

**Description:**

This is a Mostly 3D-Printable, modular, Remote Controlled car, that was designed and developed as part of a Senior Design Project by Daniel Kapuskar and Anthony Fite under the advisement of Dr. Mariappan Jawaharlal of the Mechanical Engineering Department at California State Polytechnic University, Pomona. It features a unique chassis with multiple longitudinal slots to accommodate many mounting positions for all parts, that can be 3D printed or Laser cut. There are multiple suspension design options that allow the entire system to be Printed, of partially printed with some commercially available parts. Drive-train components will need to be purchased to make this work, but this allows for a wide range of price and performance levels to be obtained. We recommend using PLA for all parts rather than ABS(ABS parts did not last long and were prone to layer separation).

**Parts Needed to Purchase:**

All parts and links are just suggestions based on what we have used and tested, you can you any parts that you want based on performance and cost. Most parts Can be found at your Local Hobby Shop also if needed quickly, but the prices are usually much greater. There are also many online sites that have similar or the same parts for different price. We suggest doing a little research and finding what works best for you, these links and prices are just a baseline.

- Motor
  - We used a 3300KV Brushless motor (can be purchased here for \$30 <http://www.ebay.com/itm/High-Speed-Brushless-Motor-KV3300-Inrunner-for-1-10-RC-Cars-Truck-Buggies-Truggy-/141503476945?> )
    - This motor was fairly cheap and fast, we would recommend going with a brushed motor with a lower speed rating in order to reduce cost and alleviate some gear failures that were encountered due to high gear speeds.
- Electronic Speed Controller
  - We used a brushless ESC for the brushless motor that was used. The configuration of the ESC will depend on the other components used such as the battery, motor, and controller. (can be purchased here for \$19 <http://www.ebay.com/itm/Waterproof-Sensorless-Brushless-Esc-Speed-Controller-45A-2S-Lipo-for-RC-Car-/381093810869?hash=item58baf612b5>)
- Differential(optional)
  - The differential that we used can be found here for about \$9 <http://www.ebay.com/itm/301310731170>
    - The gears that were designed will fit on this diff or any diff with the same mounting hub.
- Battery
  - We used a 7.2 volt NiMh battery that was compatible with our ESC and Motor. We don't have a link for this, but it was about \$25 and they can be found easily.

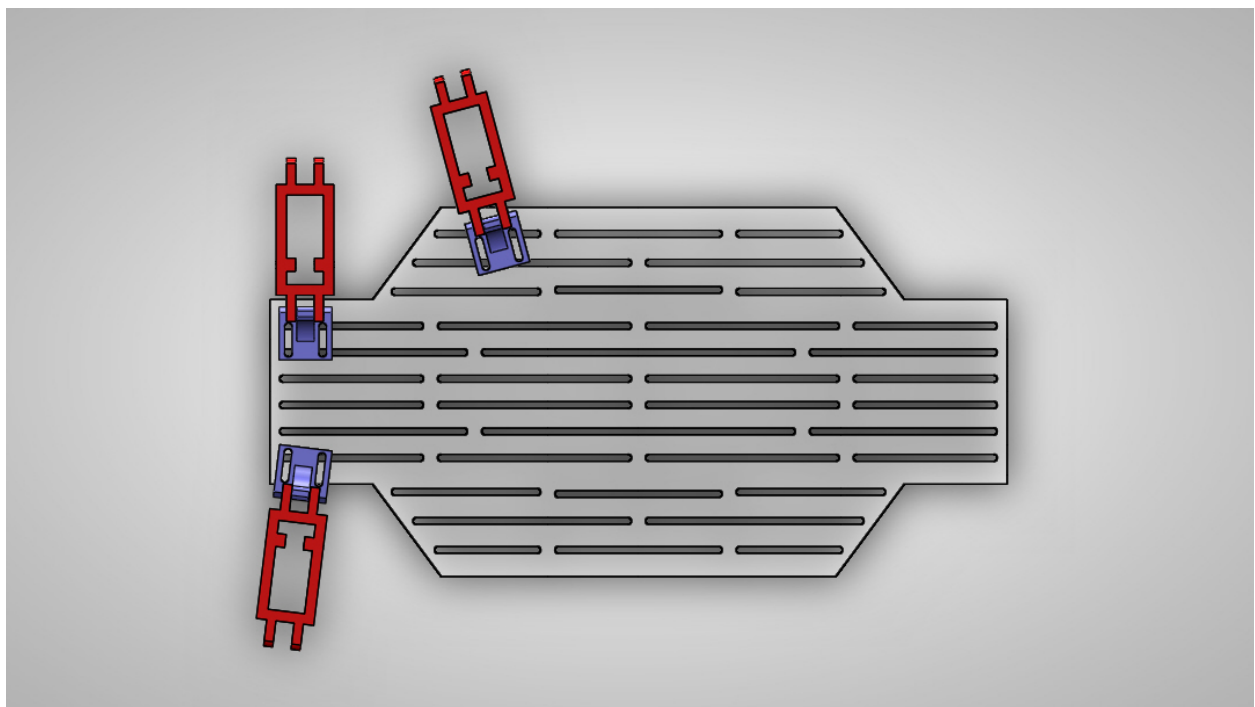
- Axle Shafts (x2)
  - The suspension designs were made around these axles, but there should be substitutions that will work just fine.  
(<http://www.amazon.com/Traxxas-6852X-Driveshaft-Assembly-Slash/dp/B004ED61D4>)
  - 12 mm hubs will also be needed to adapt the axles to standard 1:10 scale RC car wheels. These can be found for around \$2 each at any Hobby Shop, or online.
- Bearings
  - Bearings were used and integrated into the suspension design for all 4 wheels. They are 5x11x4mm ball bearings and can be found here for about \$7.  
[http://www.amazon.com/Team-Associated-25618-4mm-Bearing/dp/B000Y0MK3Q/ref=pd\\_sim\\_sbs\\_328\\_1?ie=UTF8&refRID=0JGEJ83BH6HMYPQ4SS0H](http://www.amazon.com/Team-Associated-25618-4mm-Bearing/dp/B000Y0MK3Q/ref=pd_sim_sbs_328_1?ie=UTF8&refRID=0JGEJ83BH6HMYPQ4SS0H)
- Radio
  - Almost any RC car transmitter and receiver can be used, they all use fairly standard servo style connections. We used this one and it worked great it is about \$30. ([http://www.ebay.com/itm/Axial-SCX10-AX-3-2Ch-2-4Ghz-Transmitter-AR-3-3Ch-Receiver-Tx-Rx-/261886893528?pt=LH\\_DefaultDomain\\_0&hash=item3cf9acddd8](http://www.ebay.com/itm/Axial-SCX10-AX-3-2Ch-2-4Ghz-Transmitter-AR-3-3Ch-Receiver-Tx-Rx-/261886893528?pt=LH_DefaultDomain_0&hash=item3cf9acddd8))
- Servo
  - Any servo will work fine, we used a micro servo from RadioShack for about \$6 and it worked great for us.
- Hardware
  - #6-32 x ¾ Socket Head Cap Screws for mounting parts to chassis, along with associated flat washers and nuts, or wingnuts.
    - Socket head cap and wingnuts were used for ease of assembly.
  - M3x20 hex bolts were used for the suspension pin joints.
- Wheels
  - Any 1:10 scale wheels can be used as long as they have the same 12mm hub as the axles used. These are usually around \$20 for a full set.
    - These could also be 3D printed most likely. We have not tried this yet, but anyone is encouraged to try.

### **Assembly:**

All parts needed for each Subassembly can be found in its respective folder. Both Solidworks files and STL files are provided for each part.

### Chassis Mounting:

The slots on all parts are made to run in opposite directions of the slots along the chassis. The parts are mounted with #6 screws passing through the slots, with a flat washer on each side and a wingnut on the bottom. We recommend using at least two screws per part, tightened down well in order to ensure stability and not back off due to vibrations. The image below depicts the Spring/ Damper A-Arm mounted in different positions, and shows how parts should be mounted.

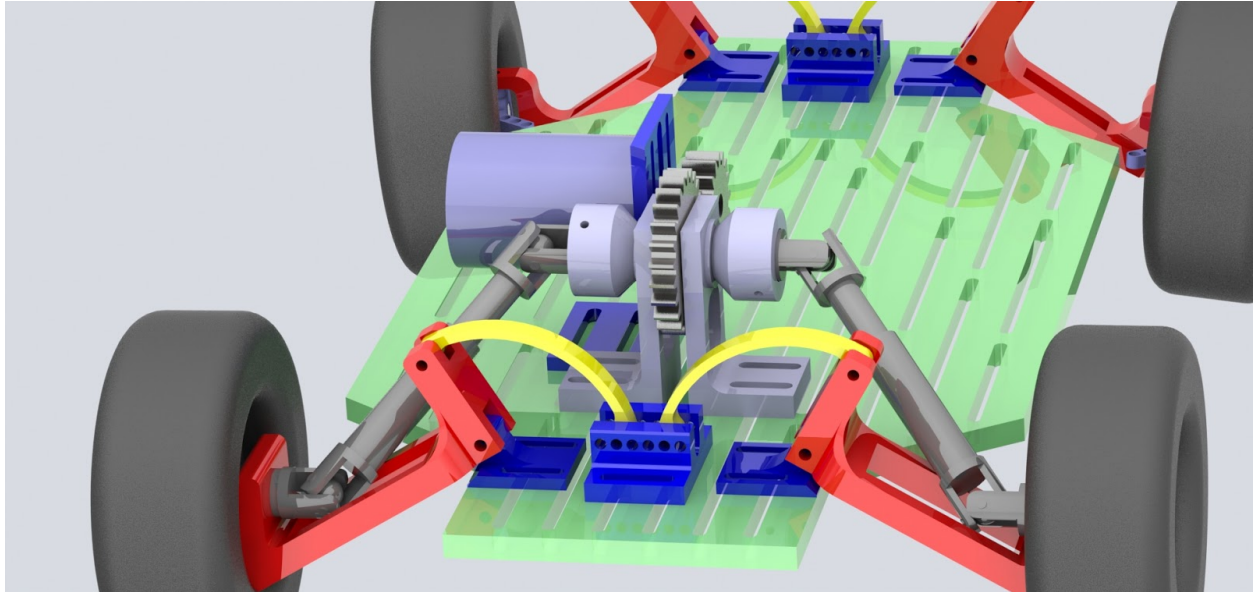


### Power Transmission:

The different power transmission methods have their own respective folder. The pulley and belt system has yet to be tested and would need to be altered to have a gear reduction, but the files are provided if anyone is willing to try them out. The belt can be printed with NinjaFlex or a similar filament material. The direct drive was tested and proved to be not sufficient as expected with no gear reduction, but these files also provide for anyone that is willing to play around with this concept. There are multiple gears with different tooth counts to achieve different gear reduction, the number of teeth is in the part name. (ex. Motor Pinion Gear 16DP 10T 20PA 0.25FW.STL part file is for a motor pinion with 10 teeth. )

### Solid Rear End:

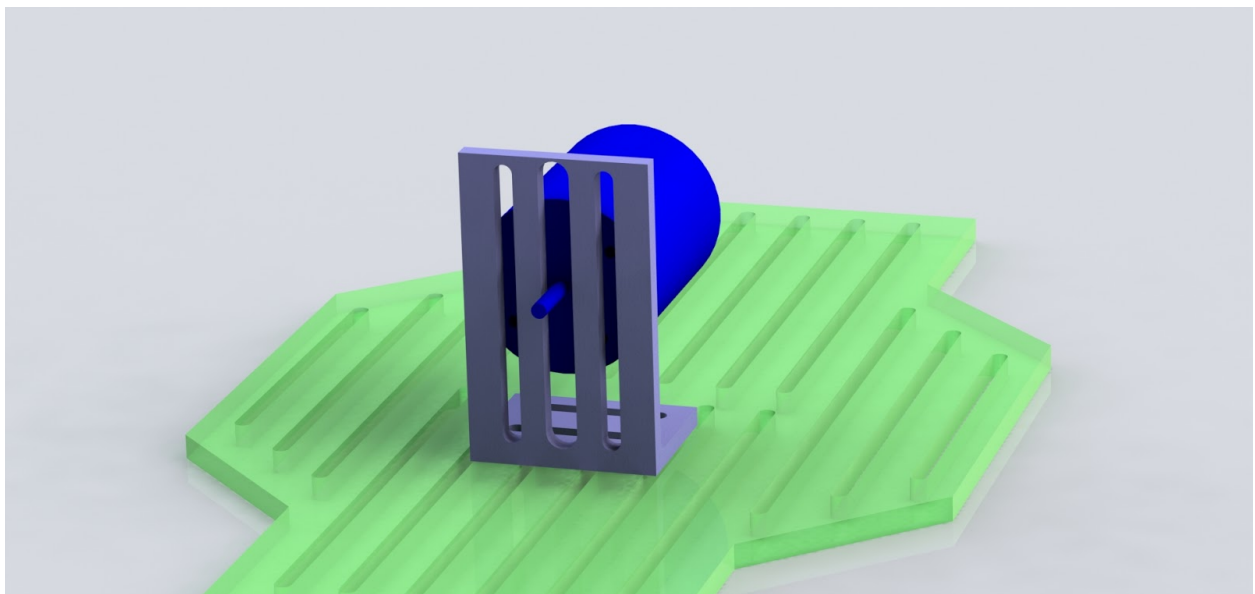
A solid rear end was designed to eliminate the need of a differential. This is fully 3D printable, and there are multiple gear ratios that can be used with this. The gears for this square shaft have the word square in the gear name. An image of this assembly is shown below.



### Motor Mount

A custom, simple motor mount was designed so the most standard motors can be mounted to it at various heights. It can be adjusted in many ways to accommodate different configurations.

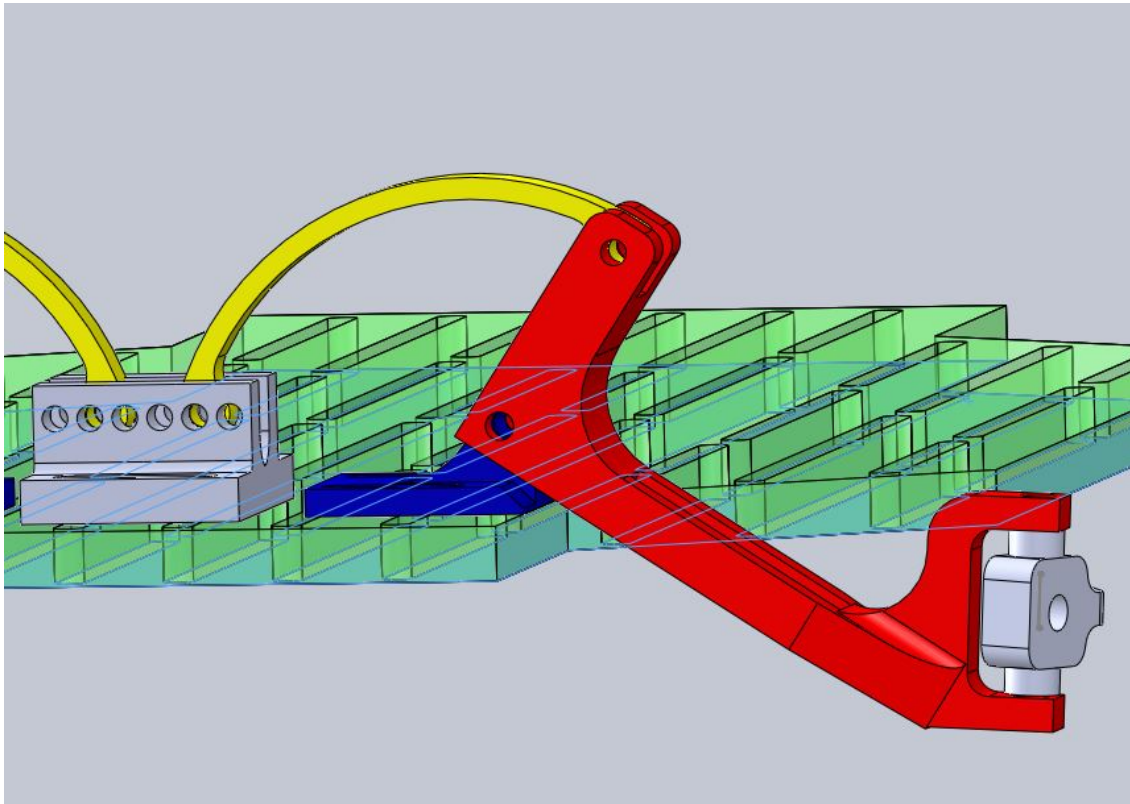
Below is an image of a motor mounted to the motor mount, and mounted to the chassis. The same hardware and technique is used to mount this.





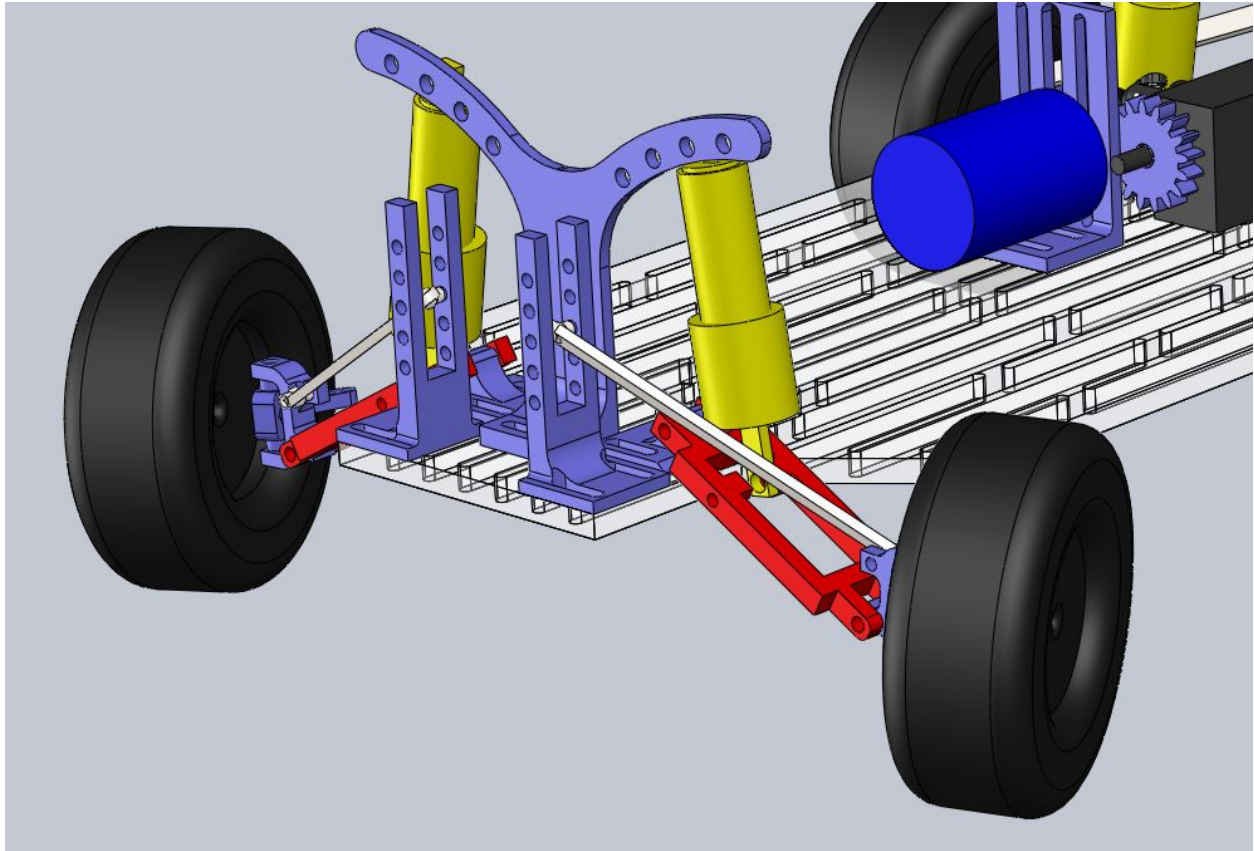
### Swingarm Suspension:

The Swingarm suspension design can be fully 3D printed, and is fully functional. It is mounted to the chassis via the lower support and #6-32 hardware as previously discussed. M3 screws are used as the pins in each joint, and they will thread into certain parts allowing them to pivot in the correct ways. An image of one side of this suspension designed assembly is shown below.



### Spring/Damper Suspension:

This suspension design is mostly 3D printed, but features more parts and requires the purchasing of spring/damper assemblies. This option is more complex and is about \$60 more than the previous design, but has the potential of higher performance applications. The same hardware and mounting method as the previous design is also used here. An image of this assembly is shown below.



### Steering:

These files are in the front suspension folder. An M4x25mm hex head bolt was used as axle for these front wheels. A part called Front bearing hub was also designed so that a bearing could fit inside, and the opposite side would mate to the 12mm hub of the wheels. There are different servo mounts that can be used to mount your servo, or you can just zip tie it one like we did. Solid metal wire from a clothes hanger was used as the steering links in this design, for simplicity and cost effectiveness.

Below are some pictures of the overall assembly of the car. If you have any questions we encourage you to contact us and ask them. We also encourage you to post pictures if you do print and build this.

