Robot Design – FTC Style

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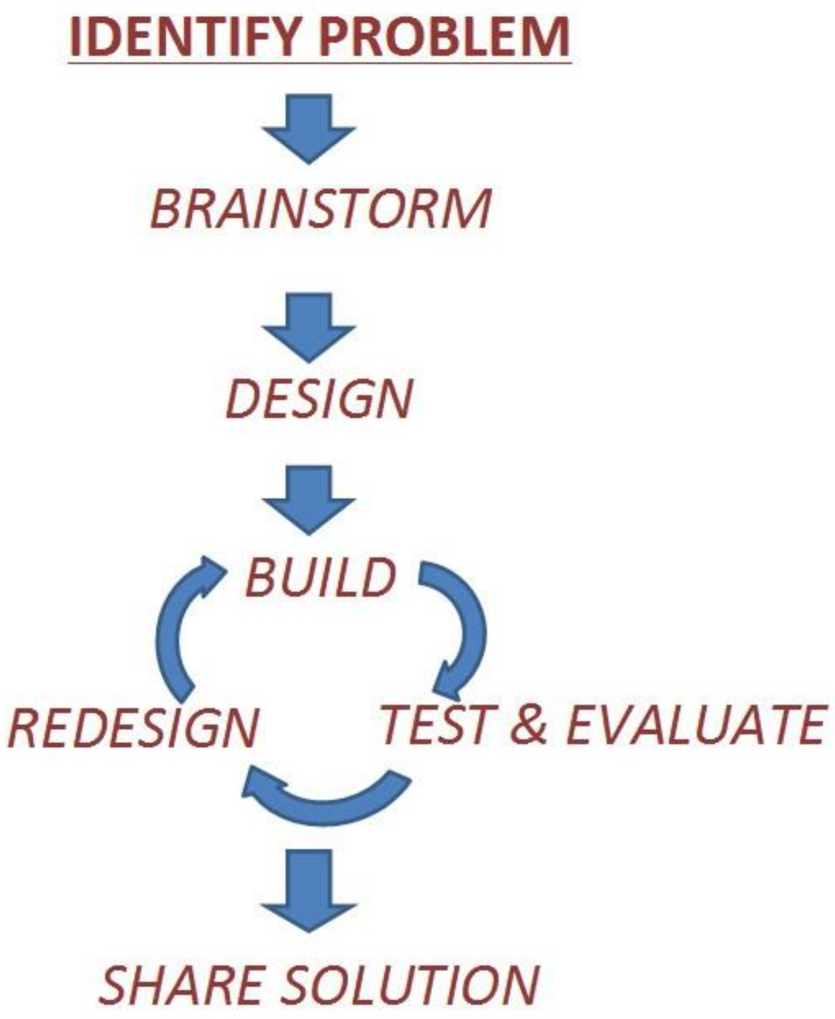
http://www.handhgraphicsorlando.com/STEM/roboknights.html

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



IDENTIFY PROBLEM

BRAINSTORM

DESIGN

BUILD

TEST & EVALUATE

REDESIGN

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
  - Quantify requirements: How Fast? How Many? How Far? How Long?
  - 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

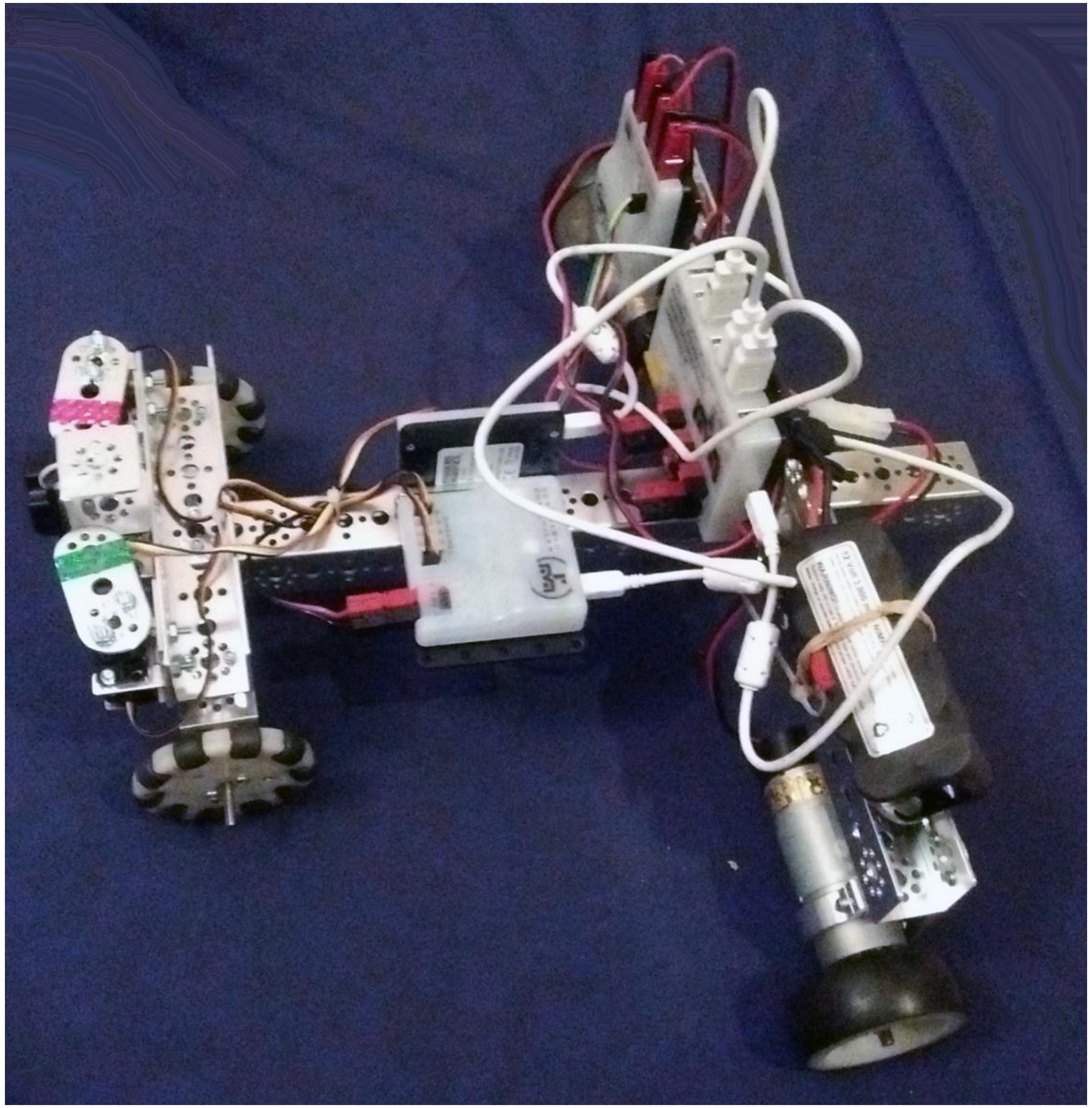
Test!

- 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

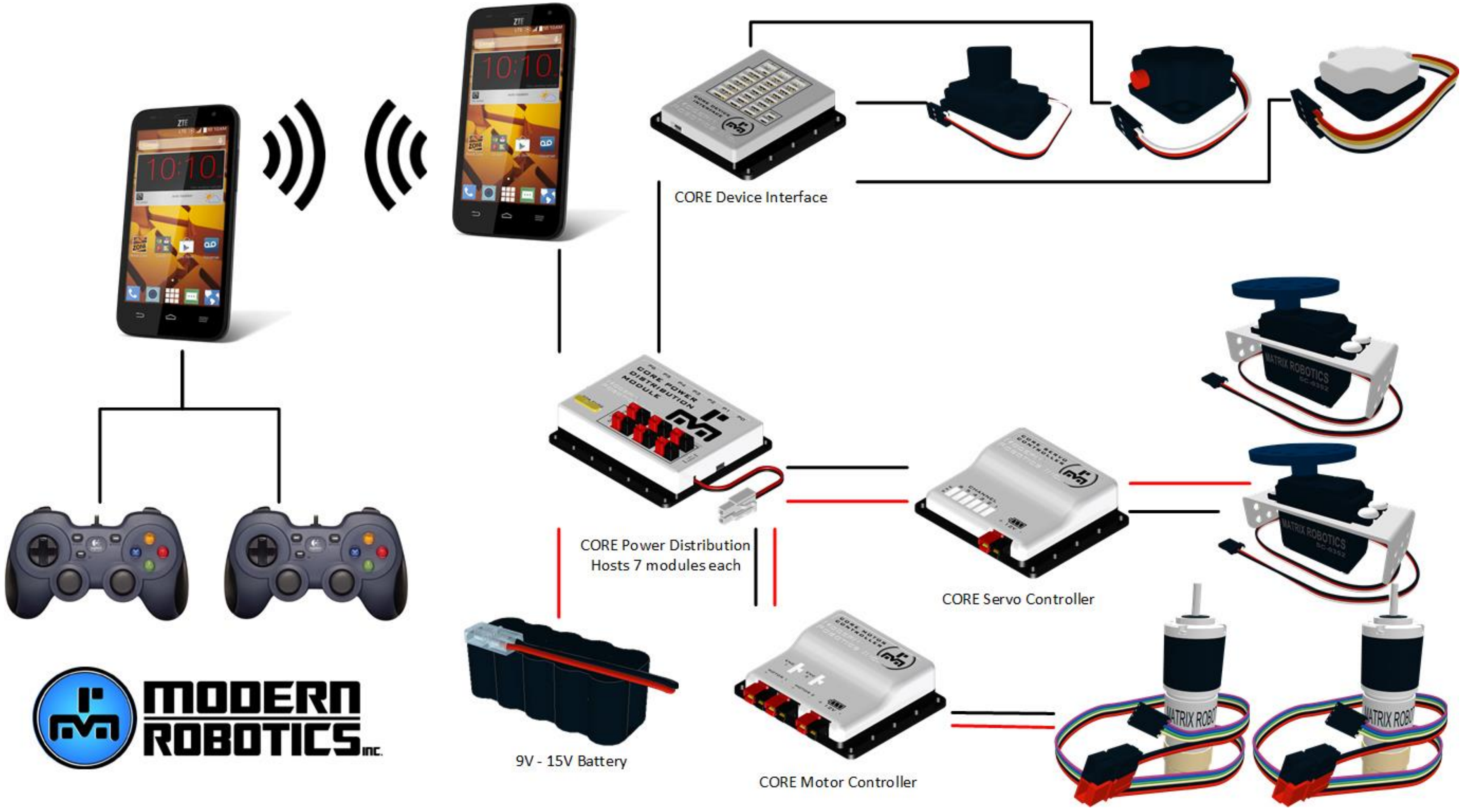
BabyBot - Overview



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



CORE Device Interface

CORE Power Distribution
Hosts 7 modules each

CORE Servo Controller

9V - 15V Battery

CORE Motor Controller

Phone Set-Up

- The detailed steps are in:

https://github.com/ftctechnh/ftc_app/blob/master/doc/tutorial/FTCTraining_Manual.pdf

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/blob/master/doc/tutorial/FTCTraining_Manual.pdf
- 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