measures the distance to obstacles on the right side, preventing collisions from the right.

The ultrasonic sensors provide crucial data for collision avoidance and path planning.

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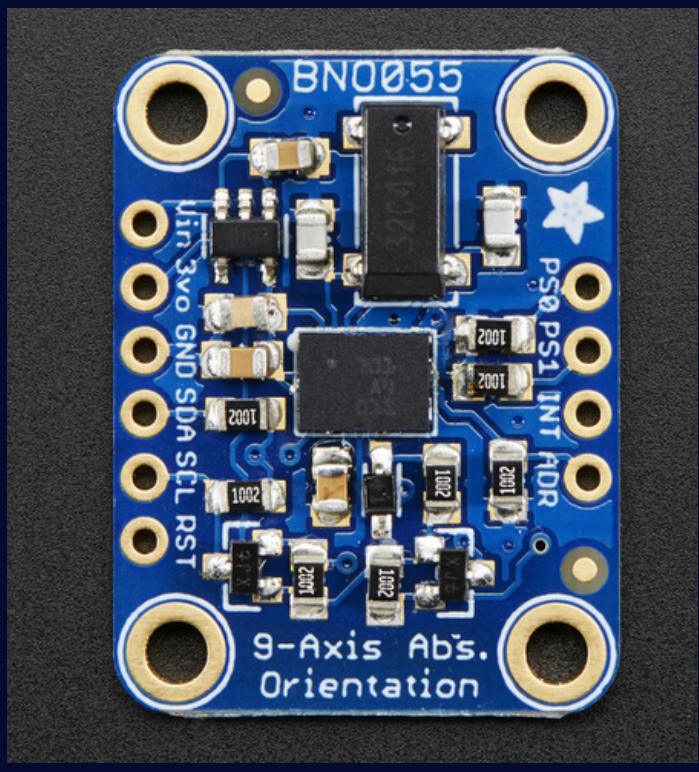
2.2 IMU (BNO055)

The BNO055 IMU is an inertial measurement unit that includes a gyroscope, accelerometer, and magnetometer, providing the orientation and motion data of the bot.

- Power specs:
  - Operating Voltage: 5V DC
  - Operating Current: 12mA
- Protocol : I2C.
- Sensor roles:
  - Gyroscope: Provides angular velocity data to help the bot maintain balance and execute smooth turns.
  - Accelerometer: Measures linear acceleration, helping with motion tracking and stability control.
  - Magnetometer: Provides compass-like orientation data, allowing the bot to maintain a specific heading or direction.

The IMU helps the bot navigate and maintain stability while moving, offering real-time orientation information.



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SENSORS.

2.3 Pixy Cam 2

The Pixy Cam 2 is a smart vision sensor used for color-based obstacle detection, identifying red and green objects on the track. It uses color codes to make navigation decisions.

Power specs:

- Operating Voltage: 5V DC
- Current: 140mA

Sensor Role:

Two Pixy Cam 2's are mounted at the back of the bot(one on top of another) and use their color recognition capabilities to detect red and green obstacles.
Red obstacle: Indicates that the bot should turn right.
Green obstacle: Indicates that the bot should turn left.
The camera processes the image and sends signals to the Arduino to determine the appropriate action based on the detected color, guiding the bot to avoid obstacles by making the correct directional turns. The second camera is solely used to detect the magenta block for parking. This i to combat issues of our reg and magenta signatures not creating errors together.

THANK YOU