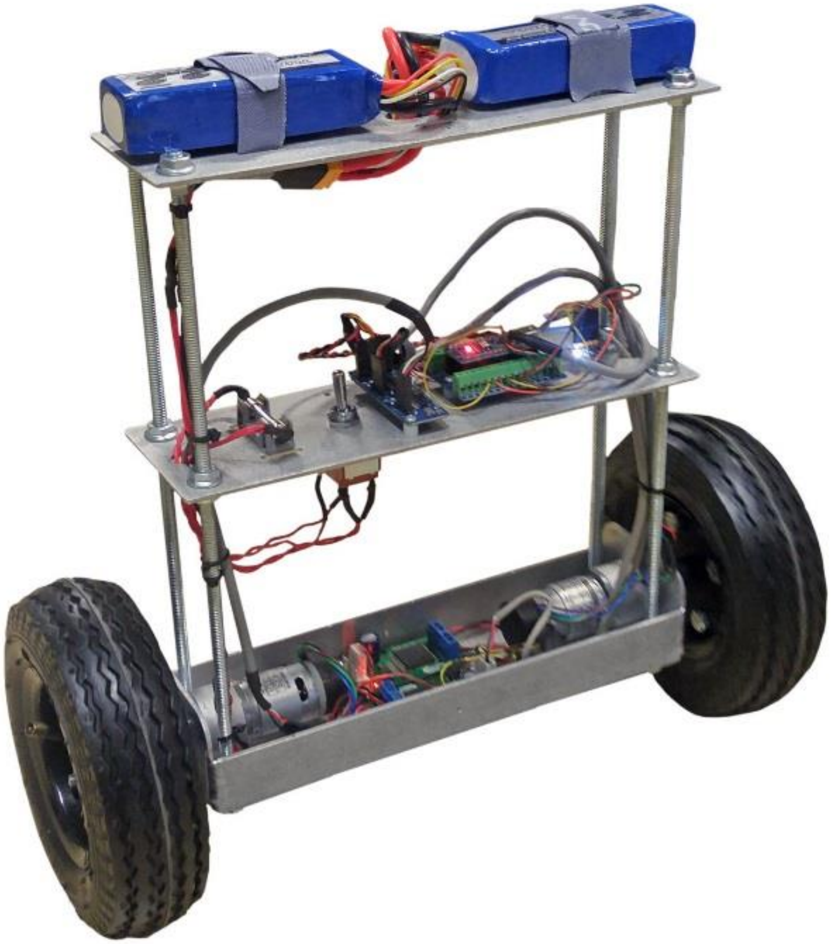


2WD Self Balancing Robot

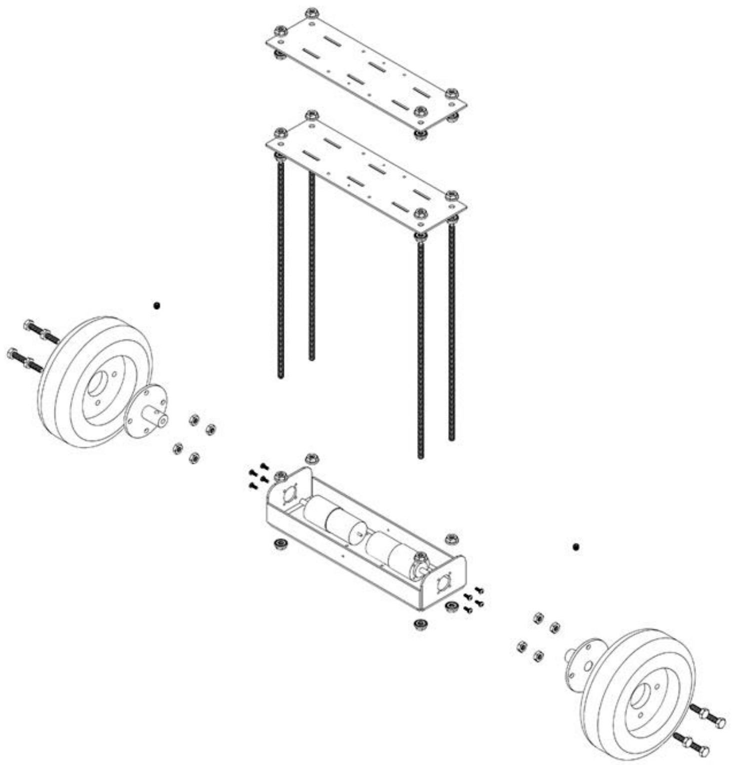
Assembly and Operation

2WD self balancing robot! This kit is a perfect platform for learning Arduino, PID control, serial communications (Serial, I2C, SPI), PWM signals, IMU filtering, etc.

Images shown may not be an exact representation of the robot's features listed in this document

Contents

Mechanical Assembly



1. Start by mounting the motors to the chassis base. Use the provided M3 screws and make sure to use threadlock to keep the screws from vibrating loose.

2. Before you mount the upper decks, mount the motor controllers while you have better access.

3. Assemble the wheels to the shafts using the provided hardware and threadlock. At this point you can mount the shafts to the motors using the provided ¼-20 set screws. It may be helpful, however, to leave the wheels off while you finish building and wiring the robot.

4. Before mounting the middle deck, mount the switch, fuse block and the rest of the electronics. Drill a ½" hole to mount the switch. Use the plastic spacers and hardware provided in the hardware kit to mount the fuse block and other electronics.

5. Mount the ¼-20 threaded rods to the chassis base using the nuts provided. The threaded rod should be about flush with the end of the nut on the bottom of the chassis base. Secure the threaded rods to the chassis base by tightening another nut on the top side of the chassis base. Secure the upper decks by again

sandwiching the plates between two nuts. Separate the plates so the spacing is relatively even between them and the chassis base.

6. Mount the batteries on the top deck using provided Velcro straps in the slots.

7. At this point, you are finished with the mechanical assembly. You are now ready to wire the robot.

Inflating the tires

Before running the robot on the ground, make sure the tires have been inflated. Running the robot with a flat tire can cause the tube to spin inside of the tire and damage the valve stem. For this reason it is a good idea to check the tires periodically to make sure they are inflated.

Electrical Assembly

For electrical assembly please follow the provided schematic on our website:

Self Balancing Robot Wiring Diagram

For additional support on wiring, soldering, and crimping, please read the following support pages:

Electric Motor Hookup Support

Electric Power Hookup Support

Soldering Tips

Crimping Wires

Software

1. Make sure you have the Arduino IDE installed on your computer from *arduino.cc*.
2. Download the Self Balancing Robot firmware from the *SuperDroid Robots GitHub*.
3. This code depends on the following libraries that need to be extracted to your Arduino libraries folder. This is typically located at C:\Users\...\Documents\Arduino\libraries.
   Includes:
   Encoder_Buffer.h

VNH3SP30.h
Kalman.h
PID v1.h
Timer.h

To verify this step has been completed properly, you can open a blank Arduino sketch and navigate to Sketch->Import Library. The libraries should show up on this list. If not, go to Sketch->Import Library->Add Library and select the missing libraries. **The firmware will not compile without successfully completing this step.**

4. Once the code is compiling, you are ready to start tuning the PID parameters. The parameter values are located in the "hardware.h" file within the Self Balancing Robot firmware package. These values will control how the motor reacts to off center angles in order to balance. More than likely, these values will need to be tuned/changed to get good results. If you are new to the PID algorithm please read through *this article* and the *PID Wiki*.
   This system has an inner and outer PID loop. The outer loop parameters will affect the target angle needed to return to the starting position. The feedback sources here are motor encoders. The corresponding PID parameters are labeled "SpeedKp", "SpeedKi", and "SpeedKd".
   The inner loop uses the IMU feedback in order to calculate error between target and measured angles. The result is a target speed which is sent as commands to the motor controller. The inner loop PID parameters are labeled "AngleKp", "AngleKi", and "AngleKd". To start tuning the PID you may tune the inner loop first to do this you can go to line 58 and set SpeedPID.SetMode(MANUAL). After you have a good tuning you can set that back to AUTOMATIC. While tuning these values, it's advised to elevate the wheelbase until the robot seems stable. An unstable PID loop due to erroneous parameter values can cause damage to the robot or its surroundings. There are multiple methods to go about tuning a PID. Please read through the links above before proceeding.

Operation

For testing/operation, stand the robot straight up and turn on the power. Hold it upright for approximately five seconds so the robot can calibrate a zero angle and it will begin balancing. For charging locate the LIPO balance lead and connect to the corresponding charger. Each battery charge individually.

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