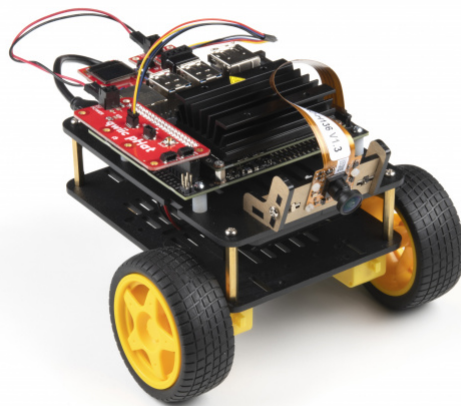




Assembly Guide for SparkFun JetBot AI Kit V2.0

Introduction

SparkFun's version of the JetBot merges the industry leading machine learning capabilities of the NVIDIA Jetson Nano with the vast SparkFun ecosystem of sensors and accessories. Packaged as a ready-to-assemble robotics platform, the SparkFun JetBot AI Kit v2.0 requires no additional components or 3D printing to get started - just assemble the robot, boot up the Jetson Nano, connect to WiFi and start using the JetBot immediately. This combination of advanced technologies in a ready-to-assemble package makes the SparkFun JetBot Kit a standout, delivering one of the strongest robotics platforms on the market. This guide serves as hardware assembly instructions for the JetBot AI Kit v2.0. The SparkFun JetBot comes with a pre-flashed micro SD card image that includes the Nvidia JetBot base image with additional installations of the SparkFun Qwiic Python library, Edimax WiFi driver, AWS RoboMaker ready with AWS IoT Greengrass, and of course the JetBot ROS. Users only need to plug in the SD card and set up the WiFi connection to get started.



Note: We recommend that you read **all** of the directions first, before building your JetBot. However, we empathize if you are just here for the pictures & a general feel for the SparkFun JetBot. We are also those people who on occasion void warranties & recycle unopened instructions manuals but please note, SparkFun can only provide support for the instructions laid out in the following pages.

Attention: The SD card in this kit comes **pre-flashed** to work with our hardware and has the all the modules installed (including the sample machine learning models needed for the collision avoidance and object following examples). The only software procedures needed to get your JetBot running are steps 2-4 from the Nvidia instructions (i.e. setup the WiFi connection and then connect to the JetBot using a browser). Please **DO NOT** format or flash a new image on the SD card; otherwise, you will need to flash our image back onto the card.

If you accidentally make this mistake, don't worry. You can find instructions for re-flashing our image back onto the SD card in the Software Setup section of this guide

The Jetson Nano Developer Kit offers extensibility through an industry standard GPIO header and associated programming capabilities like the Jetson GPIO Python library. Building off this capability, the SparkFun kit includes the SparkFun Qwiic pHAT for Raspberry Pi, enabling immediate access to the extensive SparkFun Qwiic ecosystem from within the Jetson Nano environment, which makes it easy to integrate more than 30 sensors (no soldering and daisy-chainable).

The SparkFun Qwiic Connect System is an ecosystem of I²C sensors, actuators, shields and cables that make prototyping faster and less prone to error. All Qwiic-enabled boards use a common 1mm pitch, 4-pin JST connector. This reduces the amount of required PCB space, and polarized connections mean you can't hook it up wrong.



Materials



Part	Qty
------	-----

JetBot Chassis Kit	1
Hobby Gearmotor (pair) included as part of JetBot Chassis Kit	1
Camera mount included as part of JetBot Chassis Kit	1
Wheels & Tires - included as part of JetBot Chassis Kit	2
Lithium Ion Battery Pack - 10Ah (3A/1A USB Ports)	1
Edimax 2-in-1 WiFi and Bluetooth 4.0 Adapter	1
Jetson Dev Kit v3 *only included in specified Kits*	1
SparkFun JetBot image (Pre Flashed)	1
Leopard Imaging 136 FOV Camera	1
SparkFun Micro OLED Breakout (Qwiic)	1
SparkFun Qwiic Motor Driver	1
SparkFun Qwiic pHAT v2.0 for Raspberry Pi	1
Qwiic Cable - 100mm	1
Qwiic Cable - 200mm	1
Jumper Wires Premium 6" M/M (2-pack black & red)	1
USB Micro-B Cable - 6"	1
Dual Lock Velcro	1



Part	Qty
Standoff - Nylon (4-40; 3/8in.)	10
1/4" Phillips Screw with 4-40 Thread	20
Machine Screw Nut - 4-40	10
M2 Nylon hex nut	4
M2 Nylon screw slotted drive	4
JetBot Chassis Hardware *included as part of JetBot Chassis Kit	1

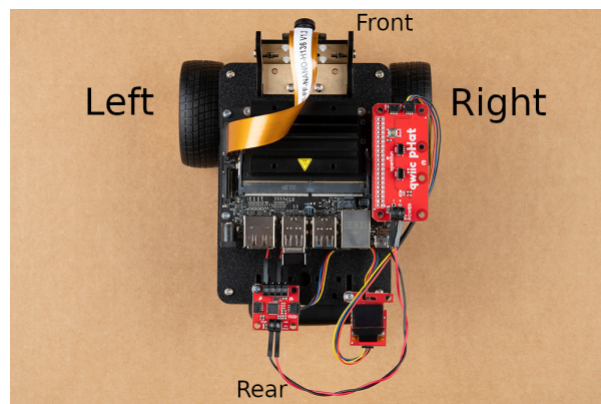
Recommended Tools

We did not include any tools in this kit because if you are like us you are looking for an excuse to use the tools you have more than needing new tools to work on your projects. That said, the following tools will be required to assemble your SparkFun JetBot.

- Small phillips & small flat head head screwdriver will be needed for chassis assembly & to tighten the screw terminal connections for each motor. We recommend the Pocket Screwdriver Set; TOL-12268.
- Pair of scissors will be needed to cut the adhesive Dual Lock Velcro strap to desired size; recommended, but not essential..
- *Optional*- adjustable wrench or pliers to hold small components (nuts & standoffs) in place while tightening screws; your finger grip is usually enough to hold these in place while tightening screws & helps to ensure nothing is *over tightened*.

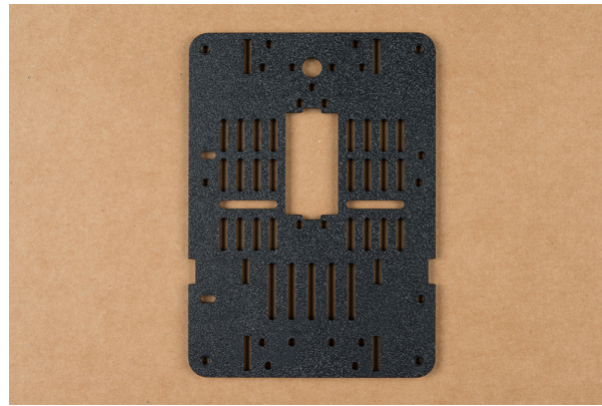
A Note About Directions

When we talk about the "Front," or "Forward" of the JetBot, we are referring to direction the camera is pointed when the JetBot is fully assembled. "Left" and "Right" will be from the perspective of the SparkFun JetBot (i.e. what the JetBot camera sees).

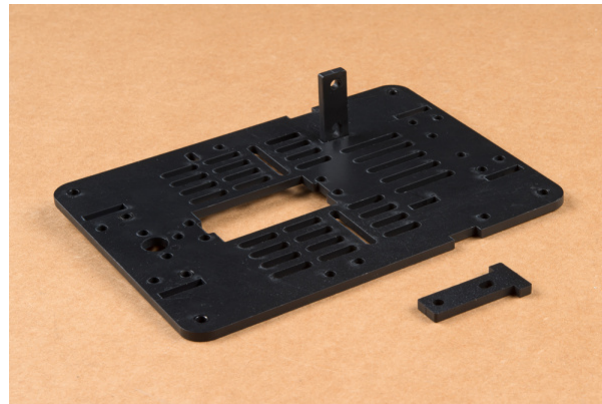


1. Robotics Chassis Kit Initial Assembly

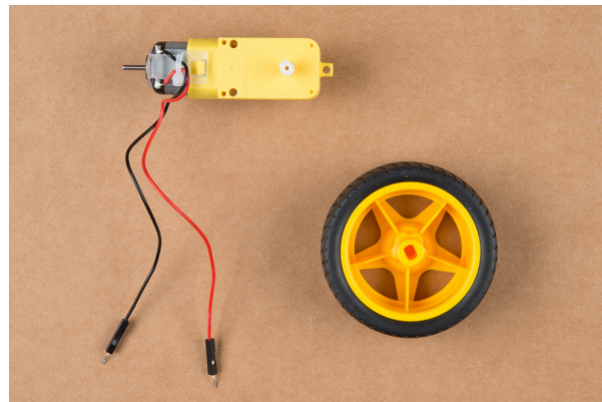
Begin with one of the two bare base plates included with the JetBot Chassis Kit. It does not matter which one, they are identical.



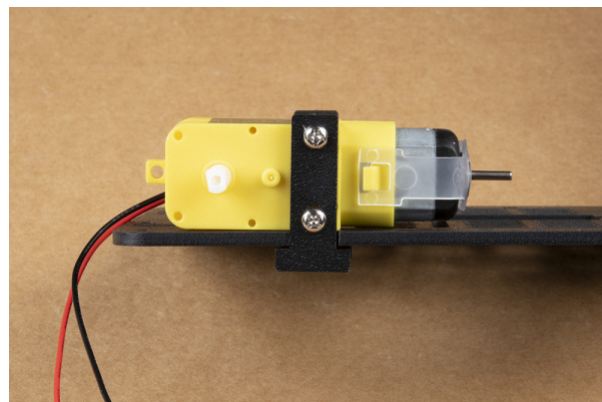
Push two of the included motor mounts through the designated holes in the base plate as shown below. Two more motor mounts will be attached on the outside of the base plate after the motor is installed.



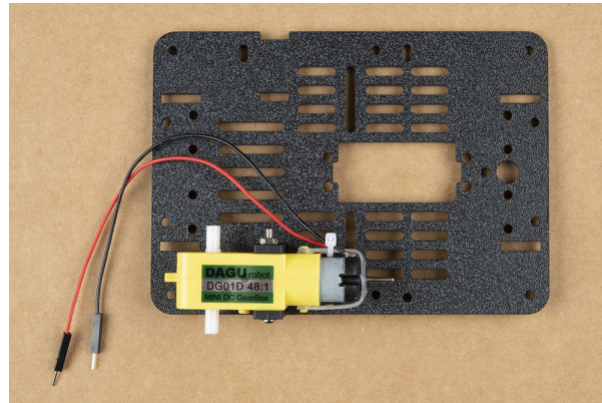
Your JetBot Chassis Kit includes a pair of hobby motors & wheel assemblies.



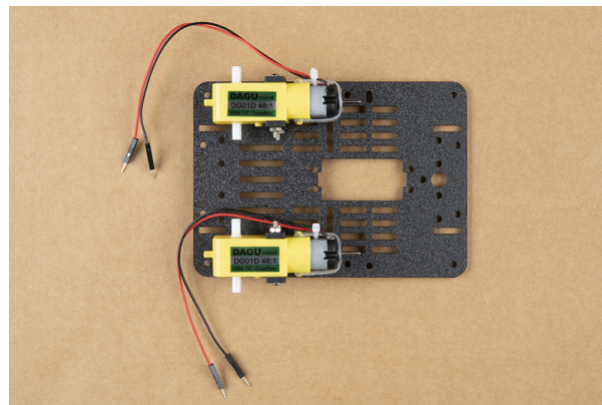
Attach the pair of motors using the long threaded machine screws & nuts included with the JetBot Chassis Kit. The motor will be sandwiched between an internal & external motor mount. Tighten the screws until they are snug.



We prefer the shown orientation below that leaves the extra length of the machine screws & nuts on the inside edge of the JetBot.

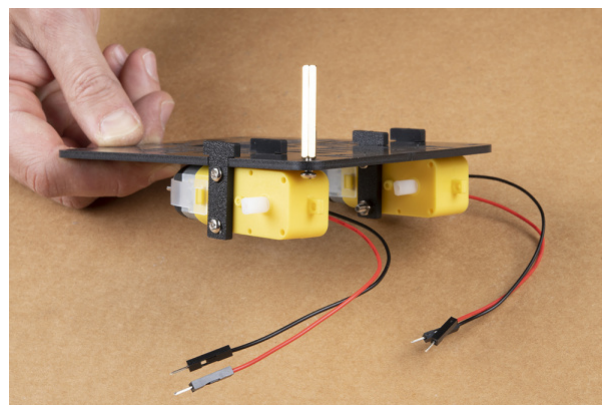


Repeat this process on the other side of the chassis so both motors are symmetric on the base plate.

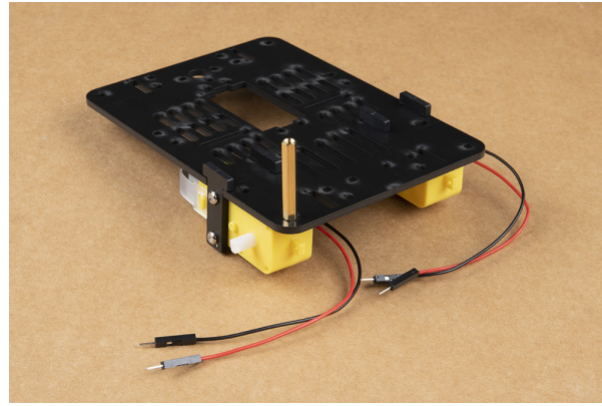


Note: Install the motors so the "DAGU robot" sticker is facing out. This will ensure that your JetBot drives forward when following the pictured hookup of the Qwiic Motor driver later in the tutorial.

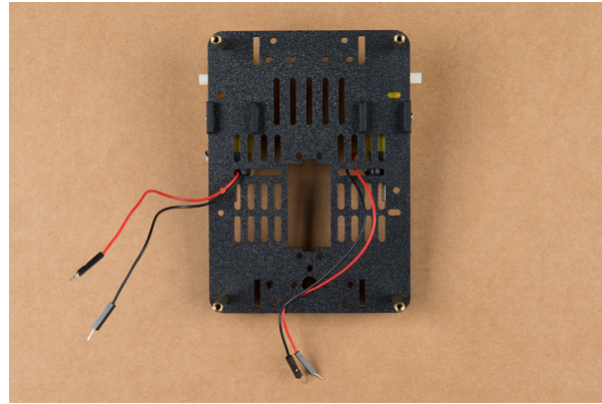
Once both motors are attached, flip the base plate over as pictured & attach the four longer brass standoffs at each corner of the base plate using the threaded screws included with the JetBot Chassis Kit. These four standoffs are packaged together. Thread one of the machine screws from the JetBot Chassis kit through the base plate & tighten into the brass standoff.



Repeat for each corner.



After all standoffs are installed, thread the motor terminal leads through the baseplate as shown. Refer to the photograph of the caster ball assembly to make sure you are using the correctly sized brass standoffs.

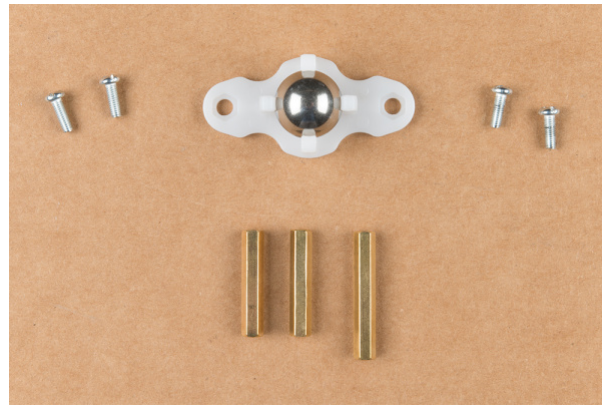


Having trouble seeing detail in the image? [Click on it for a larger view.](#)

Next, gather the parts needed to assemble the caster ball assembly.

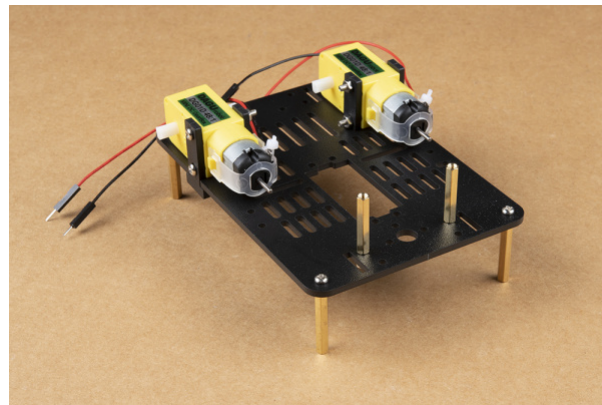


Notice that the brass standoffs used for the caster assembly are slightly shorter than those used for the chassis. The first time you build the SparkFun JetBot, each of these sets of standoffs are packaged together, but it is easy to confuse these once everything has been opened.

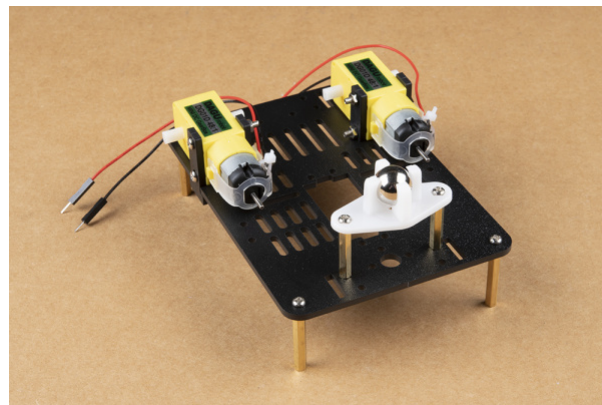


Flip the chassis over and install the shorter brass standoffs as shown in the photo below.

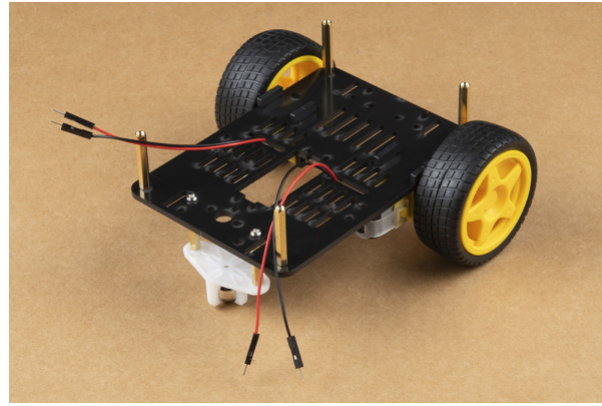
Note: The motor leads are not threaded here only for photo clarity. Keep yours threaded as instructed previously



Use the two remaining screws to attach the caster ball casing to the brass standoffs.



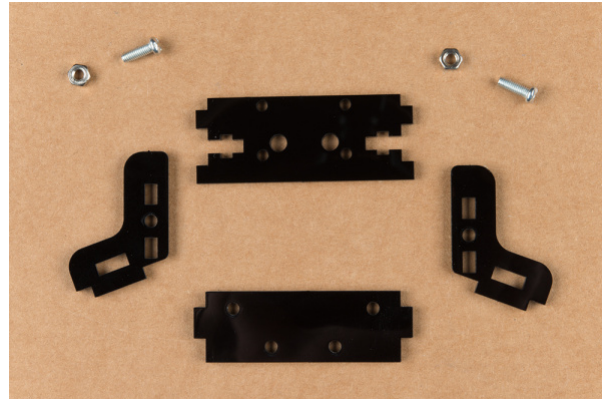
Press the wheels onto the hobby motor axles for a snug friction fit & flip it again Charley! Behold, a very stable three point stance foundation for you to build from.



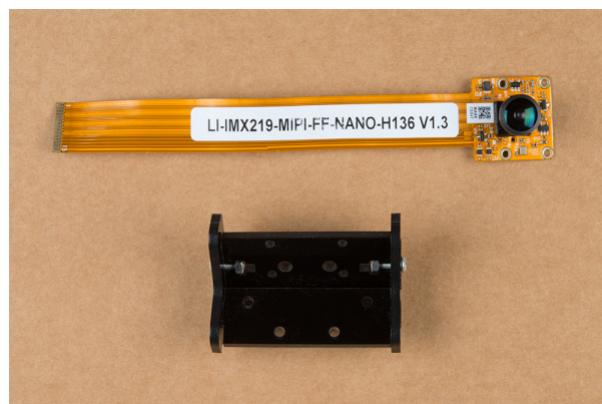
2. Camera Assembly & Installation

Next, locate the camera mount assembly in the JetBot Chassis Kit. The unassembled view of the parts is laid out in the proper orientation for assembly.

Note: This orientation is necessary to ensure the camera mount fits on the top plate of the chassis.



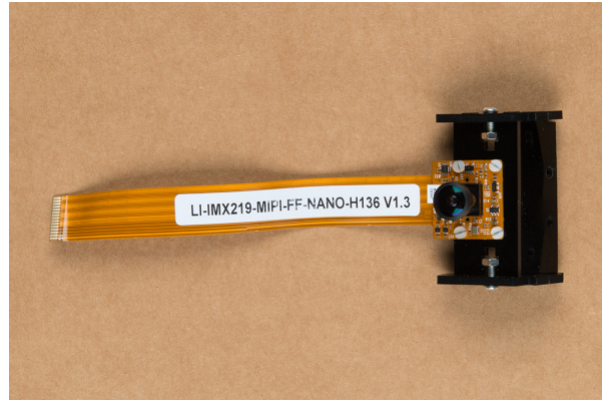
Unpackage the Leopard Imaging camera and assemble the camera mount as shown in the following photograph.



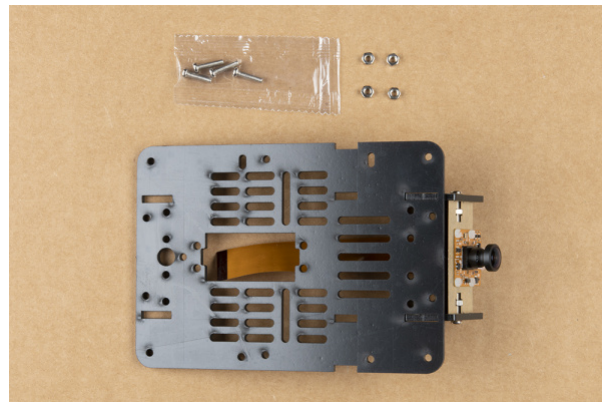
Having trouble seeing the image? Click on it for a larger view.

Please reference the note about the "Front" of the JetBot in the end of the Introduction to ensure that you mount the camera on the correct side of the camera mount. Align the four holes in the camera mounting plate with those on the camera. Place all four nylon flathead screws through the camera & camera mounting plate prior to fully tightening the nylon nuts. This will ensure equal alignment across all four screws. While holding the nuts in place with a finger, tighten the screws in a rotating criss cross pattern; similar to how you tighten lug nuts on a car rim.

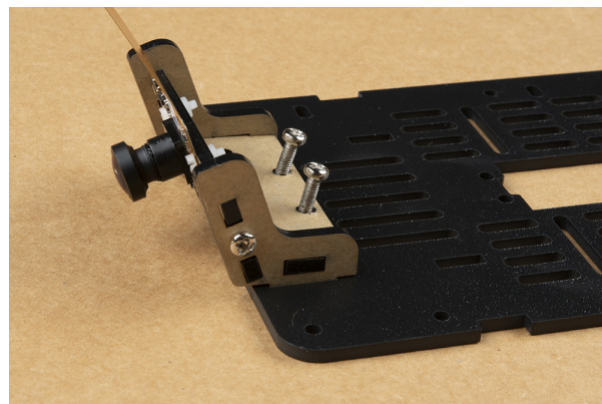
Note: Make sure to orient the camera so the ribbon cable is extending over the "top" of the camera mount as shown below.



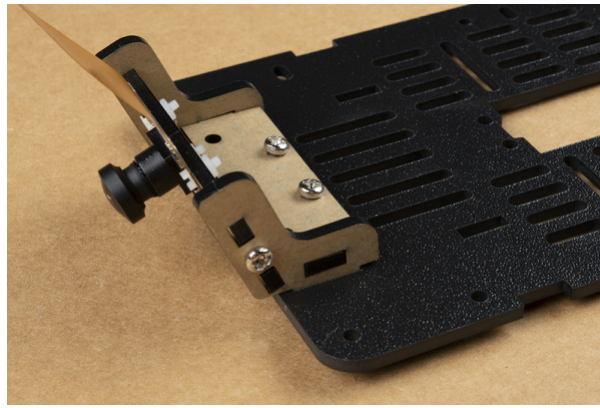
Attach the camera mount & camera to the JetBot Chassis Kit top plate (the unused base plate) using the slightly longer sets of screws and nuts included in the chassis kit (pictured below). Align the plastic tabs on the camera mount to the rectangular cutouts on the front of the chassis top plate. This will result in a snug press fit.



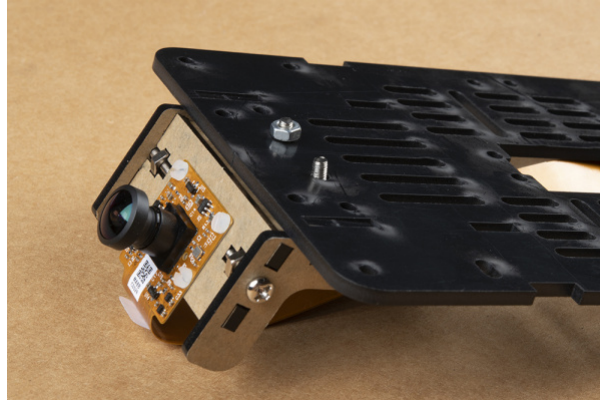
Use the screws to align the holes in the camera assembly with the corresponding holes in the chassis top plate.



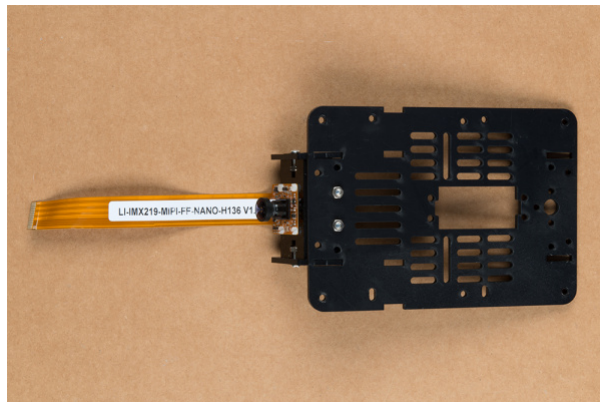
Use your small Phillips head screwdriver to thread the screws through the mounting plates. The chassis kit I got was pretty snug and required me to screw them through.



Flip the chassis over & thread two nuts onto the exposed threads of the camera mount hardware.



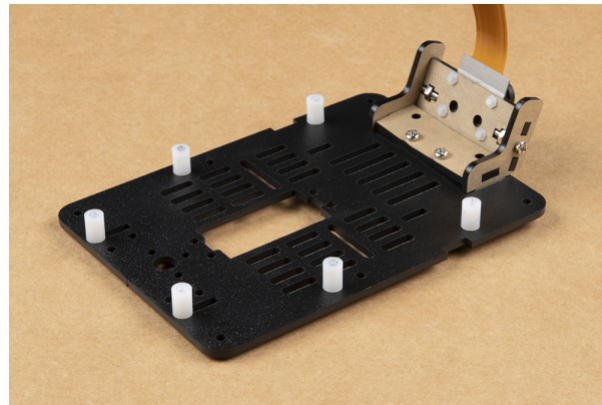
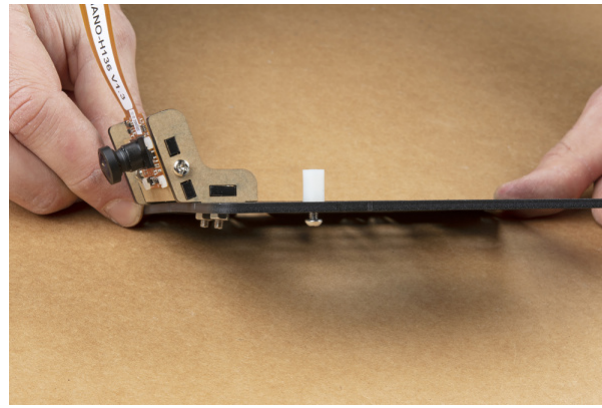
The final assembly will look something like what is pictured below. We have found that this assembly is attached sufficiently by using 2 of 4 screws, but do whatever feels right.



3. Accessory Installation to Main Chassis

Note: This section has been updated to have the battery installed on the top plate of the JetBot vs. the bottom. Some customers experienced issues with the Velcro being too thin to install the battery as shown originally.

Install the included nylon standoffs using the included 4-40 screws (10 packs) on the top mounting plate (the one we just finished attaching our camera and mount to). Pictured below are the standoffs for the Jetson Nano Dev Kit, the SparkFun Qwiic Motor Driver, and SparkFun Qwiic OLED. Be sure to keep the standoffs on the right side somewhat loose. The mounting holes in the top plate are oblong to compensate for manufacturing tolerances & ensure a secure fit to the Jetson Nano Dev Kit.



Cut the strip of dual lock Velcro into two roughly equal sized strips. Take one side of the dual lock Velcro and attach to the top of the battery pack as shown.

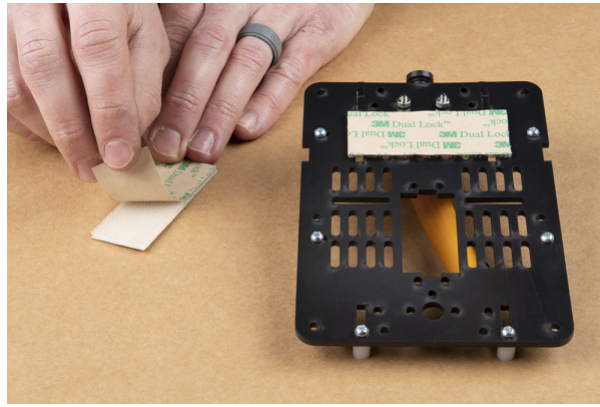


We figured you could handle this, but we already had the camera all set up & scissors in hand...

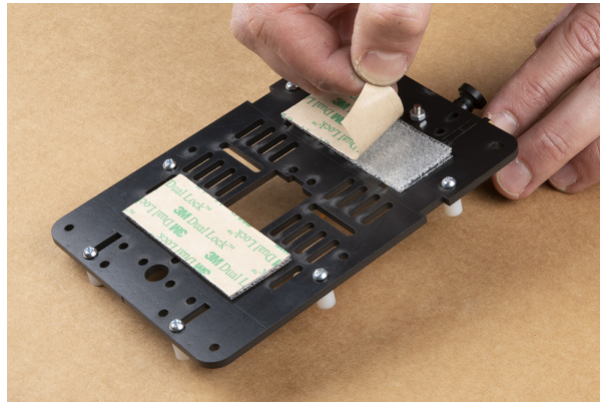


Place the corresponding pieces of dual lock Velcro on the chassis assembly top plate as pictured. Please ensure that all standoffs for the Jetson Nano & Qwiic boards are already installed on the chassis top plate; see photo. Additionally, ensure that the camera mount has been attached to the top plate as well. This will ensure that the

battery does not physically hit any mounting screws.



Remove the protective film from the Dual Lock and try not to touch the sticky part.



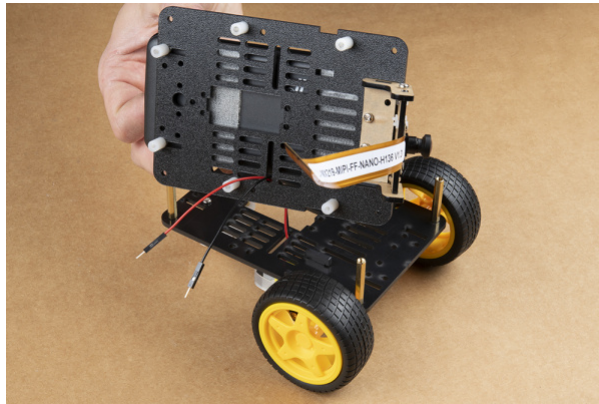
Line up the battery pack as shown to ensure correct orientation of the USB ports & no interference between the battery pack and mounting hardware.



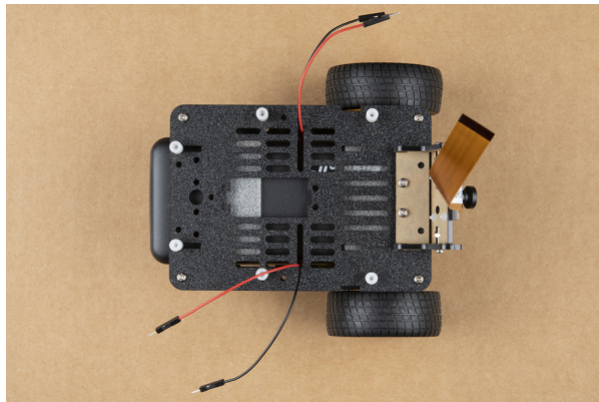
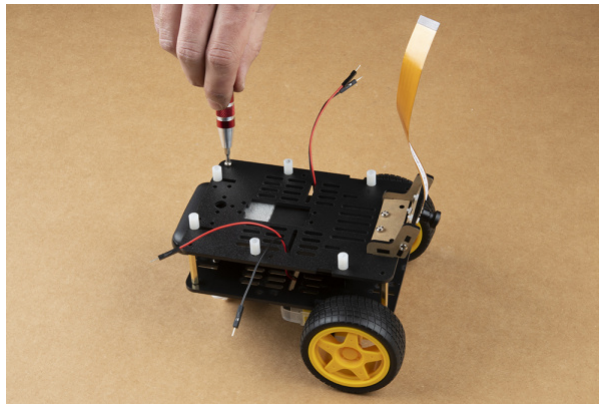
This photo shows how to place the battery pack to not touch the camera mount hardware while not extending too far out the back of the SparkFun JetBot.



Press firmly on the battery pack to attach the dual lock Velcro interface between the chassis and battery.
Route one set of motor leads at a time through the chassis top plate as shown.

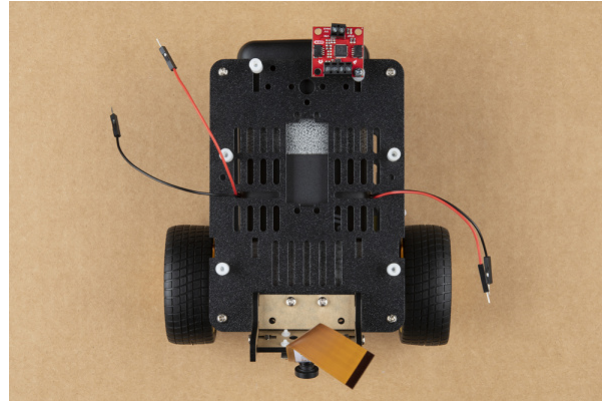


Attach the top plate to the base plate brass standoffs using the four remaining screws from the JetBot chassis kit.



Note: We have seen more than one way to attach the battery pack and multiple ways of routing the motor wires. As previously stated, we understand that these instructions are used by many customers as a reference. However, this is the configuration that SparkFun Technical Support will use as a baseline on any forums discussion. Thanks!

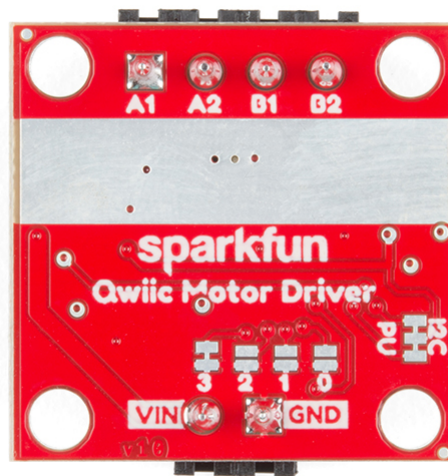
Once the chassis is fully assembled, attach the SparkFun Qwiic Motor Driver as shown using the mounting hole on the board to the right of the 4x motor screw terminal. Attach the motor leads as pictured; see below for more details.



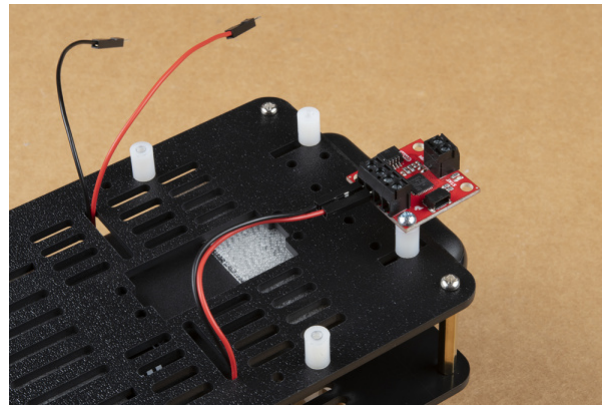
Having trouble seeing the connections to the Qwiic Motor Driver? Click on the image for a larger view.

Connect the motor leads according to the table below; remember the "Right" & "Left" designations from the Introduction. They should match the image above. The right motor is on the right side of this photo.

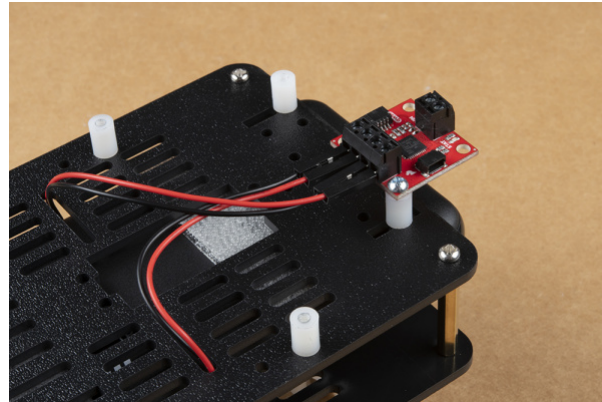
A1	A2	B1	B2
Left Motor Ground (-)	Left Motor Power (+)	Right Motor Ground (-)	Right Motor Power (+)



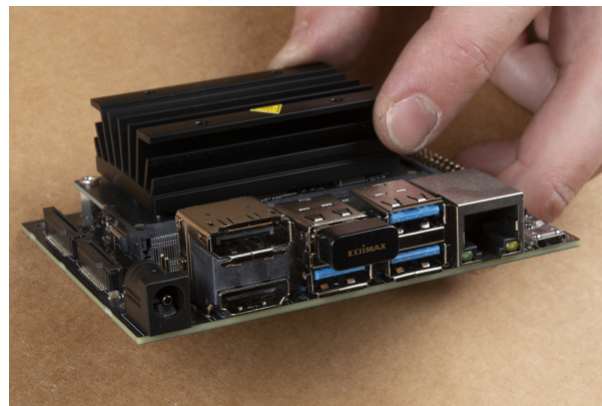
Shown below: Left motor hookup to Qwiic Motor Driver screw terminals.



Shown below: Right motor hookup to Qwiic Motor Driver screw terminals.

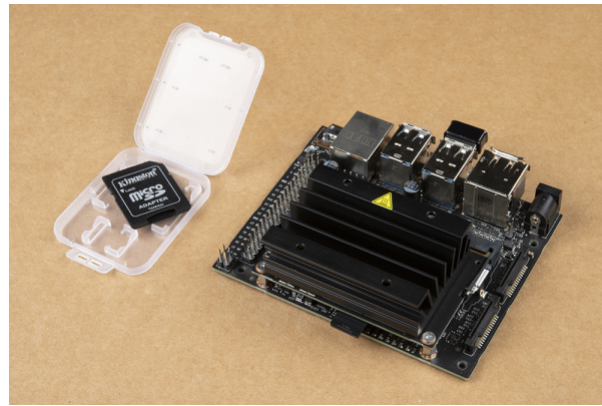


Install the Edimax USB WiFi & Bluetooth Adapter into one of the USB ports on the Jetson Dev Kit.

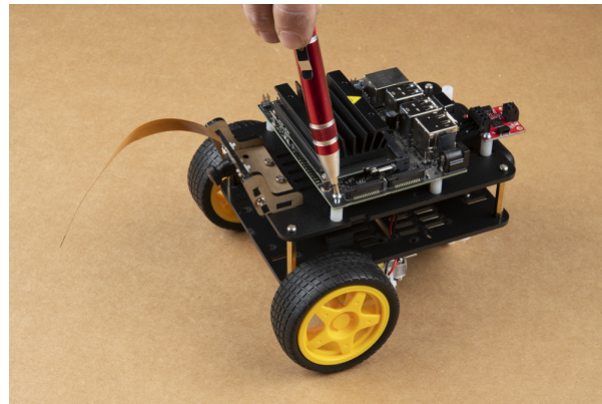


Remove the MicroSD card with the SparkFun JetBot Image (pre-flashed) from the included case & adapter and place it into the MicroSD card slot on the Jetson Nano module. It is easier to do this prior to installing the Jetson Nano Dev Kit onto the chassis and with the Dev Kit upside down as pictured, but you do you.



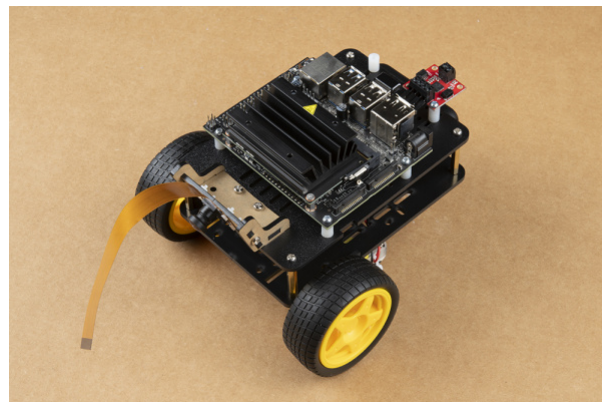


Attach the Jetson Nano Dev Kit using four 4-40 screws to the previously installed Nylon standoffs. Remember we left the right side standoffs loose so align them with the mounting holes on the Jetson Nano Dev Kit & tighten until snug.

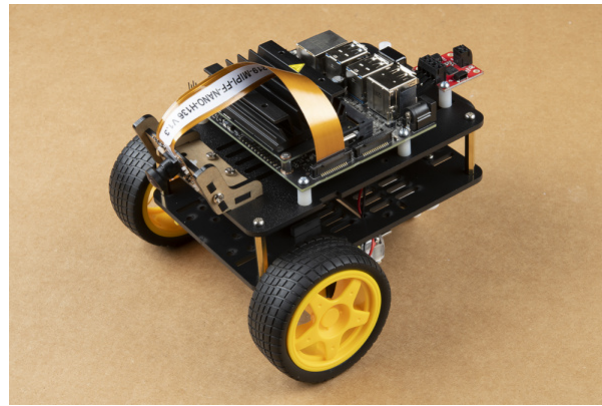


Having trouble seeing the image? [Click on it for a larger view.](#)

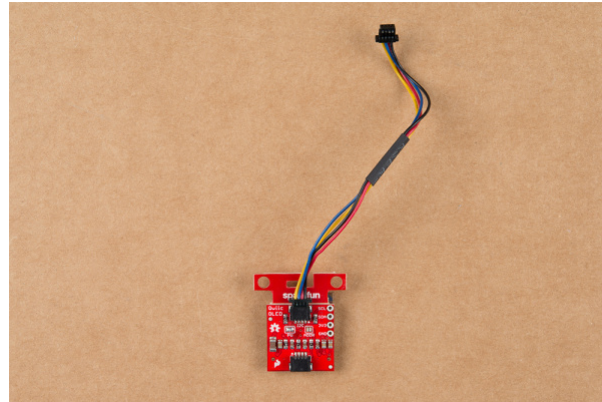
Note: With repeated cycle of connecting & disconnecting this camera the plastic connectors on the Jetson Dev Kit become increasingly fragile & are not easily replaced. Please take care when installing or removing the camera.



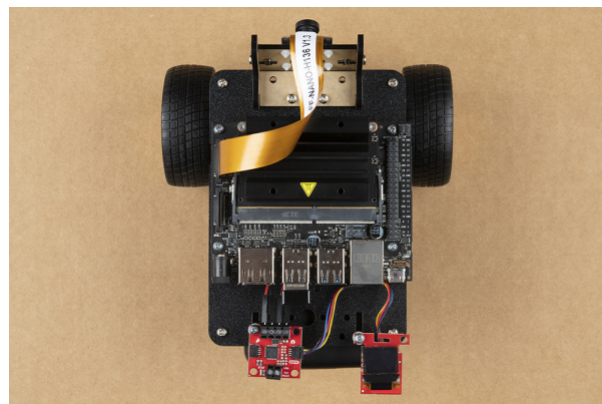
Attach the Leopard imaging camera ribbon cable as shown to the Jetson Dev Kit. This half helix ensures the contacts on the ribbon cable attach to the contact on the Jetson Dev Kit camera connector.



Attach the 100mm Qwiic cable to the underside of the SparkFun Qwiic Micro OLED as shown below.

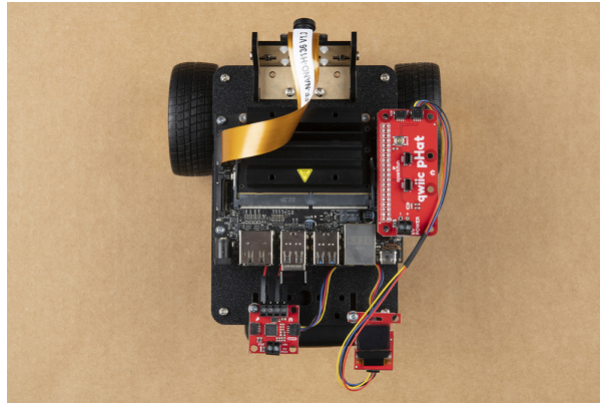


Attach the SparkFun Qwiic Micro OLED to the JetBot Chassis using another Nylon Standoff & 4-40 screw. Attach the 100mm Qwiic cable to the SparkFun Qwiic Motor Driver. Secure the Qwiic Micro OLED by tightening the screw until snug.



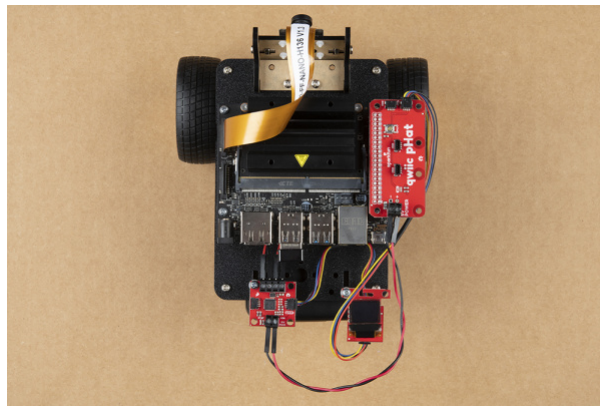
Having trouble seeing everything in the image? [Click on it for a larger view.](#)

Connect the qwiic pHAT on the Jetson Nano Dev Kit's 2x20 GPIO header taking care to align it as the photo below shows. Additionally, connect the SparkFun Qwiic Micro OLED display to the Qwiic pHAT using the 200mm Qwiic cable.



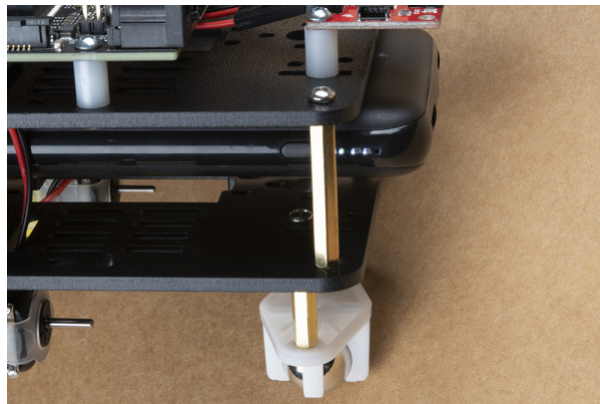
Having trouble seeing everything in the image? [Click on it for a larger view.](#)

Finally attach the Qwiic Motor Driver's motor power screw terminals to the 2 pin screw terminal for **5V** and **Ground** on the Qwiic pHAT using the included 6 inch M/M jumper wires. We recommend using one black wire (ground) & one red wire (power), but you can use any included color your head desires.



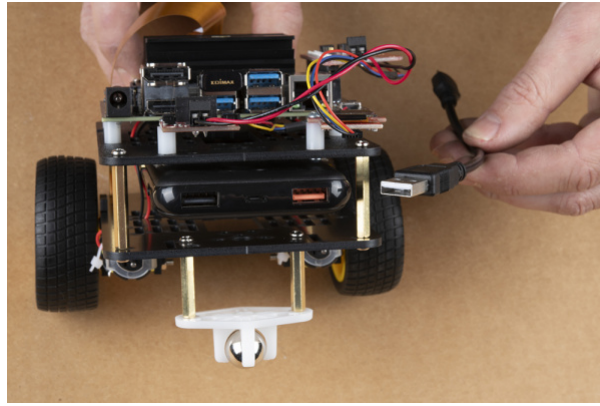
Having trouble seeing everything in the image? [Click on it for a larger view.](#)

Check the battery power on the USB pack by pressing the power button on the side of the battery. Four dots means it is fully charged. The Jetson is fairly power hungry. We recommend only powering up your SparkFun JetBot with a fully charged battery pack.



Use the included 6 inch USB Micro-B Cable to connect the Jetson Nano Dev Kit to the battery pack.

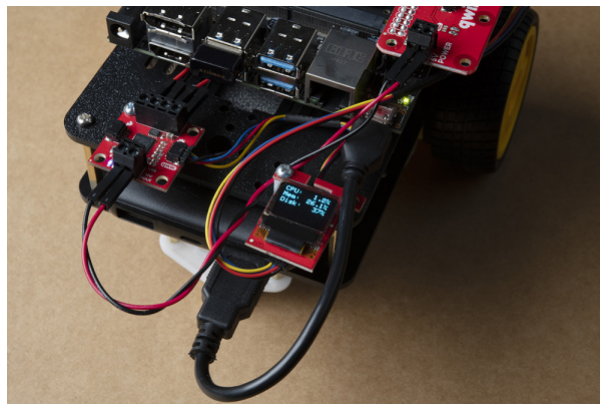
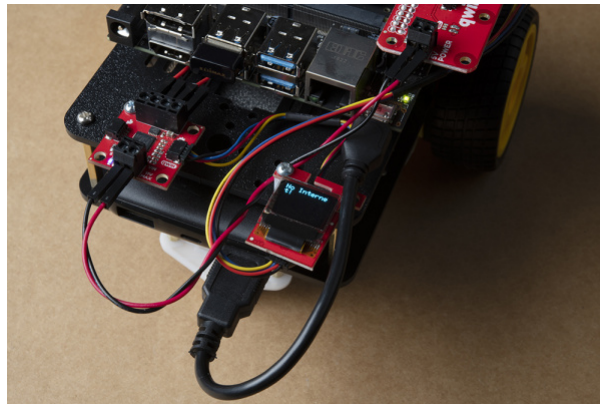
->

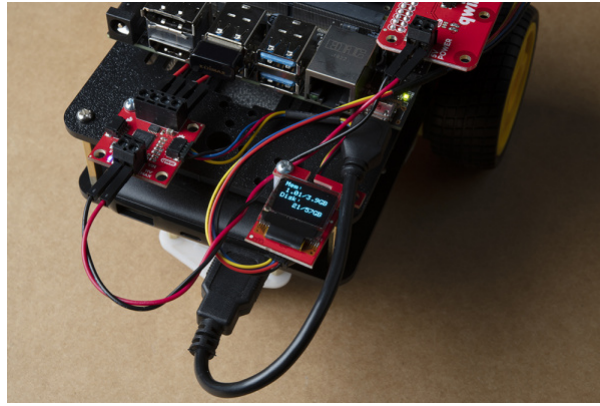


Having trouble seeing everything in the image? Click on it for a larger view.

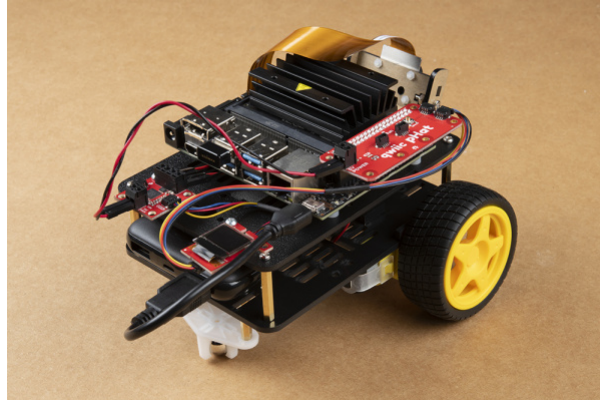
⚡ Note: Make sure the USB cable is plugged into the orange USB port (shown closest to the USB cable in the above photo) on the battery pack. This will provide the required **3.1A @ 5V** required by the Jetson Nano Dev Kit.

If the Jetson Nano does not power on once your USB cable is connected, press the power button on the battery pack to turn the JetBot on. Allow the JetBot a few minutes to power up. When the JetBot is ready, the Micro OLED will display the SparkFun flame logo followed by the available disk image space & IP address once connected to a WiFi network; see example photos below.





Congratulations! Your SparkFun JetBot is now fully assembled!



4. Software Setup Guide from NVIDIA

Attention: The SD card in this kit comes **pre-flashed** to work with our hardware and has the all the modules installed (including the sample machine learning models needed for the collision avoidance and object following examples). The only software procedures needed to get your JetBot running are steps 2-4 from the Nvidia instructions (i.e. setup the WiFi connection and then connect to the JetBot using a browser). Please **DO NOT** format or flash a new image on the SD card; otherwise, you will need to flash our image back onto the card (instructions below).

Your SparkFun JetBot comes with a **Pre-Flashed** micro SD card. Users only need to plug in the SD card and set up the WiFi connection to get started.

- The default password on everything (i.e. login/user, jupyter notebook, and superuser) is "**jetbot**".
- We recommend that users change their passwords after initial setup. These are typically covered on the first boot of your Jetson Nano as detailed in the NVIDIA Getting Started with Jetson Nano walkthrough

Software Setup

The only step needed to get your JetBot kit up and running is to log into the JetBot and setup your WiFi connection. Once that is done, you are now ready to connect to the JetBot wirelessly. If you need instructions for doing so, you can use the link below.

However, please take note of our instructions below. You will want to **skip steps 1 and 5** to avoid erasing the image on the card or undoing the hardware configuration.

NVIDIA JETBOT WIKI SOFTWARE SETUP

Instructions

1. **Skip step 1 of Nvidia's instructions:** It references how to flash your SD card, so feel free to skip to **Step 2 - Boot Jetson Nano**.

Note: Following **Step 1** will **erase the pre-flashed image** and make a lot of extra work for yourself.

2. **Skip step 5 of Nvidia's instructions:** This step should already be setup on the pre-flashed SD card.
 - If in the future, you need to update your notebooks, you can follow **Step 5 - Install latest software (optional)** to download the repository (*don't download it into the home directory and skip the last command line instruction of the forth step*).

Get and install the latest JetBot repository from GitHub by entering the following commands

```
git clone https://github.com/NVIDIA-AI-IOT/jetbot
cd jetbot
sudo python3 setup.py install
```

Note: Running `sudo python3 setup.py install` in the command line will overwrite the software modifications for SparkFun's hardware in the kit.

Troubleshooting

In the event that you accidentally missed the instructions above, here are instructions to get back on track.

Re-Flashing the SD card

If you need to re-flash your SD card, follow the instructions from **Step 1 Nvidia's guide**. Alternatively, to download and use our image instead (click link below). Please note the model of your microSD card with regard to which version you need to download.

DOWNLOAD SPARKFUN'S JETBOT IMAGE V1.10 - KINGSTON 64GB MICROSD CARD INCLUDED W/ KIT

DOWNLOAD SPARKFUN'S JETBOT IMAGE V1.11 - KINGSTON CANVAS GO 64GB MICROSD CARD INCLUDED W/ KIT

Note: Balena Etcher software (NVIDIA's recommendation) internally takes care of un-zipping disk image files. If you are using another program Don't forget to uncompress (i.e. unzip, extract, or expand) the file from the `.zip` file/folder first if needed. You should be pointing the "flashing" software to a ~62GB `.img` file to flash the image (`sparkfun_jetbot_v01-00.img`) onto the SD card. **Not every unzip utility can handle this large of a file!** The Windows 10 'Extract All' command has been found to work as well as 7Zip and Winzip.

Alternatively, there are other options for flashing images onto an SD card. If you have a preferred method, feel free to use the option you are most comfortable with.

Re-Applying the Software Modifications

If you have accidentally overwritten the software modifications for the hardware included in your kit, you will need to repeat **Step 5 from Nvidia's guide** from the desktop interface (*if you are comfortable performing the following steps from the command line, feel free to do so*).

Skip steps 1 and 2: Plug in a keyboard, mouse, and monitor. Then log in to the desktop interface (*if you haven't changed your password, the default password is: jetbot*).

Follow step 3: Launch the terminal. There is an icon on sidebar on the left hand side. Otherwise, you can use the keyboard short cut (`Ctrl + Alt + T`).

Follow step 4: However, before you execute `sudo python3 setup.py install` you will want to copy in our file modifications to the `jetbot` directory you are in.

1. Begin by downloading our files (click link below).

DOWNLOAD MODIFICATION FILES

2. Next, extract the file.
3. Next, replace the files in the `jetbot` folder. The file paths must be the same, so make sure to overwrite files exactly.

Click on the icon that looks like a filing cabinet on the left hand side of the GUI. This is your `Home` directory. From here, you will need to proceed into the `jetbot` folder. There you will find a `jetbot` folder with similar files to the ones you just extracted. Delete the folder and copy in our files (*you can also just overwrite the files as well*).

4. Now, you can execute `sudo python3 setup.py install` in the terminal.

Follow step 5: Finish up by following step 5. Now you are back on track to getting your JetBot running again!

Note: If you need to install the Python packages for the Qwiic devices (i.e. the OLED and SCMD motor driver), use the following command in the terminal: `sudo pip3 install sparkfun-qwiic` .

5. Examples

The "object following" Jupyter Notebook example won't work ~~due to the required dependencies that had not been released by NVIDIA prior to the creation of the SparkFun JetBot image. These updates can be manually installed on your Jetson Nano with the JetPack 4.2.1 release.~~

Update: The engine generated for the example utilized a previous version of TensorRT and is therefore, not compatible with the latest release. For more details on this issue, check out the following GitHub issue.

Update: One of our customers was able to find an older image that is compatible with the pre-built engine. For more details, check out the following forum post.

NVIDIA JETBOT WIKI EXAMPLES

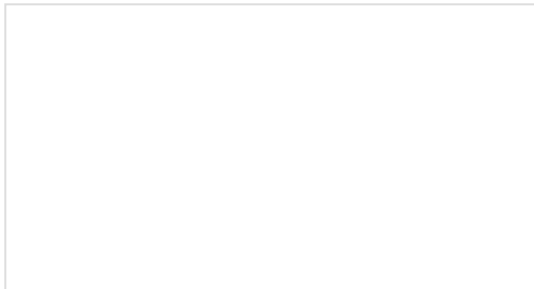
Resources and Going Further

Now that you've successfully got your JetBot AI up and running, it's time to incorporate it into your own project!

For more information, check out the resources below:

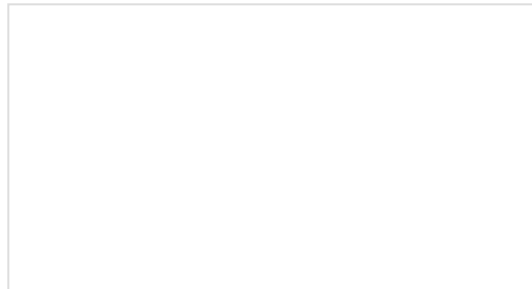
- [Getting Started With Jetson Nano Developer Kit](#)
- [Assembly Guide for SparkFun JetBot AI Kit \(previous version\)](#)
- [SparkFun Qwiic Motor Driver Hookup Guide](#)
- [SparkFun Qwiic Micro OLED Hookup Guide](#)
- [SparkFun Qwiic pHAT Hookup Guide](#)
- [JetBot ROS GitHub Repository](#)
- [Getting Started with AWS IoT Greengrass](#)
- [NVIDIA Jetson Forums](#)
- [NVIDIA JetBot GitHub Issues](#)
- [NVIDIA JetBot GitHub](#)
- [NVIDIA JetBot GitHub Wiki](#)
- [NVIDIA JetBot software setup](#)

Need some inspiration for your next project? Check out some of these related tutorials:



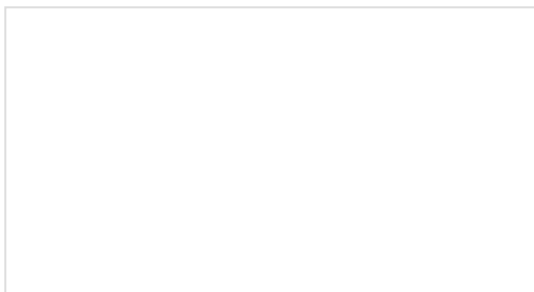
Assembly Guide for RedBot with Shadow Chassis

Assembly Guide for the RedBot Kit. This tutorial includes extra parts to follow to go along with the RedBot Inventor's Kit tutorial.



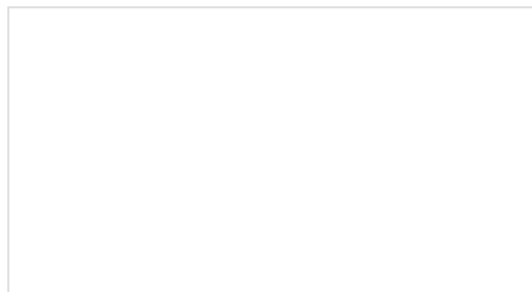
SparkFun Inventor's Kit Experiment Guide - v4.0

The SparkFun Inventor's Kit (SIK) Experiment Guide contains all of the information needed to build all five projects, encompassing 16 circuits, in the latest version of the kit, v4.0a.



Qwiic Joystick Hookup Guide

Looking for an easy way to implement a joystick to your next Arduino or Raspberry Pi project? This hookup guide will walk you through using the Qwiic Joystick with the Arduino IDE on a RedBoard Qwiic and in Python on a Raspberry Pi.



Assembly Guide for SparkFun JetBot AI Kit V2.0

Assembly Guide for the SparkFun JetBot AI Kit v2.0. This tutorial includes photos & comments to assemble the two-layer chassis & additional components unique to the JetBot kit.