

Design for Service and Repair

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Me

- Computer Engineer
 - Embedded Systems- Software/Hardware
 - 3D Printing
- Mentor #2537 2008-2014
- Control Systems Advisor 2015-Present



Design to Win

- Design is the most important factor in field success
- The next is consistency and durability
- At some point something will break
 - Will you be ready when that happens?
- First a quick video...



Design Process

You must have a process!

- Define
 - What problem are you solving?
 - Understand the game
- Ideate
 - Brainstorming. How to solve it.
- Create – Prototype/Test
 - Apply, lather, rinse, repeat
 - CAD is your friend
- Solve
 - Fab parts
 - Build the final bot based on what you have learned
 - Test/Test/Test



Sharon's Design Rules

- K-I-S-S
 - Complexity often means “easy to break”
- Nothing on the ‘bot that cannot be removed and replaced in under 5 minutes – short of the frame
 - You cannot count on downtime to make repairs
 - Battery in and out without tools
- Build modular systems
 - Easy attach points
 - Quick swap
- Use a common set of hardware
 - Same bolts/nuts – Fewer tools
 - English/Metric – choose one if you can



Service

It's gonna break

- Easy access to electronics components
 - Doors/hatches/covers/motors/sensors
- Cover all electronics and/or “delicate” mechanisms
 - Leave a way to see the blinking lights on everything
 - If protected you might not have to fix it!
- Label every wire – on both ends
- Leave room/space for tools/hands/arms/fingers to have access
 - Plan assembly and disassembly sequences



Maryland

ROBOTICS ALLIANCE

Strengthening FRC Mentorship
www.mdrobotalliance.org



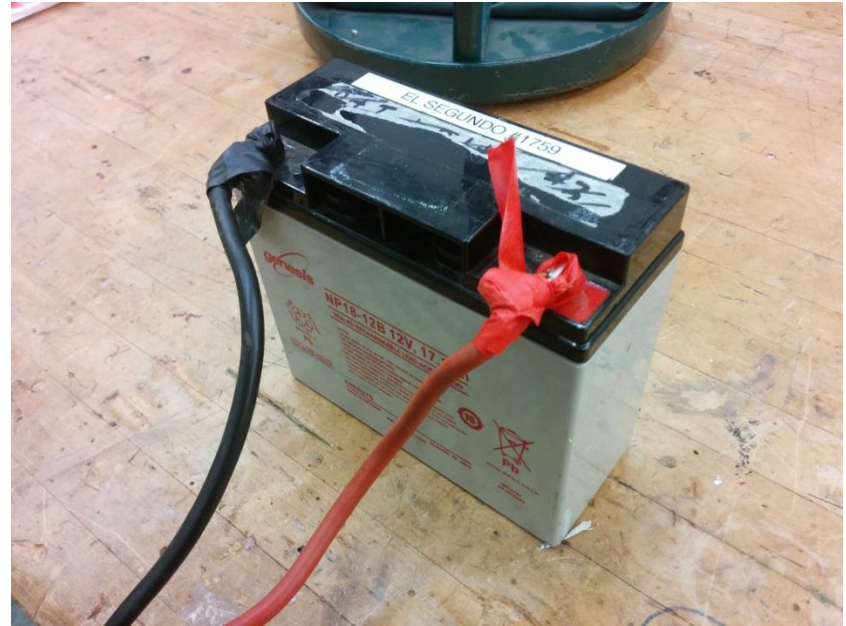


Spares

- Spare parts on hand for critical components
 - Mechanical
 - Electrical
 - Duplicate systems/mechanisms
 - Anything not common or KOP
- Spare materials
 - Plastic/metal – in case you have to improvise a fix

Top Brokenesses

- Battery Cables
 - Torque the connectors down
 - Don't carry the battery by the leads
- Crappy Battery
 - Buy a Battery Beak and test, retire the suspect batteries
- Lousy Wire Crimps
 - If you can pull it off by hand it was broken all along



Tidy Battery Idea

- 3D Printed Caps
- <https://imgur.com/a/dQOJx>



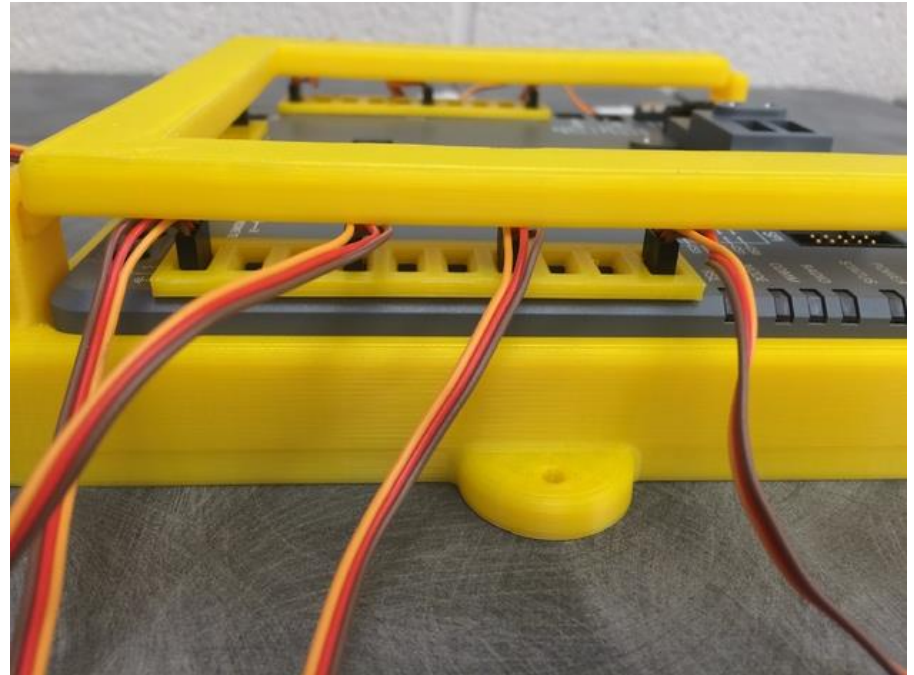
Keep Shavings and Dirt Out

- Electronics can go poof!
- Always use something to catch shavings!
- <https://www.thingiverse.com/thing:660244>





RoboRIO Mount and Cable Management



<https://www.thingiverse.com/thing:656030>



Practice

- Take the time to see how hard it is to fix something before you get to a competition
- Take that info and mod your bot to make it easy to fix
- Your bot will break something
 - It almost always happens
 - Be ready



Questions

