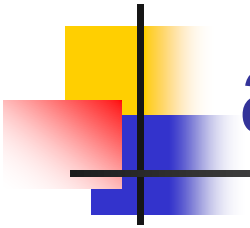

Oregon Robotics Tournament and Outreach Program

Tetrix Hardware Tips and Techniques

November 8, 2008

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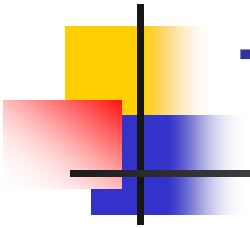


Today's Goals

- Basic construction.
- Useful tools and techniques.
- Pitfalls.
- Get some practice building hardware.

Resources

- FIRST FTC Website
  http://www.usfirst.org/community/FTC/
- Oregon Robotics and Outreach Program
  http://www.ortop.org
- FTC Training at CMU
  http://www.education.rec.ri.cmu.edu/content/events/ftc/

(The hardware portions of this site has been removed!)

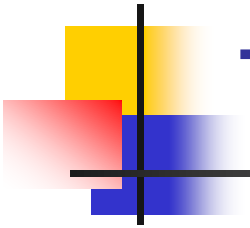
Tetrix Kit Components

- Tetrix Hardware
- Lego Mindstorms NXT Education Kit
- Software (RobotC, NXT-G and LabView)

Tetrix Hardware

- The Robot's maximum dimensions at start of challenge:
  - 18" W x 18" L x 18" H
- Tetrix kit (at registration): $900
  $450 for returning teams

Developed by Pitsco and LEGO
Over 500 parts per kit
Subset of the parts
pictured here

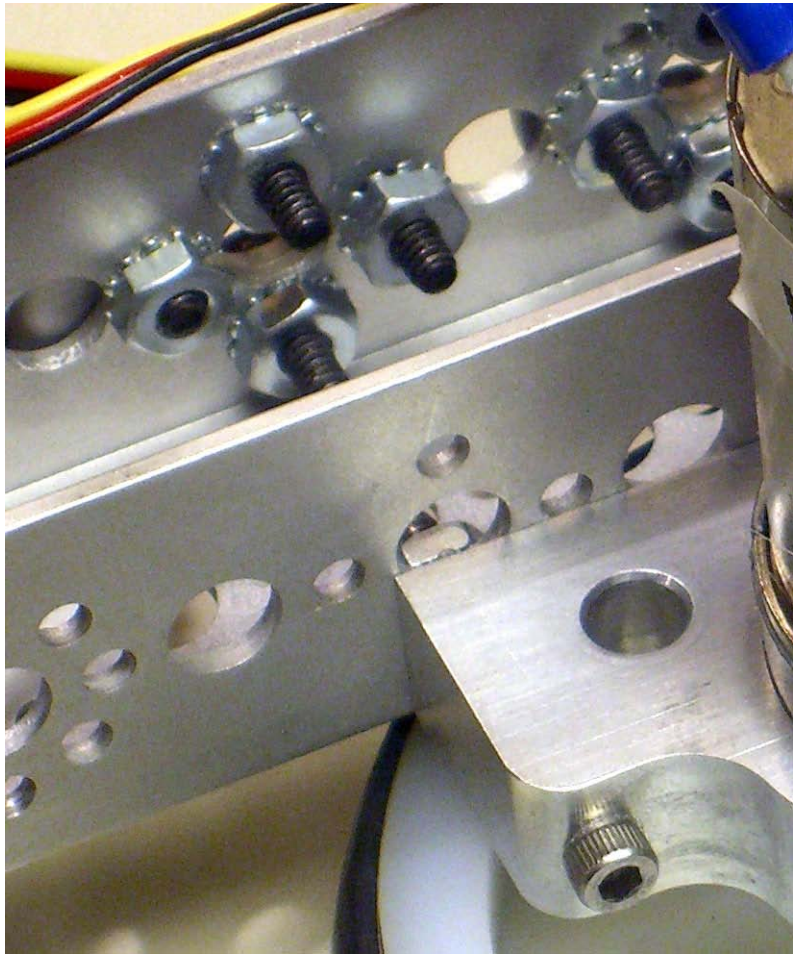


Tips and Techniques

- Advantages of the Tetrix Hardware
- Tools and such
- Arms and grabbing
- Connecting Lego pieces to Tetrix
- Extras you might need

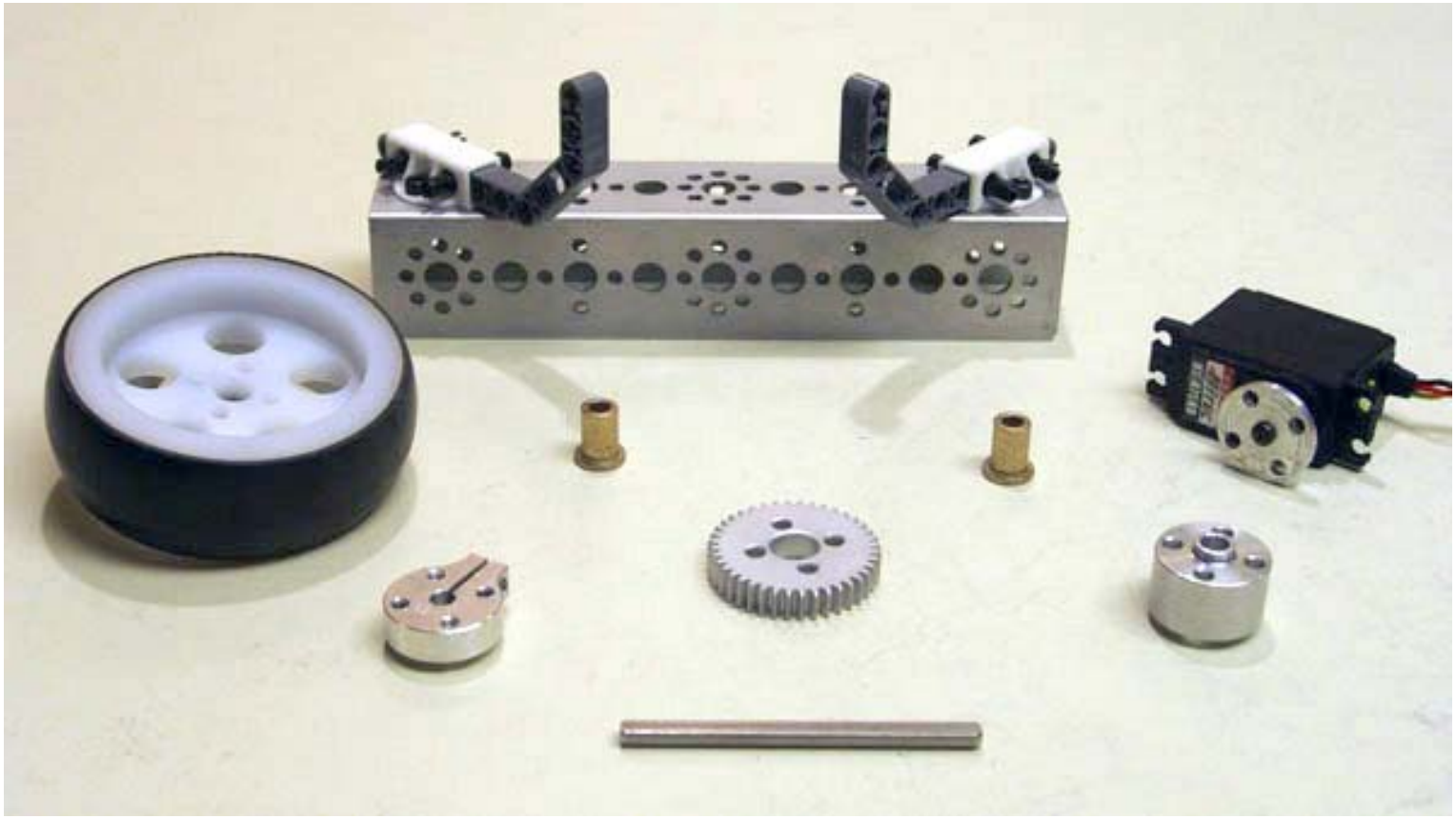
Advantages of the Hardware compared to Vex

- Tetrix system makes strong, rugged and robust ‘bots
- Screws stay tight!
- Grip screwheads with pliers



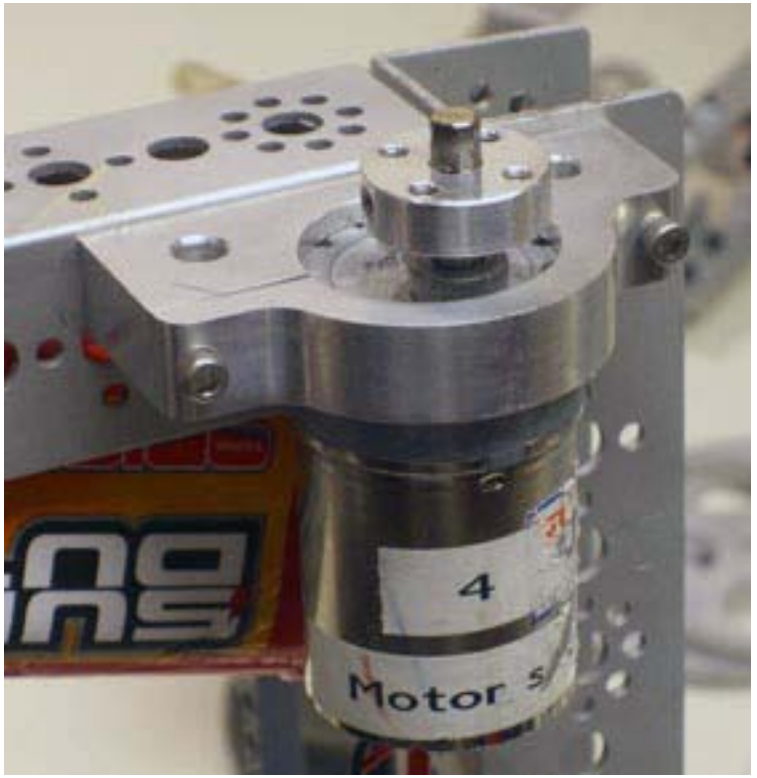
Advantages of the Hardware compared to Vex

- Versatile hole patterns



Motors

- DC Motors have lots of torque
- Two encoders supplied for speed / position control
- FTC motor controllers use encoder
- Versatile mounting hardware



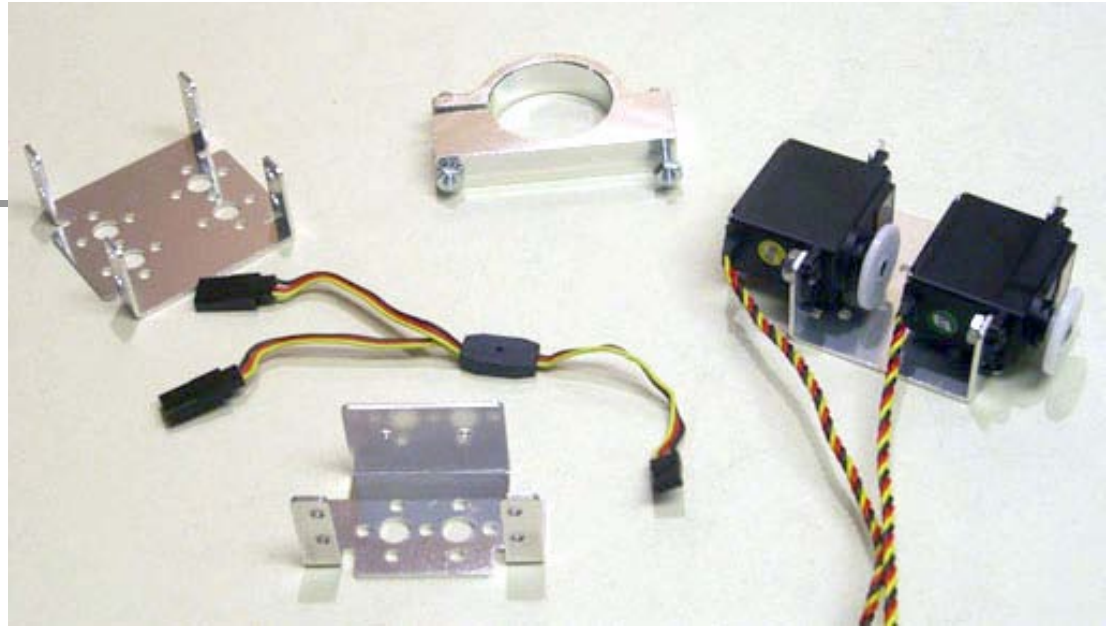
Motors

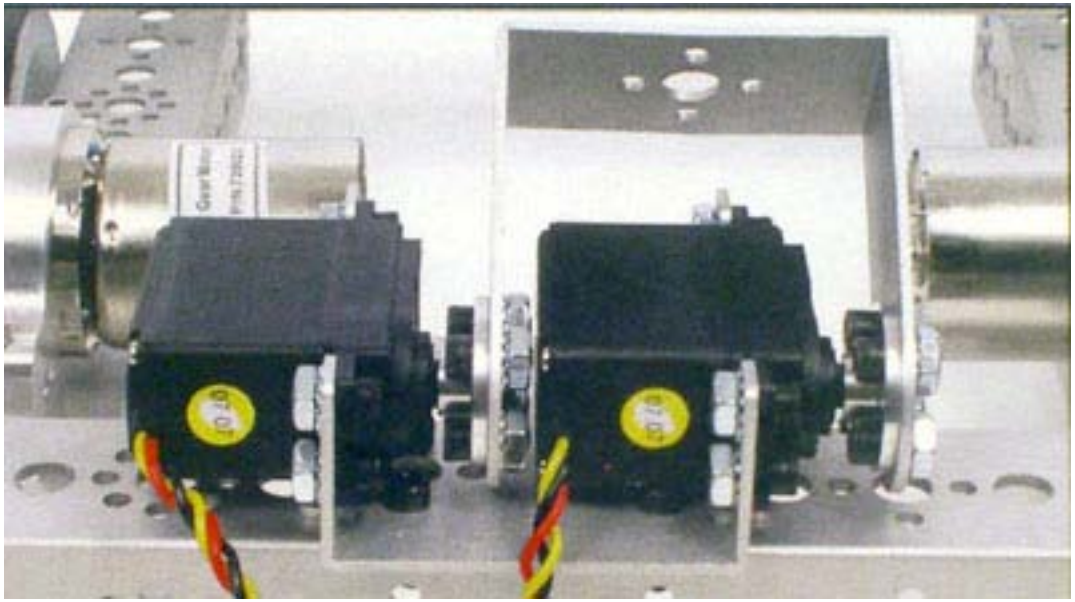
- When do you use Lego motors?
- Lego motors don’t have all that much torque, but useful for light loads
- They have position feedback

Motors and Gears

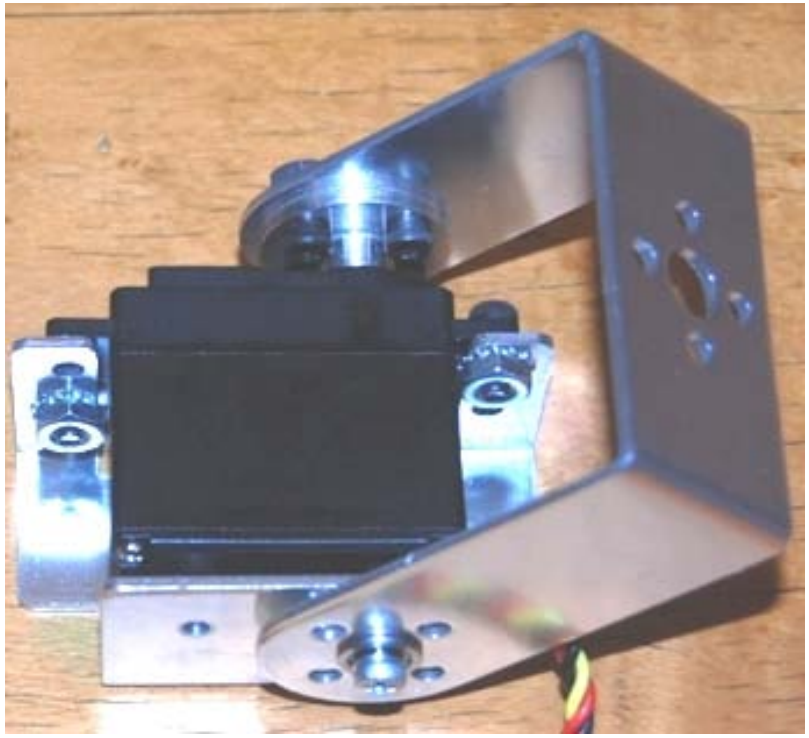
- While the Lego motors don’t have a lot of torque, there are lots of gears for them.
- There aren’t all that many aluminum gears and they are expensive - $20 - $30 each.

Servos





Robust Servo Mounting



Servos

- Ways to use servos
  - Single or double brackets for mounting
  - Horn connected to gears, wheels, structural pieces
  - Connect to end of pipe
  - Be careful of order of assembly – think first, build second
  - Warning – Picture in Tetrix Creator's Guide shows washer on wrong side

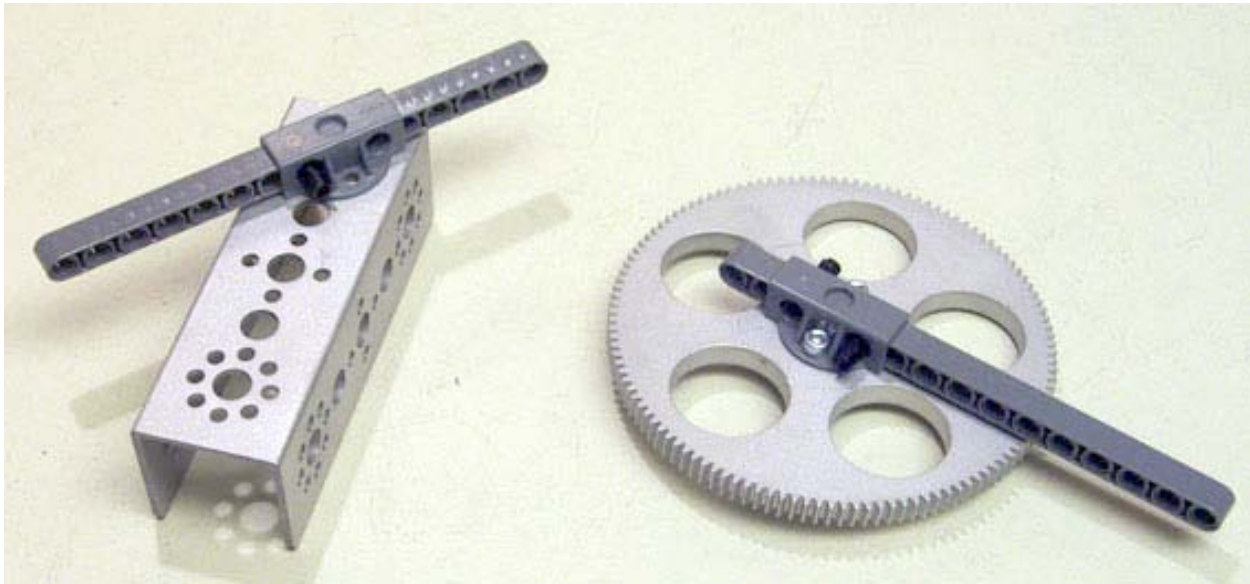
Servos

- Drive an arm with one or two servos, or use a servo on each side of a connected arm
  - Requires use of Y connector
  - Check form; there was a report of unreliable operation in this mode
- You must make sure center position of each servo is aligned when using two servos for a single drive
- Other Servo ideas...
- Specs: stall torque 61 oz. – in.

Connecting Lego to Tetrix

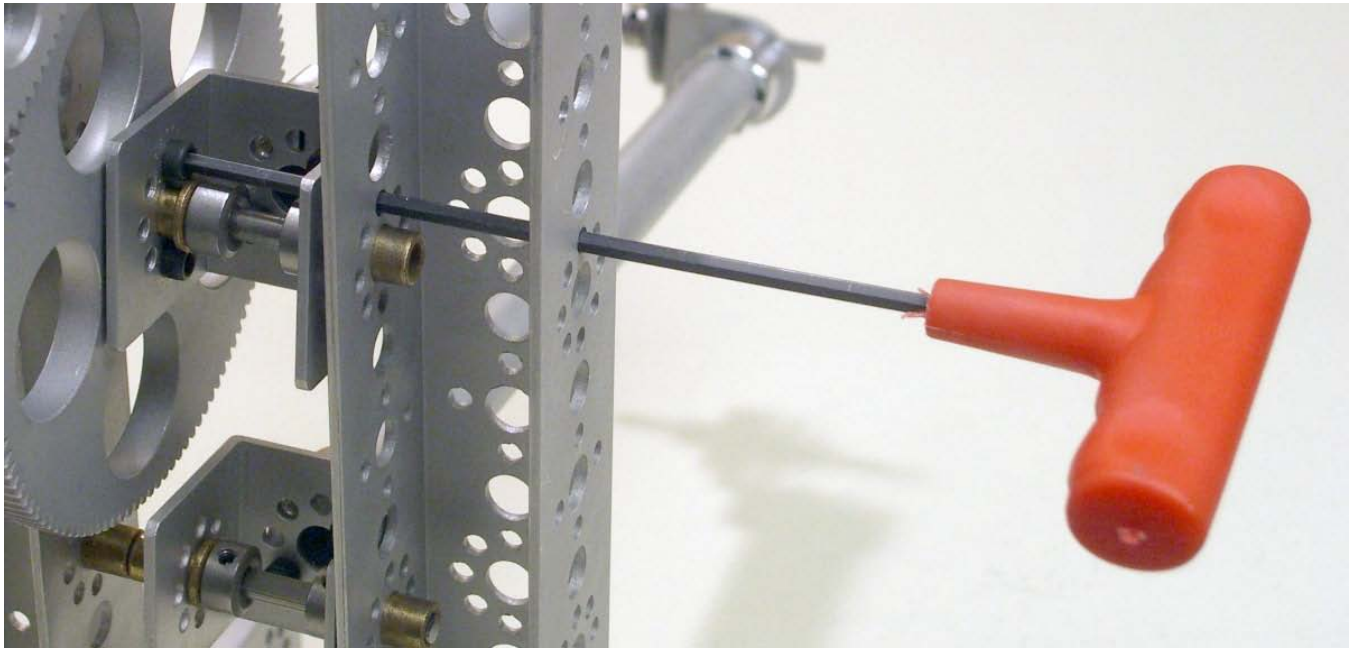
- A connecting piece is provided to connect between Tetrix and Lego parts - use Lego beams with holes.

- Direct connection to Aluminum through Lego holes works.



Tools, construction, and tips

- Long Allen wrenches are useful for reaching through holes



Tools, construction, and tips

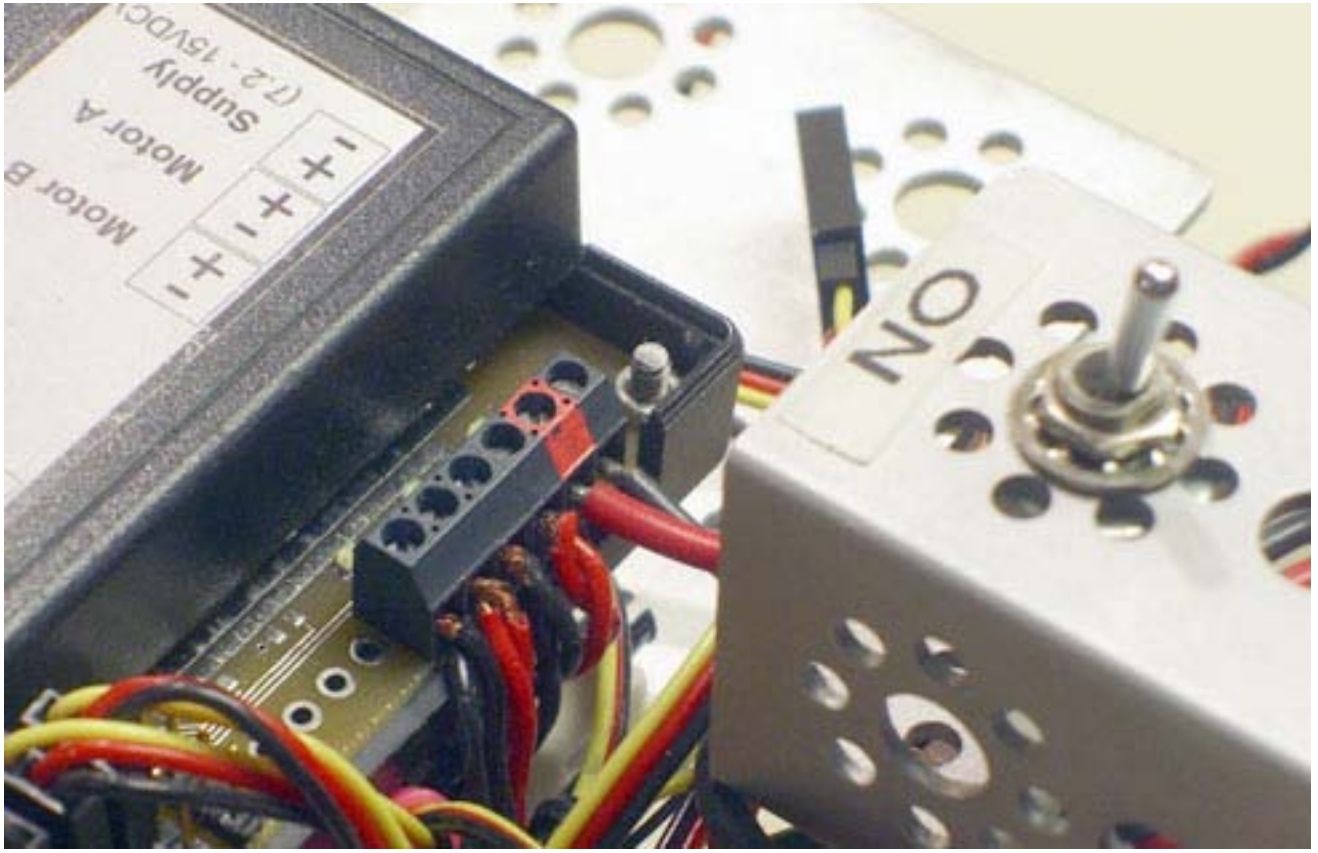
- It is always good to have more tools...
- Ball-end Allen wrenches, electric screwdriver

Tools, construction, and tips

- The Pitsco store sells “multi-nut pliers”

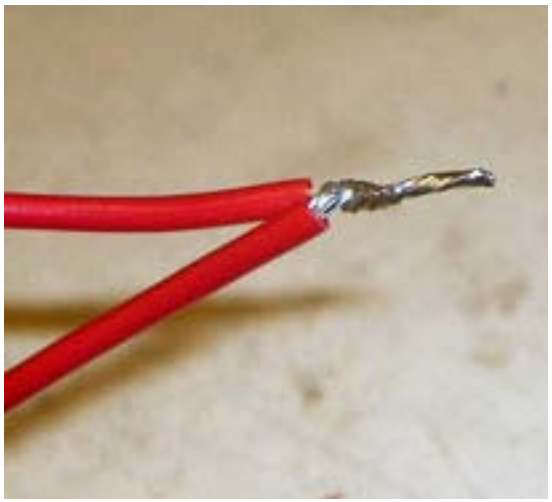
Battery management and electrical issues

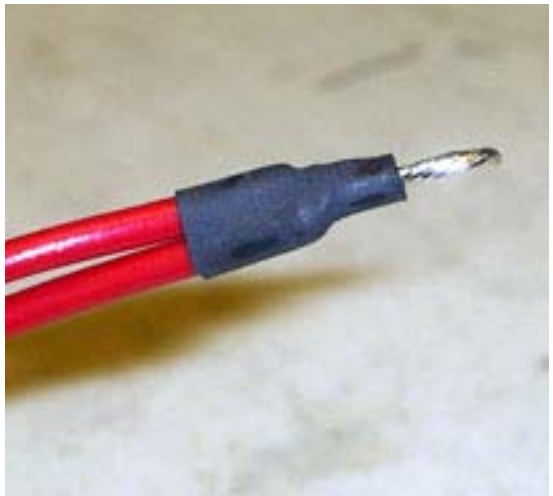
- Shorts are **catastrophic**



Battery management and electrical issues

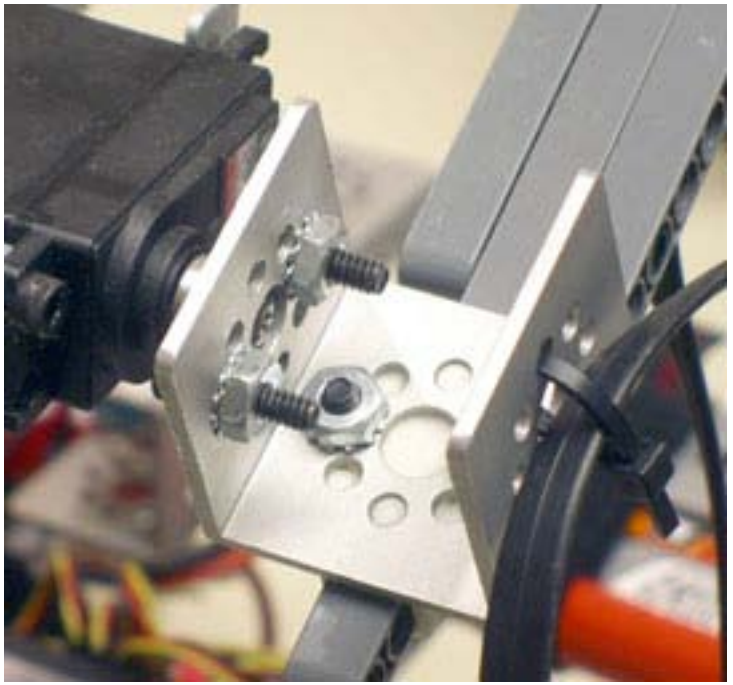
- Stranded wire can cause shorts due to single strands escaping
- It is not allowed to solder wires or use heat-shrink tubing!





Battery management and electrical issues

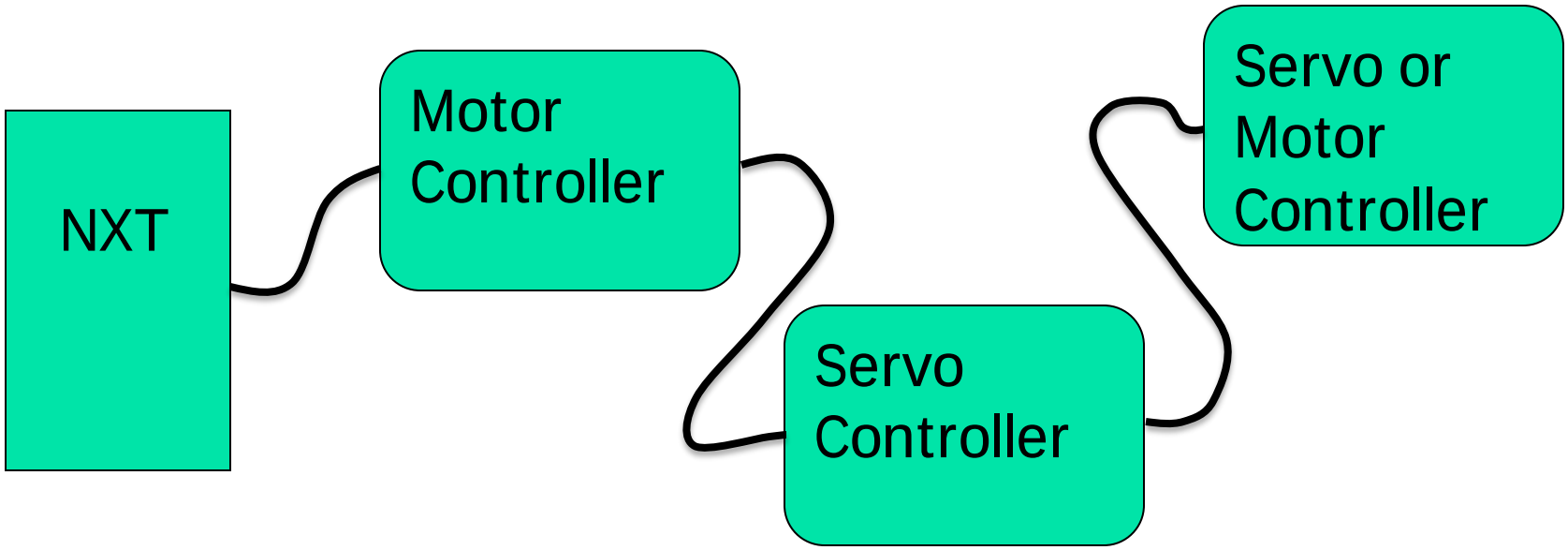
- Cable routing is important – cables are rather inflexible.



- It's a good idea to attach the cable at the pivot point
- An extra battery is essential

Battery management and electrical issues

- The controllers can be wired up in a daisy chain, in about any order.
- Only three controllers are allowed; the two with the kit and one additional,
- Additional controller can be servo or motor.



Battery management and electrical issues

- Wiring up the controllers is where caution is needed. There's a real potential for shorts.
- With the servo controller, must ensure servos are connected in correct polarity.
- Four motors can be used with one motor controller by connecting motors in parallel.

Battery management and electrical issues

- When using the encoders with the D.C. motors, must check the PID box in setup.
- **Do Not** have box checked if no encoders used.
- The encoders are very delicate and expensive...

Battery management and electrical issues

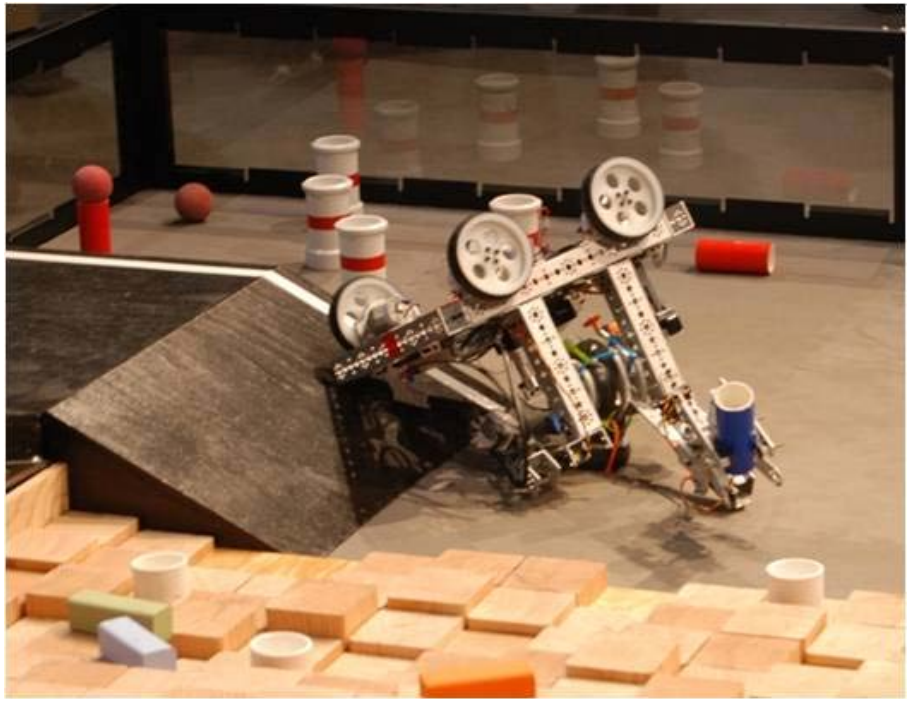
- Prototype board is the only place soldering is allowed (in the competition, this restriction in theory does not apply to this class).
- You can use any electrical or electronic component on this board.
- **But** – you can't use any more power than is supplied by the I2C connector…
- You need to know how to connect components to a micro-computer chip.
- Pull-up resistors are usually needed – to 3.3V
- **Caution** – it's easy to blow out this board!

Pitfalls and Problems

- Sonar sensor is hard to use – it seems to be *sometimes* unpredictable.
  - It seems like you cannot turn off it's pinging, and it may be interfering with itself, or getting bogus reflections.
  - If you could figure out how to write a driver for it, you might have better luck.
- There is an Electro-Optical sensor that you can buy – we haven't tried it yet.

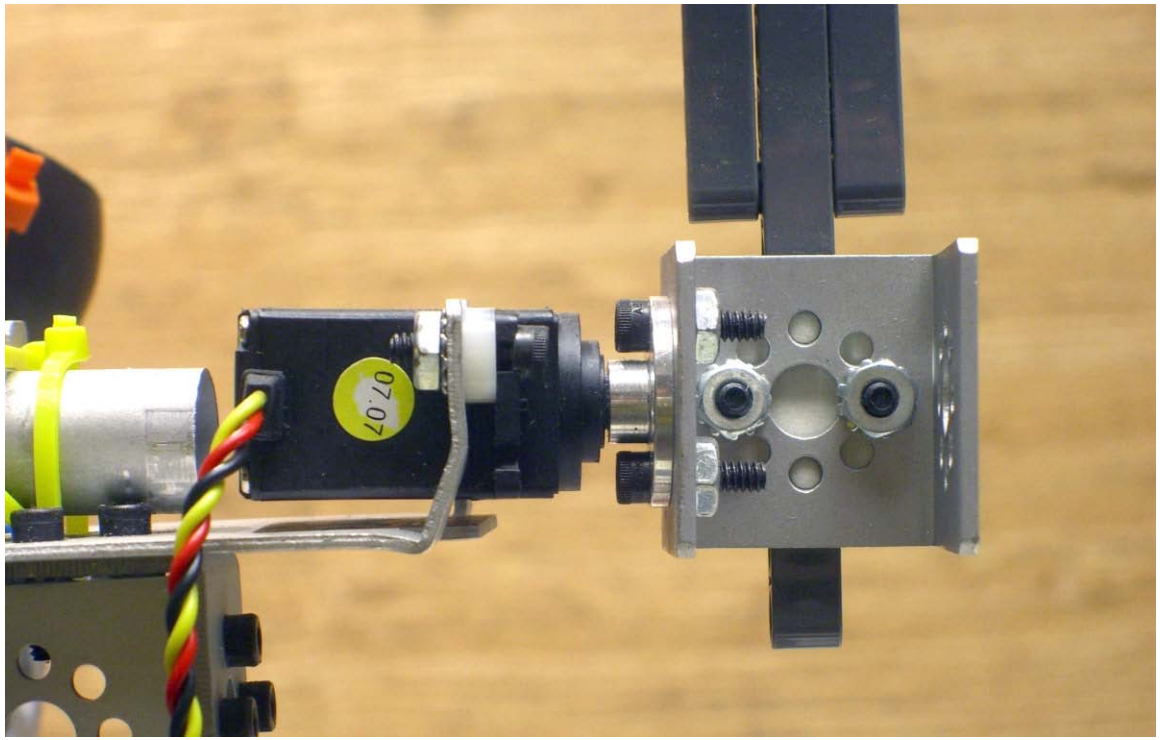
Pitfalls and Problems

- Low center of gravity, long wheel base is good
- However, you might want to plan for a tip-over - or make the ‘bot unable to tip over
- How do you recover from a tip-over?



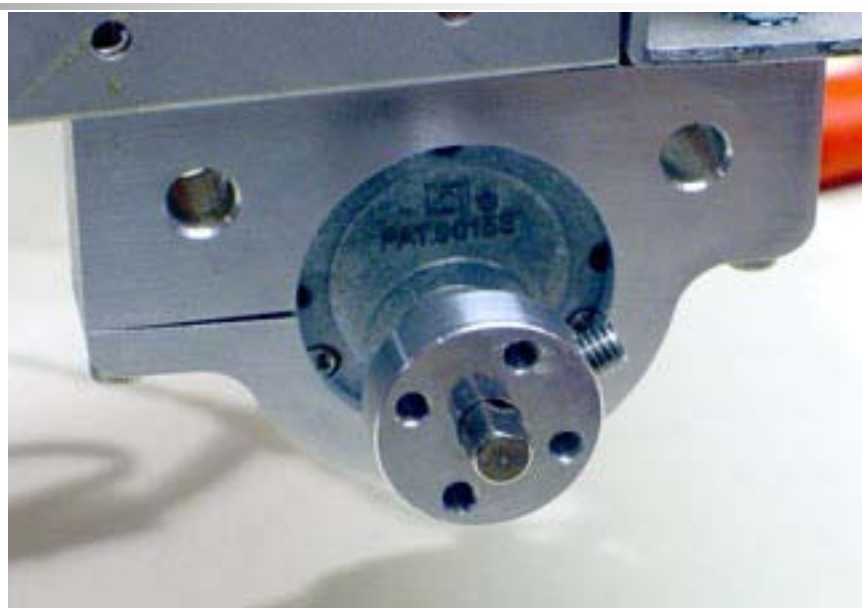
Pitfalls and Problems

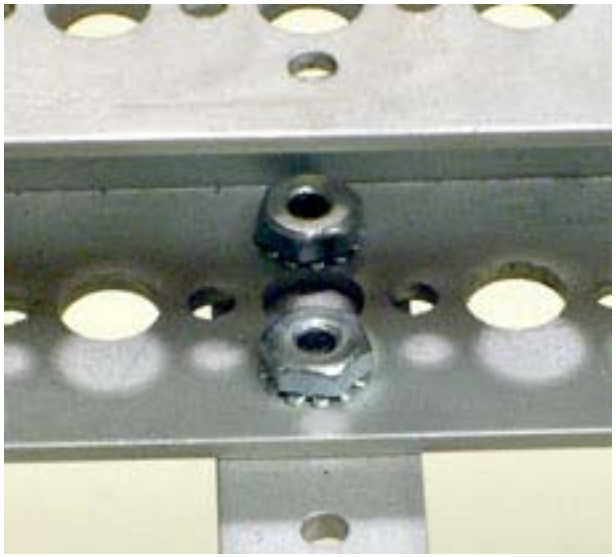
- Unsupported servos can cause problems



Pitfalls and Problems

- Use proper attachment techniques!

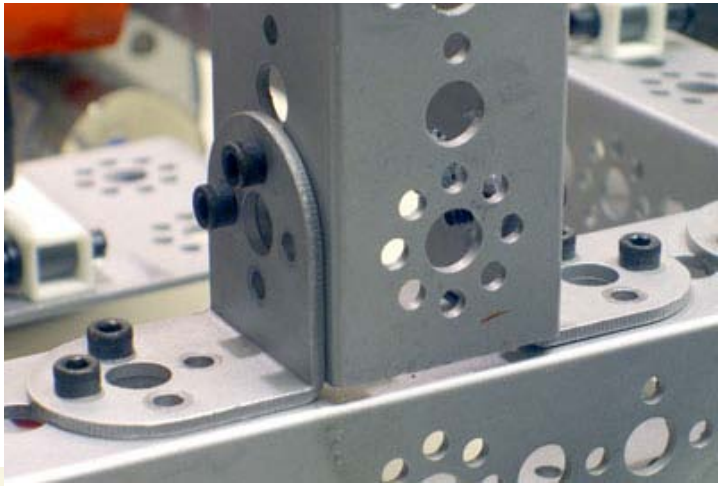


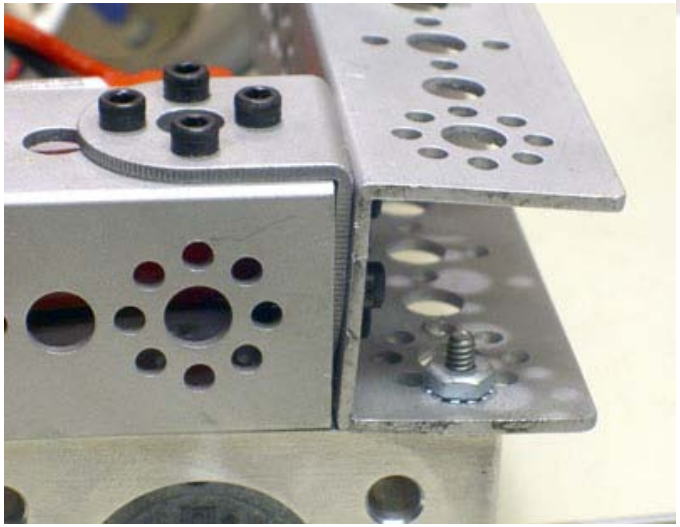


- In general, the guide recommends using ½” screws
- Other sizes used where small clearance needed.

Pitfalls and Problems

- Too few screws might be judged against the team

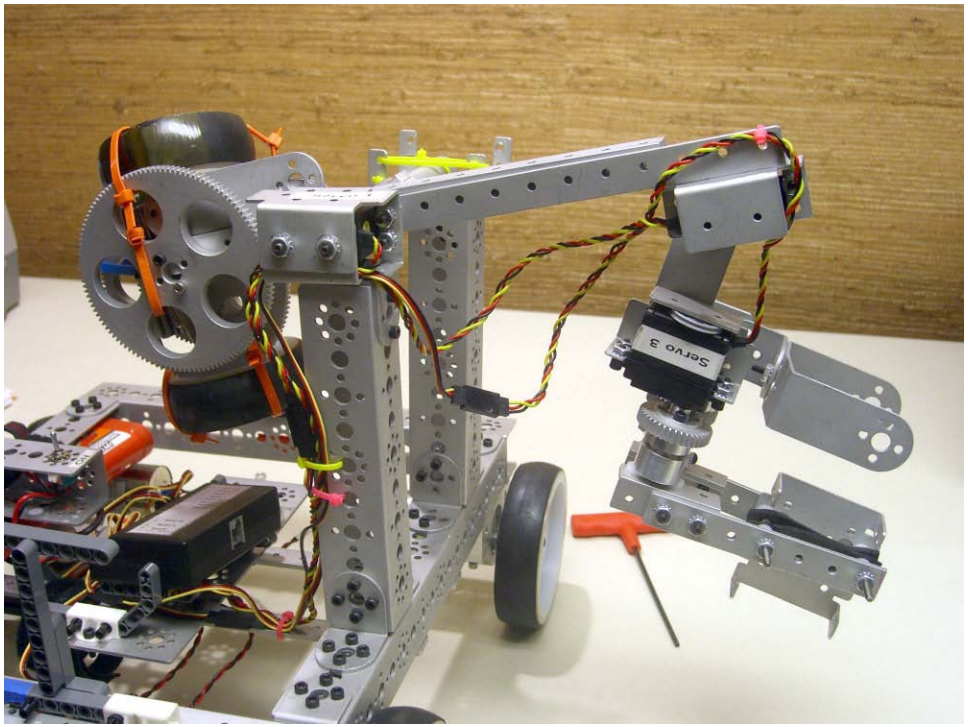




- Avoid crooked constructions
- Both of these look unprofessional

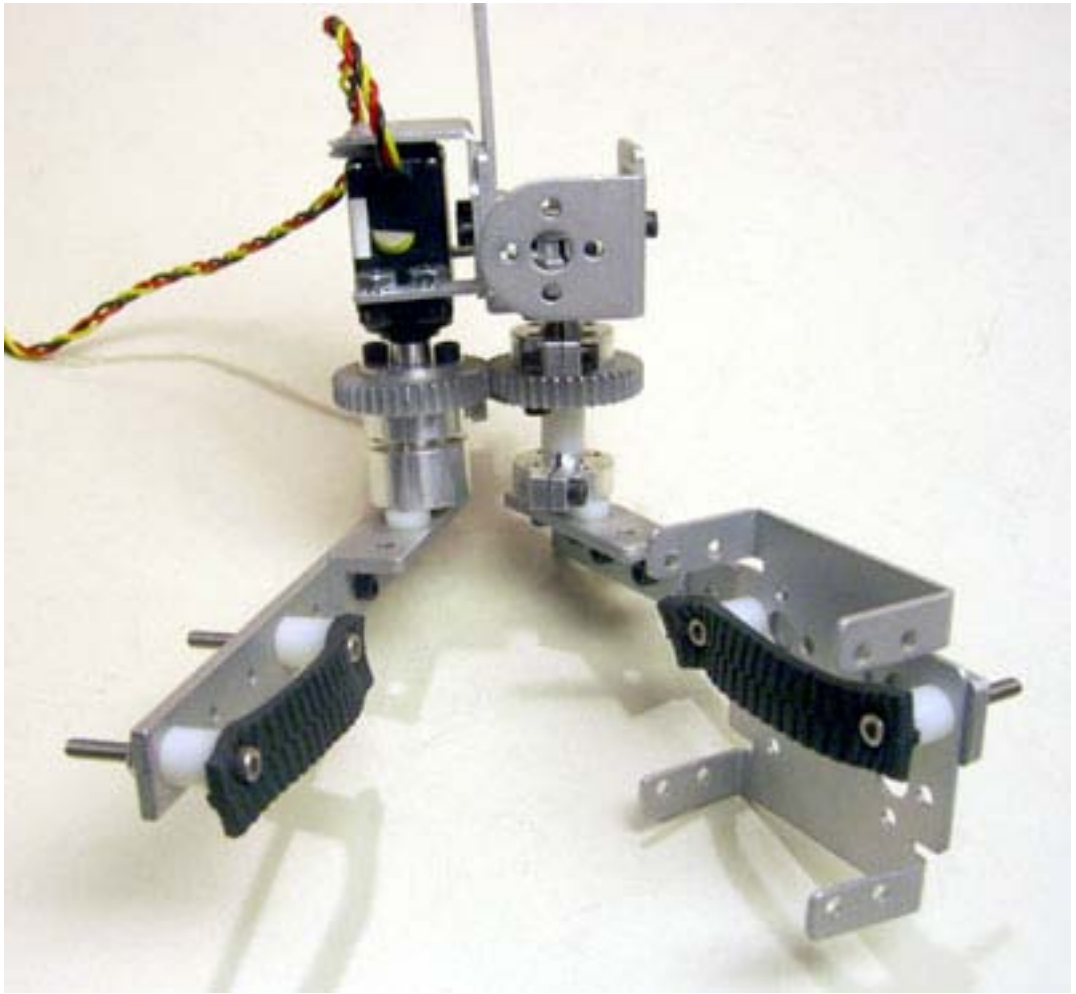
Arms and Grabbing

- Counterweights are hard
- Parallelogram arms are attractive
- Rubber bands, Velcro, cable ties and rope are allowed



Arms and Grabbing

- 12” X 15” pad of gripper material is allowed
- One piece of polycarbonate and one of aluminum – 12” X 24”
- Be creative...



Differences from Vex

- Lego sensors and Hi-Technic sensors are allowed
- More motors, servos, sensors, motors with feedback, etc.
- Vex parts, Tetrix parts and Lego parts are allowed
- As we are not in competition, we can use Vex or any other components.

Extras

- We needed more screws than provided – but the new kit has more
- Note that the 5/16 inch 6-32 screws are very hard to find locally
- Pitsco provides 250 screws and only 100 nuts! You'll definitely need more of these
- Better and more tools...

Resources

- Check the FIRST Tech Challenge Forum site regularly.
- http://forums.usfirst.org/forumdisplay.php?f=26
- Tetrix Creator's Guide – lots of good tips