

My Experience as a New Mentor in the FIRST Robotics Program

Jim Grove

Mentor at McKinley Technical High School,
Washington, DC



Presentation to
IEEE Education Society Baltimore-Washington
Chapter and
IEEE Howard University Student Chapter
November 7, 2007



FIRST Robotics

“For Inspiration and Recognition
of Science and Technology”

- **FIRST Robotics competition (FRC)**
 - aimed at high school students
 - requires building a robot for a contest
 - Contest rules are a surprise at the start of the build season
 - Build season is 6 weeks long in Jan & Feb
 - Regional competitions are across the USA over a 5 week period
 - Nationals are in Atlanta, GA

Robot Features

- All specifications are general, subject to being changed from year to year
- Footprint limit: 38" x 28"
- Height limit: 48" - 72"
- Weight limit: 120 pounds
- Kit of parts issued to all teams. Drive motors, batteries, pneumatic components, computer controllers are all standardized.

Contest Features

- Rules for contest change from year to year
- Typically, on a carpet covered arena, the size of a tennis court.
- For a given contest, three robot teams join to form an alliance. The alliances are positioned on different ends of the arena, behind safety barriers
- Time limited
- Points awarded for objectives reached
- Penalty points dispensed for fouls.

Developing New Mentors

- Recruit
- Encourage and communicate in off season
- Develop Technologically
 - Aggressively acquire public FIRST knowledge
 - Learn from successes from any source
 - Avoid my mistakes
- Have fun

Ignorance is Bliss.....

- Initially heard about the FIRST program in November 2006
- Began participation in January 2007 with kickoff of 2007 season
- Mistake one:
 - I did not research technical documents, etc., prior to kickoff. Some basic robot functions, and the types and sometimes brands of components used, are typically common from one season to the next.

Common FIRST Contest Features

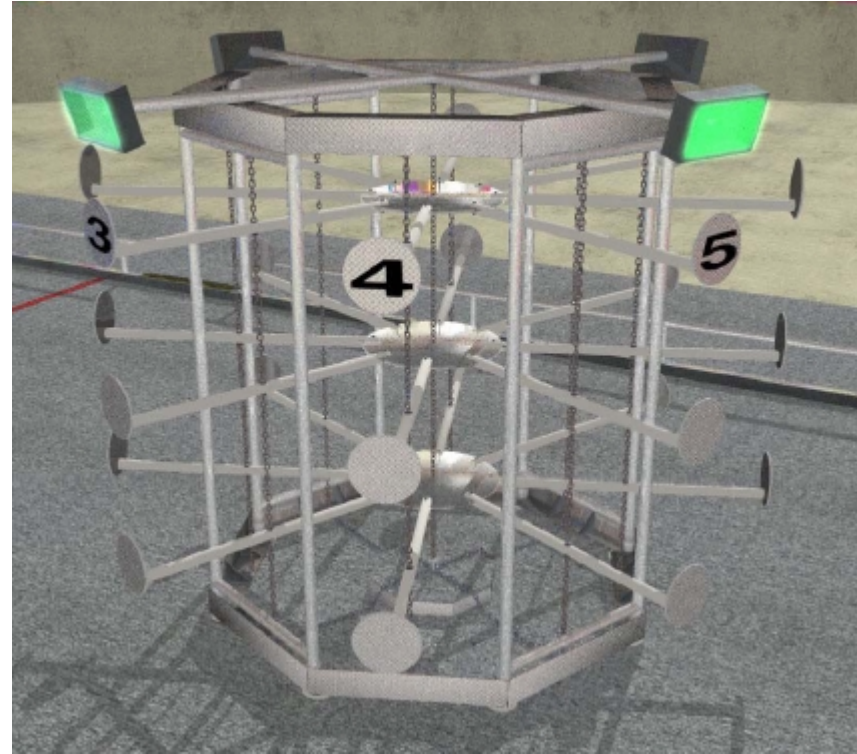
- Common requirements
 - Robot mobility (drive trains/power distribution)
 - Structural requirements
- Common systems
 - Pneumatics
 - Computer control systems
 - Camera
- Robots are essentially remote control devices, little value to autonomous functionality
- “Nuts and bolts” are paramount; solid mechanical function is essential, before fancy programming

Nuts and bolts

- Weight and height limits met
- Sturdy structure
 - survive side impacts
- Drive train functions well
 - Tensioner on chains, belts
- Low center of gravity
- Simple Controls
- Simple, sturdy devices
- Knowledge of commercially available simple parts can be critical.

2007 Contest

- Robot required to pick up an inflatable inner tube (ring) and place it on a “rack.”
- Robot functions
 - Mobility
 - Ring manipulation
 - Grasp ring
 - Lift ring
 - Maneuver ring
 - Release ring
 - Ramp deployment/climbing ability
 - Arena: 54'x26'



Problems with 2007 robot

- Drive train
 - Alignment
 - Binding—tested on tile floor at school, carpet at contest
- Pneumatics
 - Lack of knowledge on relays, layout, etc.
- Lifting arm
 - Designed complicated closed loop control when sturdy, open loop system would have been superior
 - Cost in limited design time
 - Went for ten dollar solution when ten cent solution would be better
 - Limited engineering time and talent literally wasted
 - Pneumatic lift should have been motorized
 - Grasp never tested independently prior to attachment

Chesapeake Results

- Well, Team 1915 did better
 - 2007 middle of the pack
 - 2006 dead last
- Weaknesses
 - No ramp
 - No functional grappler
- Strength
 - Weight, low CG meant we could push other teams around easily, usually pushing them laterally

Recommendations for Technical Mentors

- Learning FIRST is “like drinking from a fire hose.”
 - (author unknown)
- Hit all websites that you can (listed in Background), especially in advance of season
- Read and know rules issued by FIRST
 - Especially chapters on Game, Field, Robot
 - BEST PRACTICES manual is priceless.

Technical Recommendations (Components)

- FIRST kit components
 - Know components of this year's contest well
 - Pre-season: review last year's components
 - Be aggressive in getting information from vendor/manufacturer's website
- Non-kit components
 - Identify appropriate vendors in advance of build season, where possible
 - Standardize where possible

Non-Technical Mentors

- Big need for Non-Technical types to help
- Administrative load is considerable
 - Permission forms
 - Travel arrangements
 - Purchases
 - Bookkeeping
 - General logistical activities
- Basic concepts of construction techniques is also quite useful during build season

Summary

- Lots of work
- Lots of fun
- Extremely rewarding
- Extremely humbling
- **ANYONE** can contribute.
- Engineering background not required.

Background Websites

- Official site
 - www.usfirst.org
 - 2007 documents
 - <http://www.usfirst.org/community/frc/content.aspx?id=452>
 - BEST PRACTICES is priceless. Great source of information
- Best overview of teams/history of events
 - www.wikipedia.org
 - Search for “first robotics”
- Local contest
 - www.chesapeakefirst.org

Background Websites

- Wander through other teams websites for ideas (regional winners identified on wikipedia)
- Chief Delphi
 - Caveat: good source, but dated information is not purged
 - <http://www.chiefdelphi.com/forums/portal.php>
- Best Practices Manual has most kit manufacturers websites.

Contact

Jim Grove

James.grove@nrl.navy.mil

Jim.grove@gmail.com