2016 - 2017 ScoreBot Challenge

Introduction

Many people consider a robot as a machine that can run autonomous. However, if you broaden the definition of "Robot" slightly, remote controlled objects can often be considered to be a robot. One thing is clear, that building a competitive quality robot is not easy. It takes a lot of hard work, both physically and mentally. You will need to be prepared to spend a significant amount of time and possibly money. While also keeping safety in mind as well, and not forgetting to maintain proper instructor supervision.

Challenge

Working in teams of two and groups of two, and using two different types of RC chassis', students will design and fabricate a multi functional, Radio Controlled (RC), battery or pneumatic powered robotic system. One small ScoreBot will be designed to collect tennis balls, climb over obstacles and deliver a load to a given area within a specified amount of time and then deliver a load to a larger ScoreBot. One larger ScoreBot will be designed to collect tennis balls from the smaller ScoreBot and climb over obstacles. The large ScoreBot will then launch their specified load at a target shooting for range and accuracy. The major objective is to collect, deposit and launch as many tennis balls in a set time frame to a specific location or target on the playing floor or arena as possible.

Teaching Objective

The Scorebot Challenge provides an opportunity for students to become engineers through an active learning experience and allows them to use their math and science knowledge for practical applications.

Learning Objectives

The physical science concepts this project covers are: forces, link mechanisms and motion, more specifically; the study of kinematics. The ultimate goal of the Scorebot Challenge is to design and fabricate a mechanical system that moves quickly and picks up and launches tennis balls efficiently and effectively. Engineering principles include brainstorming of ideas, analyzing, testing, and revisions. Using creative problem-solving techniques, students will brainstorm about the best material to use: then design their solutions based on their brainstorming and researched ideas. By having each team create an individual design, each solution will be unique in its own innovative way.

Curriculum Integration

This project will not only show students how science, technology and mathematics work together, but it also allows them to use their language arts skills. Before the competition begins, each team will give an oral presentation to the class describing how their Bot works, and the principles of force and motion they are taking advantage of in their solution. Each team or individual will have to describe what type of simple machine they are using in their design process and the purpose it serves. After the competition, each team will submit a written report stating what the team did at each step in the problem-solving process. Note: This report ends with a conclusion stating why the device was successful or what changes could have been made to make it successful. Students' artistic and CAD skills will also be utilized with written descriptions and dimensions placed beside key components.

Assessment

Team efforts are measured according to multiple factors including the design, fabrication, testing, analysis and participation. The RC mechanical system will be measured first, by its function. Does the solution move by itself and work properly? Does the solution use unique or just the required materials? Is the solution's starting size within the specified limits? Was solid research used to determine the best outcome of the project? The second is how the solution finished in the competition. See below for scoring and grading.

Safety First

Be careful and avoid injury when working with all tools. Be **especially** careful while using sharp objects during fabrication and testing. Follow all safety procedures and guidelines for each tool as provided for by the instructor and identified in the fabrication lab.

Constraints / Limitations

- Each team is required to use the supplied Traxxas E-Maxx or X-Maxx chassis without any modification, meaning it must not be disassembled and must remain stock at all times.
- Students will affix and secure their ScoreBot to the top of the chassis connected by the mounting pins supplied. The chassis and upper ScoreBot must be removable from each other at any time.
- Students may use any materials to fabricate their mechanical RC system. The materials may be used in any way necessary to complete the project. They may be cut, shaped, formed, etc. If you have difficulty obtaining materials, see your instructor promptly.
- The small ScoreBot must minimally deposit tennis balls in a black plastic container in varies locations throughout the arena as well as deposit tennis balls into the large ScoreBot.
    - Container Size: 4½" x 14½" x 20½"
- The large ScoreBot can pick-up and transfer tennis balls from the small ScoreBot at any height determined by their group.
- Each team will have a ***Driver*** of the chassis and an ***Operator*** of the ScoreBot. Together they will make up the entire ScoreBot team to acquire and launch as many tennis balls to win their event.
- The driver is responsible to get the Scorebot from one point of the arena to the other and anywhere in between to assist in picking up and dropping off or launching a load of tennis balls.
- The operator is responsible to maneuver and control the ScoreBot mechanism to get as many tennis balls onboard and then dispense them into a predetermined container or dispensed into another ScoreBot or launched from their ScoreBot platform.
- Your ScoreBot may extend an arm, bulldoze, shovel, shoot, spin, scoop, throw, rotate or drop an object. It must, however, do so remotely and/or automatically, once the ScoreBot is started.
- Your ScoreBots chassis must be powered only by the supplied Traxxas E-Maxx or X-Maxx chassis. Once placed in the arena you may not touch the ScoreBot to start the competition. Also you may not touch the ScoreBot anytime once the match has begun.
- Each Scorebot will be required to have an automatic shut-off switch. Location and switch will be determined by the instructor before the build process commences.
- The Scorebot does not have any size requirements but always consider the weight factor added to the chassis at all times. Also consider your center-of-gravity. "Heavy" means slow….."Tall" means flip over.
- Know your limits…..servos and electronics overheat and have limited range, check with the appropriate operator's manual or ask instructor for assistance. Better to be safe than sorry.
- Keep batteries maintained and charged.
- ***Note:*** Be creative in developing your design ideas.

New Manufacturing Technology - Constraints / Limitations

Students will be required to incorporate three (3) different types of manufacturing technologies while building their parts in the fabrication lab (Fab Lab). Machining is one type of a manufacturing process encompassing a broad range of technologies and techniques. It can be roughly defined as the process of removing or cutting, shaping, forming, drilling, tapping or changing material from a work piece using power-driven machine tools to form it into an intended design. Most metal components and parts require some form of machining during the manufacturing process. Other materials, such as plastics, rubbers, and paper goods, are also commonly fabricated through machining or manufacturing processes. Students are not required to use every machine in the Fab Lab to complete their project.

Students may choose from the list below of machine technologies to incorporate during the fabrication process.

- 3D Printing or Rapid Prototyping
- CO2 Laser
- CNC Plasma Cutter
- CNC Router
- TIG or MIG Welder
- Acer CNC Mill
- Haas CNC Mill or Lathe

Supplied Material

Note: These items listed below are very expensive and are not toys. Handle with care at all times. If an item is damaged, lost or destroyed please inform your instructor immediately.

- (1) Traxxas E-Maxx RTR Vehicle w/2.4GHz Radio ($400.00)
- (1) Traxxas X-Maxx RTR Vehicle w/2.4GHz Radio ($690.00)
- (2) Hi-Tec HS-5645MG Digital Servo ($37.00)
- (2) Hi-Tec HS-5765MH Digital Servo ($75.00)
- (1) Specktrum DX5e Radio ($100.00)
- (1) DNYX 200 Battery Charger ($40.00)
- (1) Team Tenergy Digital Charger ($45.00)
- (2) DTX NiMH 6.0V 1600Ah Battery ($18.00)
- (2) Traxxas NiMH 7 Cell Battery ($39.00)
- (2) Traxxas LiPO 3 Cell Battery ($60.00)
- (2) Y-Harness 6" Reverser HD ($7.00)
- (2) Y-Harness 6" HD ($5.00)

Miscellaneous Parts

You'll be surprised at the number of strange odds and ends you'll need to find to construct your Scorebot, Don't limit yourself to just supplied items in the fabrication lab.

Learn to Drive

- Good drivers always have the advantage.
- Each team member will drive their Scorebot.
- Driver must take precautionary measures when driving.
- Driver must not try to intentionally or deliberately crash or wreck the chassis.
- All drivers must pass a ***"Driving Test"*** (test will be determined by instructor)
    - Test #1: Chassis Only
    - Test #2: Chassis thru Obstacles
    - Test #3: Chassis and Upper ScoreBot (non-operational)
    - Test #4: Chassis and ScoreBot thru Obstacles (operational)

Basic Design, Build and Assembly Information

- RESEARCH and be CREATIVE.
- Keep in mind that precision fabrication will result in better performance during ScoreBot testing.
- Identify each of the material components provided and possible purposes they will serve.
- Brainstorm / sketch preliminary ideas for your RC mechanical system and placement of components.
- Draw refined sketches for your mechanical system showing locations of components and how it will work. *Note:* More views with dimensions makes for an easier build.
- Select the best design from your refined sketches.
- Create a complete set of Detail and Assembly drawings.
- Create a 3D Solid Model Assembly – Inventor .iam and .ipt files
- Create 2D IDW with dimensions for all components to be made by you.
- Keep in mind RC mechanical system specifications and limitation. Does your prototype meet the design criteria?
- Understand the use of different types of material i.e. steel, aluminum, plastic and wood etc.
- Understand the weight factors of different types of material
- Fabricate or alter parts per drawing dimensions in the Fabrication Lab. (quality and precision of each part will ensure a smooth and functional assembly process)
- Assemble RC mechanical system parts.
- Pre-test RC mechanical system and make needed adjustments and alignments.
- Modify if necessary and retest.
- Always keep SAFETY in mind.

Testing Scenario

- The Scorebot may be unofficially tested as much as needed without penalty after passing drivers test.
- Upon deadline for competition, your ScoreBot system MUST be tested for a grade.
- Scorebot must complete the objective for full points. The course surface and terrain will vary somewhat due to running on rubber, plywood, carpet, cement, asphalt or other surfaces determined by the instructor. Thus the challenge will be variable and have a wide range of difficulty so design and build your Scorebot with this in mind.

The Official Contest for Grading

- Depending on your Scorebot chassis the objective is to pick-up and deposit or pick-up and launch as many tennis balls in a given time as possible.
- Small ScoreBot - Tennis balls may be collected and deposited in a large ScoreBot or deposited into a black plastic container in varies locations throughout the arena.
    - Container Size: 4½" x 14½" x 20½"
- Large ScoreBot – Tennis balls will be collected from small ScoreBot and launched at a target.
- Each competition will be timed.
- Drivers and operators may be required to switch positions before, during or just prior to the end of the competition.
- A team may shut off another Scorebot at any time for extra points. (see below)
- A team may remove tennis balls from another team's container but not from another Scorebot.
- **Event #1:** ScoreBots large and small will compete 2 at a time in a double elimination style event. The winner will advance to the next round with the other winners. The loser will compete in a "Losers Bracket". The competition will continue until a champion is crowned.
- **Event #2:** ScoreBots large and small will compete 2 at a time in multiple rounds of competition. The winner with the most accumulated points after the accumulated rounds will be crowned the champion.
- **Event #3:** ScoreBots will team up with other ScoreBots to accumulate and launch as many tennis balls as possible. The team with the most points wins.
- All testing scenarios will be determined on the day of each event by the instructor.

Scoring

- ***General Points***
    - **1 Point** pick up tennis ball in small ScoreBot and hold
    - **1 Point** pick up tennis balls in large ScoreBot and hold
    - **2 Point** transferring tennis ball into container
    - **5 Points** transferring Money Ball into container
    - **10 Points** hitting target
    - **20 Points** hitting target with Money Ball
- ***Extra Points***
    - **5 – 25 Points per event** determined by instructor on testing days
- ***Lost Points***
    - **-20 Points** Crashing Scorebot
    - **-20 Points** Head Hunting / Crashing into another Scorebot
    - **-10 Points** Did not finish your round (Scorebot must be operational at the end of each event)
    - **-10 Points** Battery(s) not charged

Open Testing – Mini Challenges

- Instructor will provide a testing scenario or gaming event depending on time left with project.

    - **Minute to Win It** – One minute to pick up as many balls as possible and place in a bin or launch at a target
    - **Corner Crook** – Pick up tennis balls from a corner location
    - **Drag Race** – Tennis Balls at end of hallway – pick up and return to finish line
    - **Multi Bucket** – layout bins all around and place a specific number of balls in each bin
    - **Fast & Furious** – Weave through cones and be first to collect the tennis balls, launch at a target and cross finish line
    - **Pass Off or Relay Race** – Team #1 picks up tennis ball then drops it in designated location or onto another ScoreBot, Team #2 then races to the finish line
    - **Soccer** – With body removed and a soccer guard added teams will shoot for points into a goal
    - **Fetch** – Large ScoreBot launches tennis balls and small ScoreBot retrieves them

Grading

- Points will be earned and calculated by using the entire design and fabrication process while successfully completing the Scorebot Challenge.

    - Oral Presentation: **50 Points**
    - Competition: **100 Points** maximum per event
    - The Concept Sketches: **50 Points**
    - The Design: **200 Points**
    - Scorebot Appearance / Build Quality: **200 Points**
    - Completed Scorebot RTR: **100 Points**
    - Individual and / or Team Participation: **100 Points**
    - Extra Credit: up to **100 Points** determined by the instructor

Final Report

- Students will develop a ***2016 - 2017 ScoreBot Challenge*** project summary and reflection paper worth **200 Points**. Instructor will hand out requirements after the final testing has been completed.

Helpful Hints and Questions to Consider

- How can I design and build my Scorebot to move easily around the arena?
- What can I design and build into my Scorebot to prevent my opponent from scoring?
- Design for maneuverability. The most successful ScoreBots are usually those that can load and unload tennis balls efficiently.
- Design for offensive strategies first then defensive strategies if needed.
- Design for durability. Opposing vehicles and accidents can damage a fragile design.
- Design for easy repair. Keep the design simple. Complex designs are more prone to breakdowns and are difficult to repair.

Time Line – Weekly Event Schedule

Description	***Week No.***	***Days of the Month 2016 - 2017***
• Introduction	Week 1	Sep 19th – 23rd
• Research	Week 1	Sep 19th – 23rd
• Preliminary Ideas Due	Week 2	Sep 26th – 30th
• Design Idea / Sketches Due	Week 3	Oct 3rd – Oct 7th
• Design (Working Drawings)	Week 4 – 10	Oct 10th – Nov 25th
• End of 1st Marking Period	Week 7	Nov 4th
• Driving Test #1	Week 8	Nov 7th – Nov 11th
• Driving Test #2	Week 8	Nov 7th – Nov 11th
• Scorebot Construction	Weeks 11 – 24	Nov 28th – Feb 24th
• Holiday Break	Weeks 16 – 17	Dec 22nd – Jan 3rd
• End of 2nd Marking Period	Week 20	Jan 27th
• Mid-Winter Break	Week 24	Jan 20th – 24th
• Scorebot Preliminary Testing	Week 25	Feb 27th – Mar 3rd
• Driving Test #3	Week 25	Feb 27th – Mar 3rd
• Scorebot Modifications	Week 25	Feb 27th – Mar 3rd
• Driving Test #4	Week 25	Feb 27th – Mar 3rd
• Competition #1 (Grade)	Weeks 26 – 27	Mar 6th – Mar 17th
• Scorebot Modifications	Weeks 26 – 27	Mar 6th – Mar 17th
• Competition #2 (Grade)	Week 28	Mar 20th – Mar 25th
• Competition #3 (Grade)	Week 29	Mar 27th – Mar 31st
• Spring Break	Week 30	Apr 3rd – Apr 8th
• SAT Testing	Week 31	Apr 10th – Apr 14th
• End of 3rd Marking Period	Week 31	Apr 13th
• Mini Challenges (Extra Credit)	Weeks 32 – 33	Apr 17th – Apr 28th
• Open Competition (Fun)	Week 34	May 1st – May 5th
• Final Competition	Week 35	May 8th – May 12th
• Engineering Report Due May 26th	Week 37	May 26th Only
• Senior Final Exams	Week 38	May 31st – Jun 2nd
• Seniors Last Day	Week 38	Jun 2nd

Note: *Weekly Events Schedule subject to change at any time do to the school district calendar or unforeseen events scheduled throughout the school year.*