Robot Design – FTC Style

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http://www.handhgraphicsorlando.com/STEM/roboknights.html
Agenda

• Brief overview of New platform
• → Software development Environment
• ◆ ZTE Speed Phone
• ◆ FTC Apps (Driver Station and Robot Controller)
• ◆ Android Studio
• → FTC SDK
• → Example Op Modes
• → Build, Deployment and Drive!!
• But first lets set the foundation.....
The Engineering Design Process

1. Identify Problem
2. Brainstorm
3. Design
4. Build
5. Test & Evaluate
6. Redesign
7. Share Solution
Project Preparation – Robotics Team

• Determine team goals

• Know your resources, strengths and limitations
• Design, Programming and manufacturing skills
• Build location

• Set schedule and expectations

• Determine concept design groups

• Determine leader to steer and manage design decisions
Defining the FTC Challenge

• Watch kickoff as a team

• Everybody should understand the FTC Game Manual rules
  • Read sections aloud to each other, as a group

• Create lists and charts
• Robot design constraints
• Maximum size, allowed materials & components
• How points are scored
• What actions are not allowed during the game
The Criteria for an FTC Robot

• Build a field
  • Buy field components you choose (certain parts / half field / full field)

• Breakdown the game, understand the different strategies
  • Create a mock game (white board, board game, full scale with people)
  • Create a chart of the various scoring methods and the points awarded
  • Estimate the time needed to score points

• Determine how the most points can be scored in the game
  • What actions carry a disproportionately large number of points
  • What actions may not be worth the risk

• Create a list of what the robot should be able to do
  • The answer can end up being “Everything”
  • Rank features by order of importance for now
  • Keep track of this, as things can change later as more is learned
Developing FTC Robot Concepts

• Brainstorm!
• Ideas may be for only a component, not necessarily a full robot concept
• Keep designs high level, don’t go down rabbit holes worrying about how it will be built
• Ideas don’t have to be on paper, use simple building tools to model concepts (LEGO, cardboard, PVC pipe, wood, foam board)
• Focus on accumulating as many ideas as possible
• All ideas are good
• Don’t criticize each other’s ideas
• Look at how various concepts may work together
• Often even more concepts will arise out of this discussion
How to Decide

• Review concepts against criteria and constraints, estimate their ability to meet them

• Compare relative complexity of concepts
  • Number of moving parts / degrees of freedom / failure modes

• From this analysis the leading options should begin to be evident

• Use a decision matrix to further rank ideas

• Have one focused concept, but have 1-2 backup options as needed

• Have one person responsible for overseeing and enforcing final decision
Developing Robot Prototypes

• Assign Design Groups
• Chassis, appendages, structure
• Build prototypes
• Make many
• **Keep things simple (KISS)**
• Use alternative materials to speed construction
• Keep records of results (pictures, video, sketches, etc.)
• Design - CAD concepts
• Assign motors, actuations, sensors
• Figure out gear ratios, keep your options open
• **Iterate - Break it, fix it. Rinse and repeat!**
• Pay attention to new ideas which pop up here
• Change is still easy at this point
• Conduct weekly design reviews, communicate results
BabyBot – Prototype

• Covers all the basics
• Electronics
• Programing
• Baselining
Detailed Design

• Use prototyping results to finalize design
• Use CAD or detailed drawings for all parts and dimensions
• Keep designs within the manufacturing capabilities of the team
• Hold regular design meetings between groups
• Track packaging issues for each component as designs develop
• Finalize motor use
• Include transition points between dependent mechanisms designed by different groups
• Design in sensors, wiring, connectors
• Buy materials and parts that will be needed
Test!

• Test drivetrain early
• Weigh down drivetrain to 30-40 pounds, drive it on Soft Tiles
• Begin testing components as they come together
• Component Level Test - Break it early!
• Early breaks = early fixes
• Program, drive, and test as much as possible
• System Level Test - Break it early! – Learn and improve
• Plan for things to fail -  Elements are made with Tolerance (not exact)
• Take time to iterate designs and re-build components that do not work as planned.
Practice!

- Practice
- Practice, practice, practice and then practice
- Break it again
- Practice some more
- Practice, practice, practice and then practice
- Break it again!
- Refine your code
BabyBot - Overview
Attendee Poll

• Experience: Rookie Team? 1-2 years? More than 2 year?`  
• → Received the Kit? Tetrix? Matrix?  
• → Installed Android Studio? Built an app?  
• → Installed the FTC App?  
• → Ran a OpMode?  
• → Wrote and tested an OpMode?
New Platform Electronics
Phone Set-Up

• The detailed steps are in:
  https://github.com/ftctechnh/ftc_app

• Recommend you all watch this videos on YouTube
  • https://www.youtube.com/watch?v=n597U6rcl2Y
Android Studio (2.2) and SDK

• The detailed steps are in:
  • https://github.com/ftctechnh/ftc_app

• Recommend you all watch this videos on YouTube (Part 1-2):
  • https://www.youtube.com/watch?v=TKPscPqsz8s
  • https://www.youtube.com/watch?v=9437L9upnpE

• Robot Configuration video:
  • https://www.youtube.com/watch?v=xQJsADvNH_k
Code Demo

• Hard-Ware
• TeleOp
• Autonomous
  • Time Base
  • Encoder
  • Color Sensor
• Q & A