Cultivating tomorrow's technologists through robotics

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Robotics in K-12 STEM education in general:

- STEM education to develop next generation of scientists, engineers, mathematicians, computer scientists
- STEM education to develop next generation of embedded systems developers

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The unique appeal of robotics

- Glamorous

- Robots move and interact with their environment

- Get a mechanical system to perform a desired task via programming

Value of robotics

- Straddles and integrates multiple disciplines in an accessible way
- Struggle with limitations of sensors, motors and the mechanical system- iterate in order to refine the system design

Engaging vs. studying a concept

- [Line Following Robot](#)

- First try- jog left and right between black and white regions on either side of the line

- Second try- proportional control based on light sensor value between black and white areas

- Robot clearly behaves better- path is smoother and more efficient

- Students have an intuitive understanding of the "why", "what" and "how" of proportional control

No Single Right Answer…

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Other important skills

- Project management

- Teaming/allocation of resources

- Documentation

- Presentation and communication

- Marketing
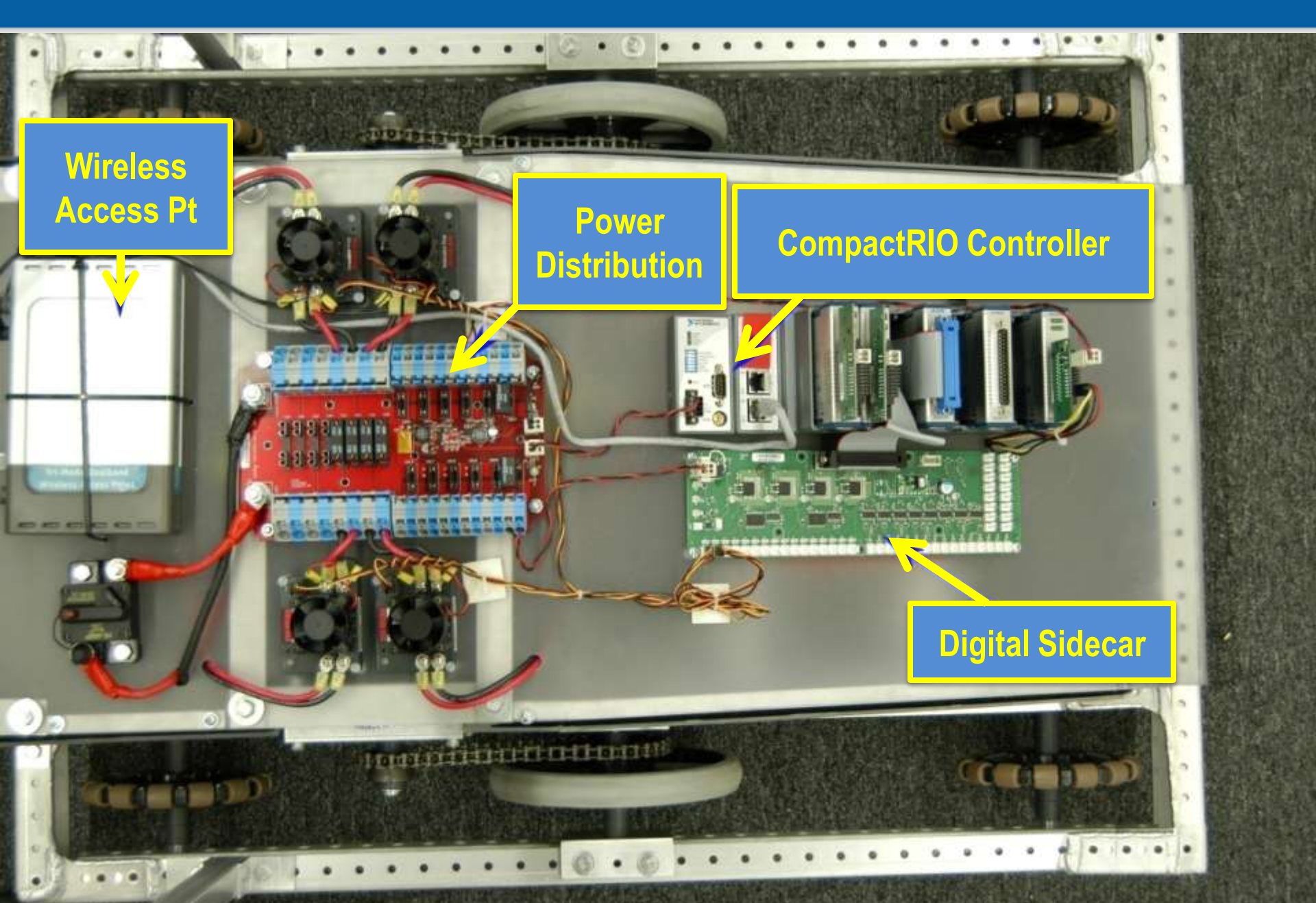
- Fund-raising

- Web design

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FIRST Robotics Competition (FRC)

Video

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NI cRIO-FRC

Build a Better Robot

Wireless Access Pt

Power Distribution

CompactRIO Controller

Digital Sidecar

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Driver Station- Linux box with ARM microcontroller

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FRC Topology

Game Modes
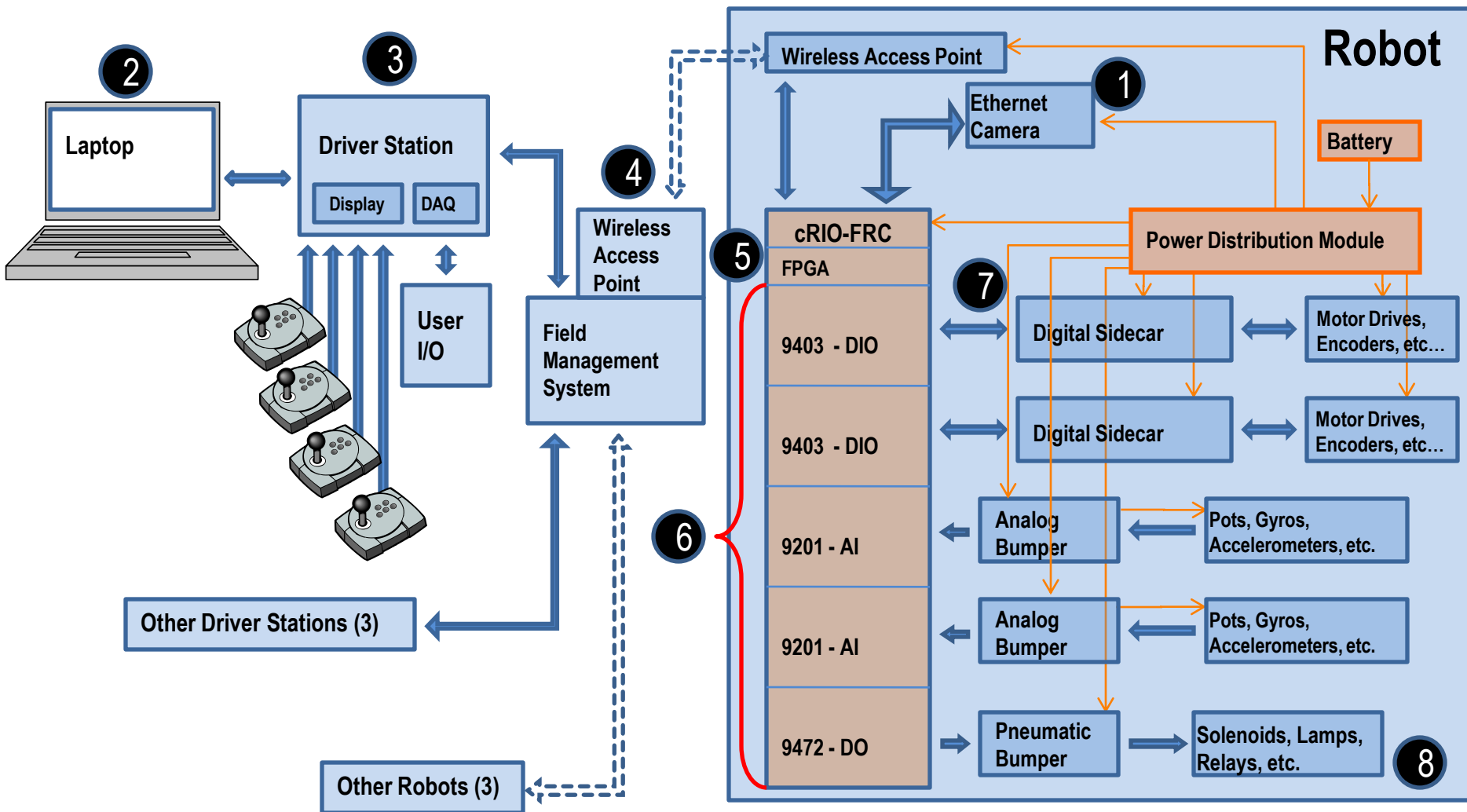
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Benefits of the New *FIRST* Controller

- Students can build more sophisticated robotics systems
    - Improved autonomous performance
    - Advanced vision capabilities
    - Additional sensor choices
- Intuitive, graphical LabVIEW software development will increase participation in autonomous programming
- Industry-standard technology means students gain knowledge for university studies and professional careers

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Easy to Program

- Programmable in C and LabVIEW

- Wireless debugging

- Laptop dashboard

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Brandeis University Study

- New York City, Detroit/Pontiac Areas

- FRC Alumni versus Control Group

- Control group had similar demographics, academic history

- VS. Control group:

  - 88% vs. 55% attended college on a fulltime basis

  - 2x as likely to major in Science or Engineering (55% vs. 28%)

  - 4x as likely to major specifically in Engineering (41% vs. 13%)

- Trends applied across race, ethnic and gender lines

FIRST Technical Challenge, FTC

- Adoption of the LEGO MINDSTORMS NXT platform, programmable with NI LabVIEW or RobotC
- Tetrix (made by Pitsco) as extension platform for NXT

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Lego Mindstorms NXT

- Community truly consists of all ages
- K-12 education
- FIRST Lego League and First Technical Challenge
- Hobbyists
- University programs and projects
- Grad school projects
- Prototyping by engineering groups at major technology companies
- Native programming (NXT-G) is LabVIEW-derived
- Firmware available for programming in LabVIEW, C, Java, C#, etc.

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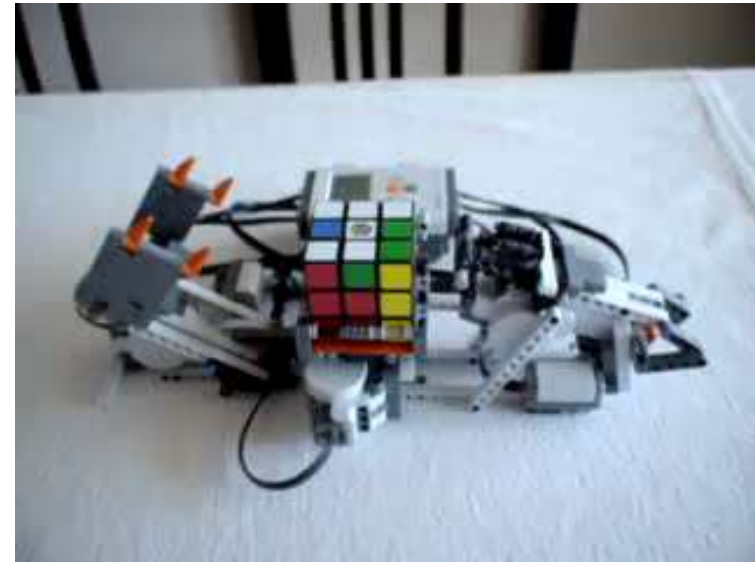
Tetrix, by Pitsco (works with NXT)

- Aluminum parts- brackets, mounts, structural channel and plates, tubing, hubs, servos, motors, wheels, gears, drive train, etc.

- Works with NXT intelligent brick. Can mount integrate Technics subsystems into

- Core of the FTC platform for 2009-2014

FIRST Lego League

- Middle School students use NXT kits programmable via LabVIEW or RobotC

FIRST Junior Lego League

- Ages 6-9
- Build Lego model with moving parts

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The value of mentoring

- Role model and mentor for students
- Role model and trainer for teachers
- Provide real-world context for system designs
- Allow for more challenging tasks
- Provide industry contacts/resources
- Help raise money

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Questions, Comments, Discussion

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