

Advanced Electronics/Programming

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1

Advanced Electronics and Programming presentation
given at the 2007 Oklahoma Robotics Summit.

Resources

- FIRST Rulebook
- FIRST Guidelines, Tips, and Good Practices
- Chief Delphi
- FIRSTwiki
- IFI

2

FIRST: <http://usfirst.org/>

Chief Delphi: <http://chiefdelphi.com/>

FIRSTwiki: <http://wiki.chiefdelphi.com/>

IFI: <http://ifirobotics.com/>

Warning: <http://usfirst.org/> requires Javascript.

Reminders

- Wire size
- Connector size
- Short circuit check
- Wire harnesses
- Label wires

3

Wire size: Use the correct size wire for the load. Don't use PWM size wire for a CIM motor.

Connector size: Use the correct size connector for the wire. Don't use a connector made for 8 AWG wire on 14 AWG wire.

Short circuit check: After making wiring changes, check for short circuits. Do this *before* powering up.

Wire harnesses: Bundle wire together with either zip ties or cable wrap. Separate power and PWM harnesses.

Label wire: Always label wiring for ease of maintenance.

Sensors

- Encoders
- Potentiometers
- Switches
- Ammeters
- Ultrasonic rangefinders
- Accelerometers
- Yaw rate gyros

4

Encoders: measure rotation. Infinite range, but has processor overhead dependent on resolution and speed of rotation.

Potentiometers: measure rotation. Limited range, no overhead.

Switches: on/off only, no overhead.

Ammeters: measure current draw. No overhead.

Ultrasonic rangefinders: measure distance. Constant overhead per ping.

Accelerometers: measure acceleration. No overhead.

YRG: measure rotation. Overhead dependent on rate of rotation.

StangSense

- Team 111 “Wildstangs”
- Ammeters on motors
- Graph current draw

5

111 uses ammeters on most of their motors, sending current draw data to a Palm Pilot in the driver's station through the dashboard port. They graph the data and use it to detect malfunctions (e.g. drive motor out of alignment).

Automatic Transmission

- Encoders on wheels
- Ammeters on drive motors
- Detect stalls and slipping

6

You can determine when to shift a transmission by knowing:

- Speed the wheels are turning
- Current draw on the drive motors
- What the driver is telling the wheels to do

If the wheels are moving quickly, the current draw is low, and the driver is telling the wheels to move near full speed, you should shift to a higher gear.

If the wheels are moving slowly but the current draw is high, you should shift to a lower gear.

If you add an accelerometer, you can determine if the wheels are slipping (high speed but no acceleration).

Autonomous Mode

- Encoders or accelerometers
- Waypoints

7



111 uses home-brew software to define “waypoints” to drive through in autonomous.

You can use either encoders or accelerometers to determine your current position, *if* you know the starting position.

Reminders

- Pair programming
- Revision control
- Master code updates
- Kill switch nearby
- Simplify constantly

8

Pair programming: If possible, work with a partner by you. If you can't explain what the code is doing to their satisfaction, then simplify it.

Revision control: Use a good revision control system (Subversion, Mercurial, etc.) and make commits often. That way, you always have a known good version to go back to.

Master code updates: Check the IFI website often for master code updates. They often fix serious errors in the controller.

Kill switch nearby: Always keep a kill switch for the robot nearby, in case it turns out that that code you downloaded was not, in fact, perfect.

Simplify constantly: If you see a complicated piece of code, simplify it. It makes maintenance easier.

Dashboard Port

- Log data during matches
 - Laptop
 - Handheld
- IFI website

9

FRC does allow a laptop or handheld connected to the dashboard port in the driver's station.

A reference to the dashboard port data format is available on the IFI website.

Interrupts

- Sensor overload
- *EasyC, WPILib*: Stop functions

10

Sensor overload can occur if too many interrupts are firing.

The controller starts to miss interrupts, causing sensors to report inaccurate readings.

easyC and WPILib users that are not using a sensor should call the correct Stop function.

Competition Port

- Enabled/Disabled
- Autonomous/Operator control
- Kill switch

11

The competition port controls the disabled and autonomous/operator control states of the robot.

You can make a kill switch that disables the robot. A pinout for the port is available on the IFI website.

Joystick Ports

- Make custom controllers
- IFI website



You can make custom controllers that interface with the joystick ports. For example, if your robot has an arm, you can make a model arm to control it.

A pinout for the joystick ports is available from the IFI website.