Sourcing Parts

Below you'll find a list of all the electrical components and hardware required as well as some affiliate reference links you can use to double check your components. Remember you can find pretty much all of these parts for cheaper on Aliexpress but will likely take a little longer to arrive. Always double check reviews and delve into the part descriptions to make sure you're really getting what's advertised.

PRINTED CIRCUIT BOARD COMPONENTS

1.) 1x Pack 40pin Female Headers Single Row 2.54: https://amzn.to/4bmDsSK
2.) 1x Pack 40 pin Male Headers Single Row 2.54: Use Link Above
a.) Aliexpress alternative
3.) 1x Pack(4 are required)Screw Terminal Blocks 5mm 2pin: https://amzn.to/3yjh5yX
a.) Comes with 2&3pin terminal blocks. The 3pin will be useful for future projects.
b.) Aliexpress alternative
4.) x1 2-3A Switch 3pin 2position: https://amzn.to/3wCvohk
a.) Aliexpress alternative
5.) x1 5x20 Fuse Holder C3131: https://amzn.to/3BJERpz
a.) Aliexpress alternative
6.) x2 CR123A Battery Holders: https://amzn.to/3wE5Xw4
a.) Aliexpress alternative

All Other Components

1.) 1x ESP32 30Pin Development Board(Micro USB): https://amzn.to/4bzrJzC
2.) 2x DRV8833 H-Bridges: https://amzn.to/3UKd3H7
3.) 1x Buck Converter:https://amzn.to/3QMb2cC
4.) x3 100RPM 12v N20 Motor: https://amzn.to/4e5HS0A
5.) x2 MG90S Servos:https://amzn.to/4bhSGIF
6.) x2 125v 5x20mm 5a Fast Blow-Glass fuses: https://amzn.to/4dKQVW3
7.) OPTIONAL: PS4 Controller: https://amzn.to/3Yv8T80
8.) x1 2.6mm Truss Head Screw kit: https://amzn.to/3znOCsi
a.) If the first option is sold out these will also do the trick just sub in the 12mm screws when 10mm are called for https://a.co/d/d64GyEw.
9.) 22awg Wire(Preferably 2 different colors): https://amzn.to/4aoeO2P
10.) Thread: https://amzn.to/48fVoNZ
11.) x1 Box of car tire weights: https://amzn.to/3XdfyD4
a.) Alternative: Local auto or harbor freight store.
12.) x2 Fenix Batteries: https://fenix-store.com/products/fenix-arb-l16-700up-usb-rechargeable-16340-battery

COMPLETE AND CONTINUE >

Required Tools

REQUIRED TOOLS
1.) Soldering Iron:
2.) Small Wire Cutters:
3.) Small-Medium Phillips head Screw Driver:
4.) Small Flathead screwdriver:
5.) (Optional but Recommended) Hot Glue Gun:
6.) (Optional but Highly Recommended) Multimeter for testing output voltage:
7.) And of course a 3D Printer...

COMPLETE AND CONTINUE >

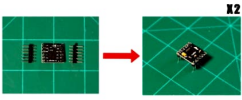
Soldering H-Bridges & Buck Converter

Tools Required

- Soldering Iron
- Small Wire Cutters

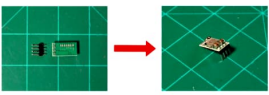
H-Bridge Steps

1.)Insert the 2 rows of 6pin male headers from the bottom and solder(repeat 4 times).

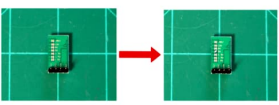


Buck Converter Steps

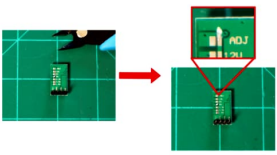
1.)Solder on a 4pin Male header.



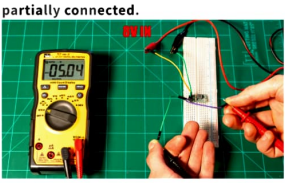
2.)Solder the 2 5v Pads together.



3.)Using a small pair of wire cutters cut the trace just above "ADJ". Make sure its deep enough and removes the top layer of copper.



4.) Using a breadboard, multimeter and DC power supply input 8v into the "IN+" pin, "GND" to the GND on your power supply and multimeter, "VO+" to the positive lead on your multimeter. Measure the voltage output of the buck converter. It should read 5v, if it doesn't and your solders look good try cutting the trace deeper as it could still be partially connected.

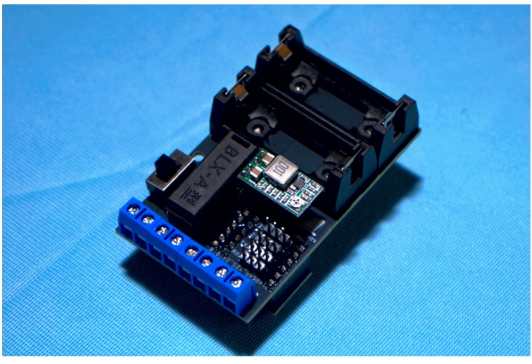


Potential Problems

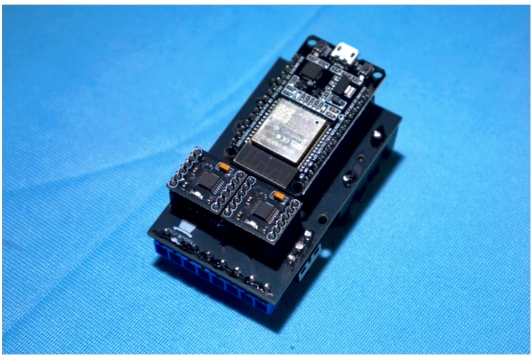
1. **Due to the wide range of quality found in esp32 dev boards It has come to my attention that occasionally they will not properly pair to ps3 controllers when powered off 5v. I have not personally encountered this but if your esp32 will only pair to the ps3 controller when its plugged in via USB try altering your buck converter to supply 6v instead of 5v.**
2. **If none of your motors work but the LEDS do try soldering the J2 pads together on the H-Bridges.**

Populating Electronics

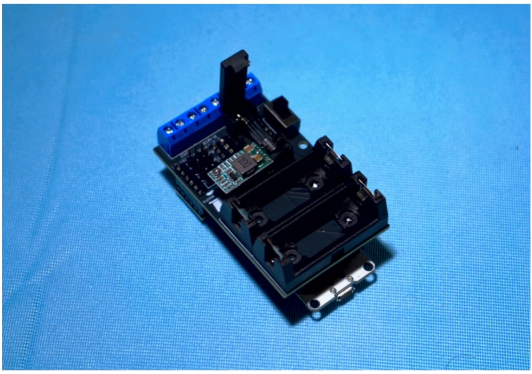
Use the reference photos below to properly populate your electronics.



Make sure to align the "EEP" pin on the H-Bridges with the "EEP" pin labeled on the PCB.



Then open the fuse holder and insert a 5a fast blow fuse.



COMPLETE AND CONTINUE >

Soldering Wires to N20 Motors

Tools Required

- **Soldering Iron**
- **Wire Strippers**
- **Small Wire Cutters**

STEPS

1. **Cut the following lengths of wire using 22AWG wire(Note: If you really want to get fancy use two different colors so you can match one color to the positive terminal of the N20 Motor)**
    a. **Cut 2 pairs of 6cm wires.**
    b. **Cut 1 pair of 10cm wires.**
2. **Using wire strippers strip one end back about 3mm and the other end back 8mm.**
3. **Solder on the stripped 3mm side of the wire lengths to the N20 motors (Note: coating both sides in some flux can really make your life easier especially if you haven't soldered much)**
    c. **Solder all 3 Pairs onto x3 100rpm N20 motors(Or your preferred motor RPM speeds).**
4. **I recommend securing the wires directly to the back of the N20 motors using some hot glue.**

ESP32/BluePad32 Dev Board Add-On

STEPS

1. In the Arduino IDE navigate to File->Preferences
2. In the "Additional boards manager URLs:" dialogue box copy and paste the following links as one.
    a. https://raw.githubusercontent.com/espressif/arduino-esp32/gh-pages/package_esp32_index.json,https://raw.githubusercontent.com/ricardoquesada/esp32-arduino-lib-builder/master/bluepad32_files/package_esp32_bluepad32_index.json
    b. Click "OK"
3. Now open the boards manager by going to "Tools -> board -> board Manager"
    c. If using a PS4/5 or Xbox controller search for "esp32_bluepad32" and click "install" on the one created by "Ricardo Quesada". Select your board by going to "Tools -> board -> esp32_bluepad32 -> esp32 Dev Module". If using a PS3 controller or WIFI connection skip this step and continue to "d."
    d. Search for "esp32" and click install on the one created by Espressif Systems. Select your board by going to "Tools -> board -> esp32/esp32Arduino -> esp32 Dev Module"

COMPLETE AND CONTINUE >

Downloading GitHub Code

STEPS

1. Using the GitHub Link below navigate to the "ProfBoot/Mini-Fork" Repository
    a. https://github.com/ProfBoots/Mini-Fork.git
2. Once there click the green "Code" drop down and "Download ZIP"
3. With the folder downloaded right click and "extract all"
    b. If you don't "Extract all" it can cause compiling errors"
4. Now open the "MiniFork_Bluepad2.0", "MiniFork_Wifi2.0", or "MiniFork_PS3_Controller" sketch with the Arduino IDE.

Installing Libraries

GAMECONTROLLER(PS4/5 OR XBOX) CODE STEPS

1. Navigate to Manage Libraries by going to "Sketch -> Include library -> Manage Libraries"
2. Search for and install "ESP32Servo" by "Kevin Harrington"

WIFI CODE STEPS

1. Navigate to Manage Libraries by going to "Sketch -> Include library -> Manage Libraries"
2. Search for and install "ESP32Servo" by "Kevin Harrington"
3. Search for and install "ESPAsyncWebSrv" by "dvarrel"
4. Search for and install "AsyncTCP.h" by "dvarrel"
5. Search for and install "ESPAsyncTCP.h" by "dvarrel"

PS3 CODE STEPS

1. In your desired search engine search of "SixaxisPairTool".
2. A variety of different websites will appear, carefully select your desired platform to download it. If the website looks sketchy it probably is and don't download anything from it. I personally used LO4D.com to download my version.
3. Once downloaded go through any setup steps required until you have the application open.
4. With the "SixaxisPairTool" open plug your PS3-Controller in via USB to your computer.
5. The "SixaxisPairTool" should automatically detect your PS3-Controller and display the MAC address.
6. Copy that MAC address and paste it into the "MiniFork_PS3" Arduino sketch where it says "Ps3.begin("MAC Address") This is inside "setup{}".
7. Navigate to Manage Libraries by going to "Sketch -> Include library -> Manage Libraries"
8. Search for and install "ESP32Servo" by "Kevin Harrington"
9. Search for and install "PS3 Controller Host" by "Jeffrey van Pernis"

Upload & Settings

STEPS

1. Connect your esp32 dev board to your computer via micro-usb. Select the appropriate com port by navigating to "Tools -> Port -> Com#"
    a. The com port of your ESP32 should show up when you plug it in so if you're not sure unplug it, check what's available, then plug it back in and see what new com ports show up.
    b. A secondary option is to navigate to "device manager -> ports" if you're using windows and plug/unplug your esp32 to determine which com port it is.
2. With the appropriate com port selected upload your sketch by clicking the right arrow at the top of the Arduino IDE.
3. We will double check that the sketch was uploaded successfully later in this workshop.

Verify the following if you're having trouble uploading the code

1. Tools > Upload Speed > 115200 from the Arduino IDE menus.
2. If you have an error related to "LedCDetachPin" This was caused by the release of 3.0.0 of the espressif "esp32" board. You'll want to use "esp32" version 2.0.17 otherwise the compiler will not work with library "ESP32Servo". Version 3.0.0 of the Espressif "esp32" board has broken some of the code - they note this in their release.

Material & Infill

Material

PLA & TPU

For the PLA parts I like to to use 15-25% infill with a wall thickness of 2-3. I recommend using a newly opened filament roll or one that's been properly dried as any warping could cause issues. Keep in mind not all PLA filament is created equal with some being extremely brittle("Ask me how I know").

The only parts that use TPU on the MiniFork are the tires and fenders. I like to use 10% infill with a wall thickness of 2. I recommend 95A for the tires as it provides a good amount of flexibility.

COMPLETE AND CONTINUE >

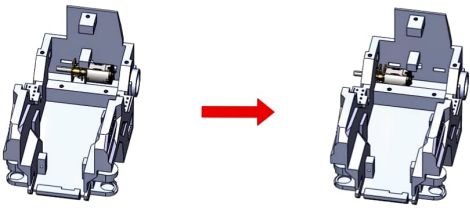
Drive Motors

Parts Required

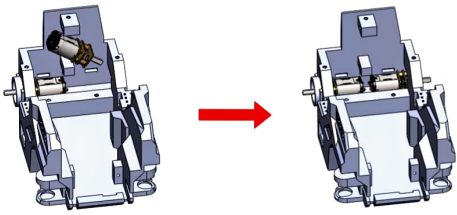
- **x2 2.6x8mm Truss Screws**
- **x2 100rpm N20 Motors(or your preferred RPM)**
- **x1 3D Printed Body**
- **x2 3D Printed Motor Lock**

STEPS

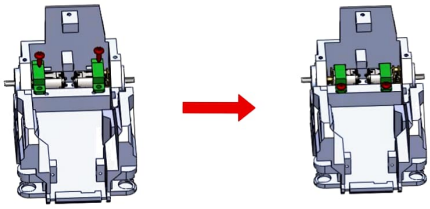
1.) Insert the left N20 motor into the body making sure to press it all the way to the left.



2.) Insert the right N20 motor, again pressing it all the way to the right.



3.) Secure both motors with a motor lock and 2.6x8mm Truss Screw.



COMPLETE AND CONTINUE >

Mast Motor

Parts Required

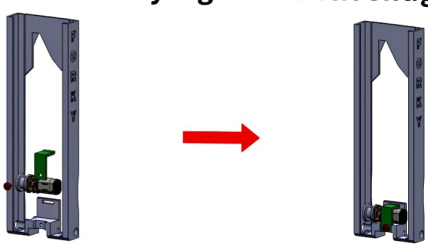
- **x1 2.6x6mm Truss Screw**
- **x1 100rpm N20 Motor**
- **x1 3D Printed Mast1**
- **x1 3D Printed Mast Motor Lock**
- **x1 3D Printed Spool**
- **x1 65cm length of thread/floss**

STEPS

1.) Tie off one end of the thread/floss to the spool. I usually just triple knot it and call it good!

2.) Press the spool onto the N20 motor shaft.

3.) Place the N20 motor onto the motor cutout on mast1. Secure in place with the mast motor lock and a 2.6x6mm truss screw. Only tighten until snug.



COMPLETE AND CONTINUE >

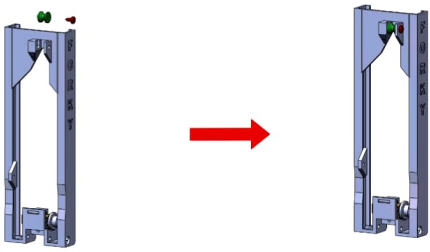
Prepping Mast Parts

Parts Required

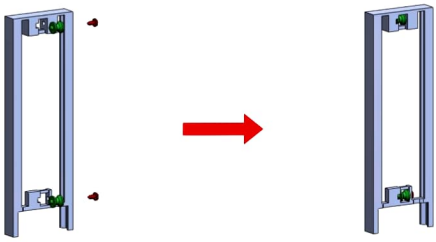
- **x3 2.6x6mm Truss Screw**
- **x1 3D Printed Mast2**
- **x1 3D Printed Carriage**
- **x3 3D Printed Pulley**

STEPS

1.) Insert a pulley into mast1 and secure with a 2.6x6mm truss screw.

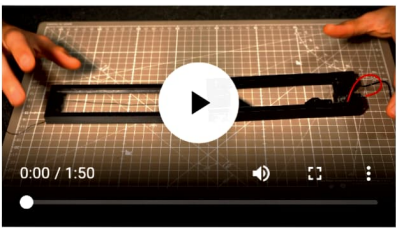


2.) Insert 2 pulleys into mast2 and secure each with a 2.6x6mm truss screw.



3.) Take extra care to make sure the surfaces on mast1, mast2 and the carriage are smooth and free of any deformities. This is crucial to the operation of the mast.

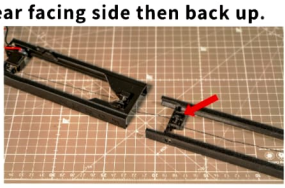
Routing Thread/Floss



STEPS

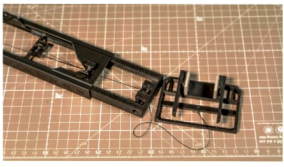
1.) Begin by guiding your thread or floss over the top of the mast1 pulley and out the front.

2.) On mast2 route the thread or floss under the bottom pulley coming in from the rear facing side then back up.

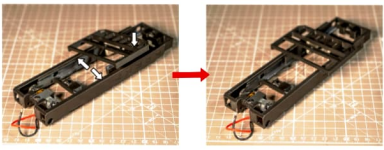


3.) Pass it over the top pulley of mast2, again coming from the rear facing side.

4.)Tie off the thread or floss to the middle spar on the backside of the carriage. You will want just enough length so the carriage can touch the ground which will result in some extra thread or floss. Leave about 1cm after the knot and cut the excess off.



5.) Insert the carriage into the mast assembly by gently spreading the mast apart and inserting the carriage.



COMPLETE AND CONTINUE >

Securing Mast to Body

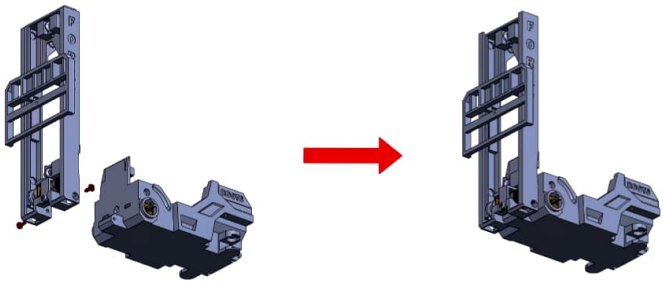
Parts Required

- **x2 2.6x8mm Truss Screw**

STEPS

1.) Route the mast n20 motor wires through the center cutout on the front of the body.

2.) Secure the mast to the body using x2 2.6x8mm truss screws.



COMPLETE AND CONTINUE >

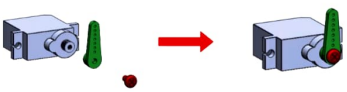
PCB Connections

Parts Required

- **PCB Assembly + Batteries**
- **x2 MG90S Servo**

STEPS

1.) Start by routing each of the N20 motor wires into their respective terminal blocks which are listed below.
a.) Left N20 Motor -> L-MTR
b.) Right N20 Motor -> R-MTR
c.) Mast N20 Motor -> AUX1
2.) Plug x2 MG90S servos into pin sets 23 and 22. The brown wires should be furthest away from the pin set names on the PCB.
3.) Insert x2 Fenix batteries into the PCB and power the model on. You should hear the servos move to their startup position. If you're not sure they moved turn the model off and manually turn the servo 30degrees and turn the model back on.
4.) Once you're sure the servos are in the correct startup position place a servo horn on the servo coming off of pin set 23 as shown below and secure with the short silver screw that came with the servo.



5.) Place a servo horn on the other servo(Coming off pin set 22) as shown below and secure with the short silver screw that came with the servo.

6.) Refer to the "Connecting & Testing" Module to verify all the functions on your model are working appropriately.

COMPLETE AND CONTINUE >

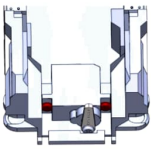
Securing Servos

Parts Required

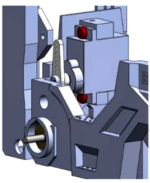
- **x2 2.6x6mm Truss Screw**
- **x1 3D Printed Mast Push Rod**
- **Silver screws that came with the MG90S Servos.**

STEPS

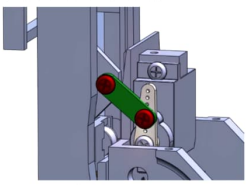
1.) Place the servo coming off pin set 23 onto the body as shown and secure using the 2 long silver screws that came with the servo.



2.) Place the servo coming off pin set 22 onto the body as shown and secure using the 2 long silver screws that came with the servo.



3.) Connect the Mast to the servo using a mast push rod and x2 2.6x6mm truss screws. Attach to the 3rd hole from the center of the servo horn.



4.) Tuck/press the PCB assembly into the body pushing it as far forward and down as possible while still being able to see the motor lock screws, I prefer routing the N20 motor wires on top of the motors themselves.(OPTIONAL: Feel free to trim any excessive wire lengths coming from the front motors for a tidier look.)

COMPLETE AND CONTINUE >

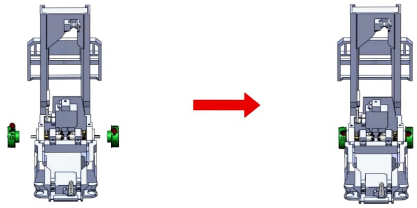
Wheels

Parts Required

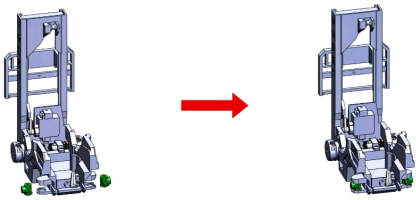
- **x2 2.6x10mm Truss Screws**
- **x2 2.6x8mm Truss Screws**
- **x2 3D Printed Wheel**
- **x2 3D Printed Rear Wheel**
- **x2 3D Printed Rear Wheel Pivots**

STEPS

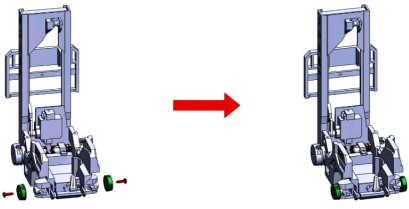
1.) Press a wheel onto both drive N20 motors and lock to each motor shaft using a 2.6x8mm truss screw.



2.) Press a rear wheel pivot into each side of the body.



3.) Secure a rear wheel to each rear wheel pivot using a 2.6x10mm truss screw. Tighten so the wheel doesn't wobble side to side to much but can spin freely on the screw.



COMPLETE AND CONTINUE >

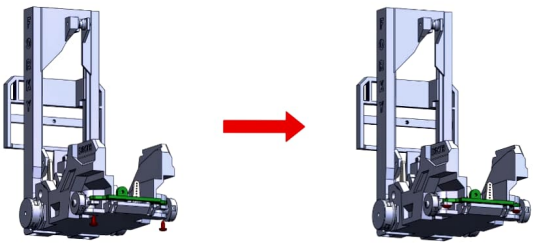
Steering Linkage

Parts Required

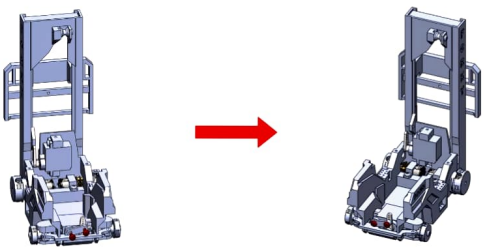
- **x2 2.6x8mm Truss Screw**
- **x2 2.6x6mm Truss Screw**
- **x1 3D Printed Steering Bar**
- **x1 3D Printed Steering Pushrod**

STEPS

1.) Secure both ends of the steering bar to a rear wheel pivot using x2 2.6x6mm truss screws.



2.) Secure one end of the steering push rod to the steering bar and the other to the 3rd hole from the center of servo horn using x2 2.6x8mm truss screws as shown.



COMPLETE AND CONTINUE >

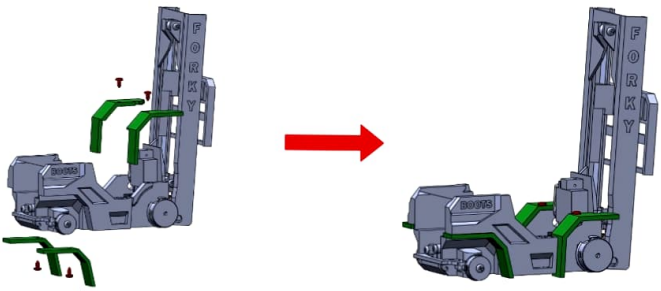
Fenders

Parts Required

- **x4 2.6x6mm Truss Screw**
- **x1 3D Printed Front Left Fender**
- **x1 3D Printed Front Right Fender**
- **x1 3D Printed Rear Left Fender**
- **x1 3D Printed Rear Right Fender**

STEPS

1.) Secure all 4 fenders to their respective locations using x4 2.6x6mm Truss Screws.



COMPLETE AND CONTINUE >

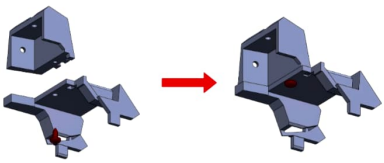
Front Cover & Dash Assembly

Parts Required

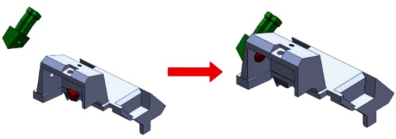
- x2 2.6x8mm Truss Screw
- x2 2.6x6mm Truss Screw
- 3D Printed Lower Interior
- 3D Printed Dash
- 3D Printed Steering Wheel
- 3D Printed Levers

STEPS

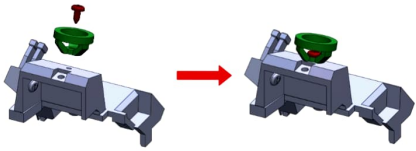
1.) Secure the dash to the lower interior using a 2.6x6mm truss screw.



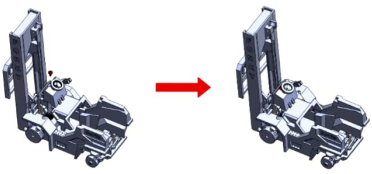
2.) Attach the levers to the dash using a 2.6x6mm truss screw.



3.) Attach the steering wheel to the dash using a 2.6x6mm truss screw.



4.) Press the assembly onto the body, align the two tabs on each side of the lower interior with the cutouts on the body and press together. Lock the dash to the body using a 2.6x8mm truss screw. Verify everything is flush and the on/off switch is visible.



COMPLETE AND CONTINUE >

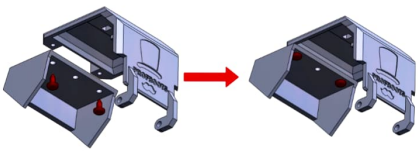
Rear Hatch Assembly

Parts Required

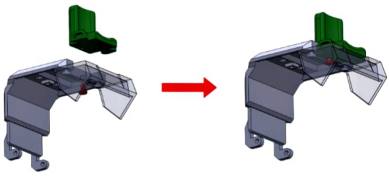
- x2 2.6x10mm Truss Screw
- x4 2.6x6mm Truss Screw
- x1 3D Printed Rear Hatch
- x1 3D Printed Upper Interior
- x1 3D Printed Seat
- x1 3D Printed Propane Tank Holder
- x1 3D Printed Propane Tank Strap

STEPS

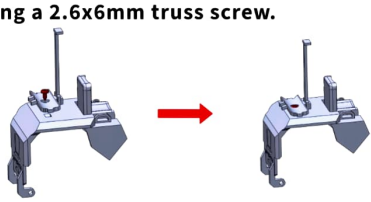
1.) Attach the upper interior to the rear hatch using x2 2.6x6mm truss screws.



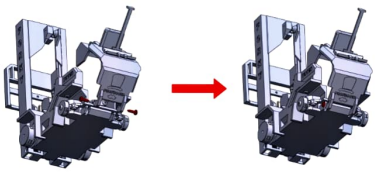
2.) Secure the seat to the upper interior using a 2.6x6mm truss screw.



3.) First place the propane tank strap on the propane tank holder then secure the propane tank holder to the rear hatch using a 2.6x6mm truss screw.



4.) Attach the rear hatch to the body using x2 2.6x10mm truss screws, make sure it can pivot freely.



COMPLETE AND CONTINUE >

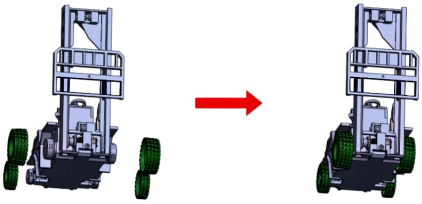
Wheels

Parts Required

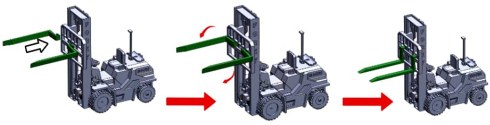
- **x2 3D Printed Front Tire**
- **x2 3D Printed Rear Tire**
- **x1 3D Printed Propane Tank**

STEPS

1.) Press the front and rear tires onto the wheels.



2.) Attach the forks to the carriage by turning them 90 degrees and then slotting them on.



3.) Place the roll cage on by placing the front 2 posts into the cutouts on the front fenders and the rear posts can be pressed into the body.

4.) Strap the propane tank on and take it for a spin!

COMPLETE AND CONTINUE >

Bluepad32 Sketch(PS4/5, Xbox controllers e.t.c.)

Connecting

Pros: (My Personal Choice) Easy to upload code/sketch to mini-fork, can be used with an extremely wide range of controllers. Look here to determine if you already have a controller that would work well.
Cons: The controller in use "searches" and "binds" every time meaning it can be hard to customize specific controllers to match their corresponding minis. (Only applicable if you're making a lot of the projects!)

1. **Power "ON" the mini-fork.**
2. **On your controller of choice start by pressing and holding the "share" button(Located to the left of the main center pad on ps4/5 controllers) then press and hold the "PS" button. let go once the controller starts flashing.**
3. **The light on the controller should turn solid to verify the controller has connected.**

Controls

- **Left Joystick Up/Down -> Throttle(Proportional)**
- **Right Joystick Up/Down -> Mast Up/Down**
- **Right Joystick Left/Right -> Steering(Proportional)**
- **DPad Up/Down -> Mast Tilt**
- **R1/L1 Bumpers -> Steering Trim**
- **R2/L2 Triggers -> Hard Left/Right**
- **R3 Pressing Right Joystick like a button -> Auxiliary on/off(Lights can be added to "AUX2" on PCB which can be toggled on and off via this function)**

COMPLETE AND CONTINUE >

WIFI Sketch (Phone/PC Controller)

Connecting

Pros: Can be used with a phone or laptop meaning no extra equipment is required.
Cons: Connection process is by far the most complicated and time consuming. Doesn't have the trimming or hard left/right controls found on the game controller options.

1. **Power "ON" the mini-fork.**
2. **Using a phone/pc navigate to your "available networks".**
3. **Look for the "profboots mini-fork" (or whatever custom name you gave it) in the "available networks" list and select it. (If any notifications display such as "No WIFI available" just press okay or ignore and continue)**
4. **In a web browser(I prefer google or safari) enter "192.168.4.1" into the URL search bar and hit enter.**
5. **A controller interface should display verifying you've properly connected.**
6. **On a phone I prefer holding the phone vertically and then locking the display so it doesn't turn. Rotate your phone 90degrees which will resemble a more traditional game controller.**

Phone Controls

- **Left Slider -> Throttle(Proportional)**
- **Bottom Right Slider -> Steering(Proportional)**
- **Up Down Buttons -> Mast Up/Down**
- **Top Right Buttons -> Mast Tilt**
- **Center button between the Up Down buttons -> Auxiliary(Meaning you can add lights to "aux2" on the PCB and this will toggle them ON/OFF)**

PC Controls

- **WASD -> Throttle and Steering movement**
- **JL -> Mast Tilt**
- **IK -> Mast Up/Down**

COMPLETE AND CONTINUE >

PS3 Sketch(PS3 Controller)

Connecting

Pros: This is a good option if you're making multiple and want to stylize each controller to match the corresponding mini-fork. This is because in the code we manually set the mac-address for each controller which only lets the controller connect to that specific mini-fork. Versus the bluepad32 sketch "searches" and "binds" to available minis every time.
Cons: Obtaining the mac-address off the PS3 controller requires downloading 3rd party software which is only easily done on windows/Linux machines. If you're on a apple computer its a lot more challenging and I wouldn't recommend it.

1. **Power the mini-fork "ON".**
2. **Press the "PS" button on the PS3 Controller.**
3. **Verify Connection: 4 Lights will blink initially on the front of the controller, once connected it will switch to just 1.**

Controls

- **Left Joystick Up/Down -> Throttle(Proportional)**
- **Right Joystick Up/Down -> Mast Up/Down**
- **Right Joystick Left/Right -> Steering(Proportional)**
- **DPad Up/Down -> Mast Tilt**
- **R1/L1 Bumpers -> Steering Trim**
- **R2/L2 Triggers -> Hard Left/Right**
- **R3 Pressing Right Joystick like a button -> Auxiliary on/off(Lights can be added to "AUX2" on PCB which can be toggled on and off via this function)**

COMPLETE AND CONTINUE >