

IEEE Southeastcon 2014

Student Hardware Competition Rules

I. Introduction

In Kentucky, collegiate basketball is serious business and we'd like to bring the thrill to you in a lighthearted competition. For this year's competition, you will design a robot that will shoot a projectile from various distances to emulate the playing and shooting dynamics of basketball.

II. Objective

Teams will build a robot that operates on a simulated basketball court. The robot must follow three lines of random lengths and then fire a dart from the end of each line. Winners will be decided by number of points earned by completing goals and completion time so the highest scoring robots will be both fast and precise.

III. Field Materials

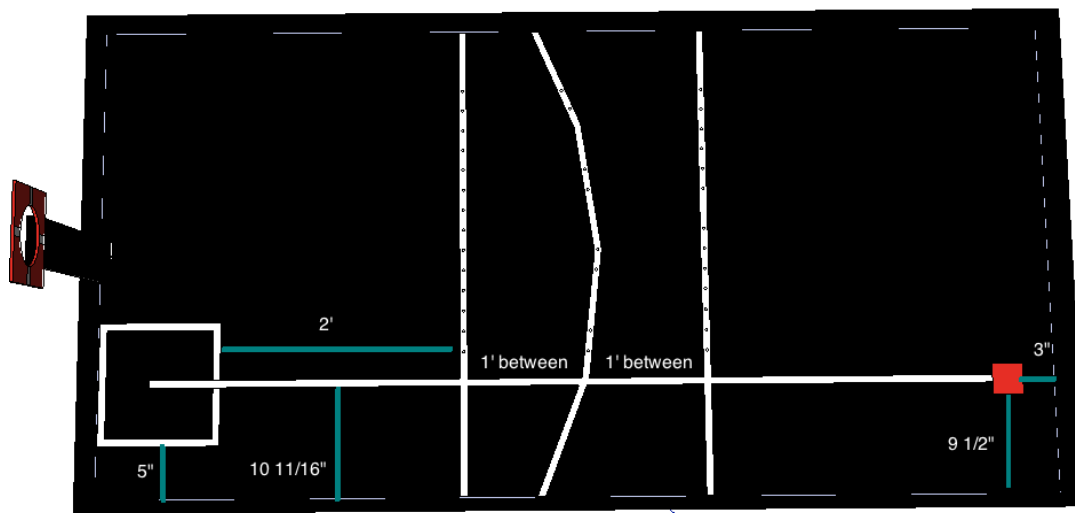
The SketchUp document is always the most accurate source of information on the layout of the course.

All items can be purchased from Lowe's, Walmart, Amazon.com, and Digikey. Lowe's part numbers are provided here as well as web links, which are provided at the bottom.

The list numbers are used below in the description of the course.

1. ½ x 4' x 8' Premium MDF (#74794)
2. 4 pieces of 1' x 4' x 8' Spruce-Pine Furring Strip (#4510)
3. 8 oz Lilac Frost Interior Satin Paint Sample (White) (#144337)
4. 8 oz King's Robe Interior Satin Paint Sample (Blue) (#144549)
5. 8 oz Heart's Desire Interior Satin Paint Sample (Red) (#144549)
6. 8 oz Black Elegance Interior Satin Paint Sample (Black) (#144549)
7. 2 Hillman Sign Center Blank Sign (#236805)
8. Madison Mill ¼" Diameter x 3' Round Dowel (#432502)
9. Blue Nerf N-Strike Elite Darts (Available at Amazon)
10. Nylon Mandel Fabrics Craft Net, Black (Available at Walmart)
11. 9 Simple Green LEDs LTL-4238 (Available at Digikey)

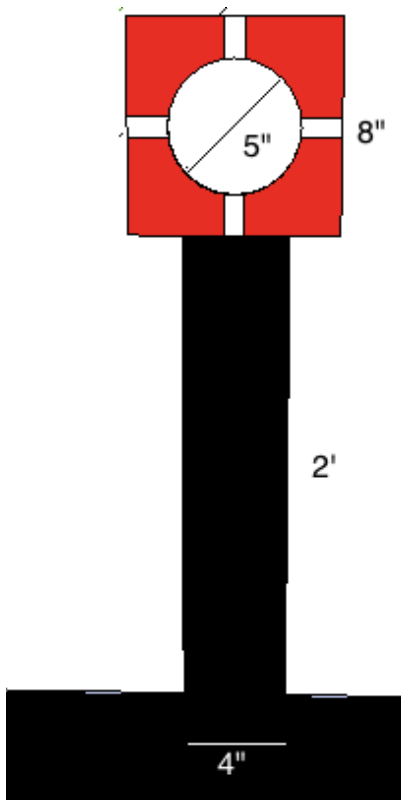
IV. Playing Field & Tolerances



- The course will be made out of a 4'x8' piece of MDF **(1)** with walls constructed by 1 x 4 pieces of plywood **(2)** that is attached to the top of the MDF. The course will be painted black **(6)**.
- A 1' x 1' area will be marked in white paint with thickness of $\frac{3}{4}$ " **(3)** for the starting zone. Note that the painted length is included in the boundary so the inner area is $10 \frac{1}{2}$ " x $10 \frac{1}{2}$ ".
- On the course, there will be a line painted with white paint **(3)** 7' long, starting 6" from each end of the course that is located directly through the starting box. This line will have the start position box at one end and the end position box at the other.
- From the main line, there are 2 shooting lines painted with white paint (thickness still $\frac{3}{4}$ ") **(3)** that span the width of the course. Their centers are 2' apart and are parallel to the target. On those lines, there are holes in the center of the line, 2" apart that have diameter $\frac{1}{4}$ " and go through bottom of the course.

They begin on the right side of the main line and stop 6" from the wall on the right side to produce 14 dots.

- In the middle of the 2 straight lines painted with white paint with the same thickness **(3)** is a curved line representing a '3-point perimeter.' on the left straight line, this curved line's center is 1' from each of the straight lines. The center of this circle will be the middle of the bottom of the 1x4. Making a circle starting at this point creates this line. To create this line, one can use a string and a pencil to draw with an exact radius. The radius of this line will be about 4'.
- Placed on each shooting line, there is a (firing block) block of plastic **(7)** that is $\frac{1}{4}$ " thick x 3" x 3" that is painted blue **(4)** that has two dowel rods **(8)** that are $\frac{1}{2}$ " from the left and right side and 1 $\frac{1}{2}$ " from the top and the bottom. This square is the shooting point for each line.
- The target is a $\frac{1}{4}$ " thick x 8" wide x 8" tall block of plastic **(7)** cut from a piece of corrugated plastic with a 5" diameter hole in the center to shoot through. The target is mounted on a base block of wood that is 1 x 4 x 2' **(2)**. The base will be painted flat black; the target area will be painted red **(5)** with white lines painted with thickness $\frac{3}{4}$ " **(3)** coming vertically and horizontally out of the circle. There will be a net **(10)** attached to the back of the net assembly that will be used as the final judge of if a dart made it successfully.



- The end zone will be painted red **(5)** in a 3" x 3" square, if the robot stops

and covers the entire red square; the round is over and bonus points will be awarded if applicable.

- There will be netting **(10)** around the course for safety reasons supported by PVC piping. The area of netting is 5' x 10' x 8' and there is an opening on the side of the course

Course Tolerances:

All course wooden materials have a tolerance of $\pm 1"$ for the length and width and $\pm \frac{1}{4}"$ for the thickness. All painted squares and lines have a tolerance of $\pm \frac{1}{4}"$. The tolerance of the target hole will be $\pm \frac{1}{2}"$. The remote start leds have a tolerance of $\pm \frac{1}{2}"$.

Course Assembly

The base board will be the MDF and it will have the '1 x 4' x 8' wood boards for the sides with the outside edges of the wood lined up with the outside edges of the MDF. For the shorter sides, we recommend cutting them and using the excess on the target base. This makes the inner area of the course 4 $\frac{5}{8}'$ wide x 7 $\frac{5}{8}'$ long. The walls will be secured from under the plywood with screws through the floor. This whole course will be painted black. The target base should be made with the remaining portion of the wall wood and should have dimensions 1' x 4' x 2' and will also be painted black. This will be attached to the main course with L brackets. The target will be cut from the corrugated plastic and painted red. It has dimensions $\frac{1}{4}"$ x 8" x 8" and there is a hole with diameter 5" directly in the center of the plastic. From this circle, there are "guide lines" in the form of white paint coming from the top, left, right and bottom of the circle. The net is stapled to all four corners of this piece of plastic. This plastic assembly is nailed onto the base with the bottom inch of the plastic attaching to the top inch of the base.

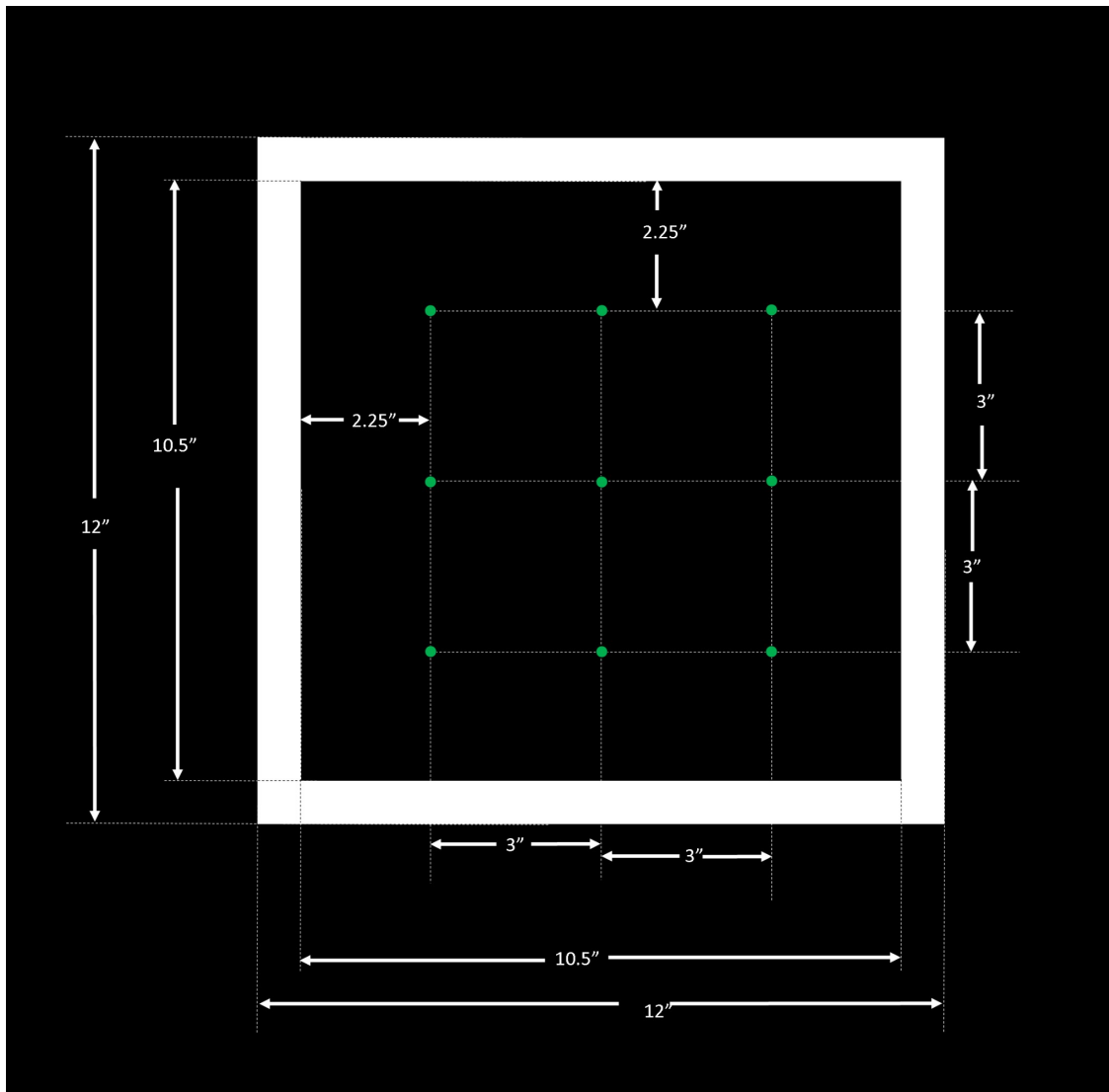
v. Robot

The robot must fit into a 1'x1'x2' (L W H) space at all points in the competition. There will be a separate box independent of the course that will be used to judge size constraints. The robot must be able to cover an area of 3"x 3" so that it can fully cover the squares in the course and must start via our remote start system (described below) and only one team member is allowed to set the robot on the course and turn it on. The robot is only allowed to carry 3 darts, which must be loaded into the robot at the beginning of the round. After that, any touching of the robot or communication with it (wired or wireless) ends the round immediately with no further points being awarded for that round.

Remote Start

For safety reasons the robots are obligated to comply with a remote start system. Robots are not permitted to start the competition until the remote start signal is sent. The starting signal is the illumination of a 3 by 3 grid of green LEDs, which will be embedded below the surface of the starting location. The center of the LEDs will be spaced 3 inches apart.

The 3 by 3 grid will be aligned with the starting block. The image below demonstrates the led positioning .



The white border is the starting block.

The tolerances for the LEDs is a special ± 0.5 inch tolerance. The tolerance applies to each LED's absolute position, not the distance between the LEDs. In other words the position error for one led will have no bearing on the position error for the next LED.

The LEDs are simple green LEDs. The current through each LED will be 19 to 21 mA. The LEDs can be found at Digi Key with the part number 160-1132-ND.

Projectile Safety

All team members and spectators are requested to wear protective eyewear when around a course in the competition room. No teams are allowed to fire any projectiles outside of the netted practice or competition courses, failure to heed this warning will result in disqualification. No chemical propellants are allowed. No area of the robot may contain a pressure of above 50 psi at any point in the competition. Teams using compressed canisters should bring a psi gauge with them to verify the pressure in their canister.

VI. Rules

- One team member will set the robot on the course in the start zone. The robot must be contiguous at the start (all in one initial piece) and there is no communication allowed. The team member will press the power button when told to by the judge and then no communication is allowed between the team and the robot. The robot must remain in contact with the course at all times.
- Each round will last 2 minutes. The robot is not required to go to the ending position, however if the robot fully covers the end position box, the round will immediately end.
- In the competition, teams will be provided with three darts that have no clear deformities and are straight. If a team is not happy with the quality of darts they have received, they may request new ones.
- In each round, points will be given for each task only once.
- At any point, a team member or a judge can call for the end of the round. No further points will be awarded from that round and the robot must be removed from the course by the team.
- All teams will be required to bring their robots to the competition area before each round starts and all robots will be tested on a course with the same shooting positions.
- The judges reserve the right to change the competition rules between rounds.
- The judges reserve the right to disqualify any team for unsportsmanlike behavior or unethical behavior.
- The judges' reserve the right to end any robot's run at any time if the robot is a risk to spectators or is causing damage to the course.
- The judges' decision is final.

- The team members are financially responsible for any damages resulting from accidental or intentional projectiles fired.

VII. **Competition Format**

Qualifying Round

Each team must be able to demonstrate that their robot can move at least 1' along the main line from the starting position of the course before the competition rounds begin. Other tests, such as checking the pressure of compressed areas may also be done at this time. If a robot fails to do so, it may be excluded from other rounds depending on the number of competitors.

Competition Rounds

All qualified robots will be allowed to participate in all 3 heats. For each heat, the shooting positions will be randomly generated and all robots will compete on a course with the same specifications for that round. To encourage teams to be ethical, all robots will be called to the front before the start of each round to make sure that the robot is not modified to accommodate the parameters for that round. When a team's robot is announced, one member of the team must come and set the robot on the course. After all 3 heats, the sum of each team's scores will be calculated and the top 8 teams will go the final round.

Final Round

The top 8 teams will compete in the same competition as they did in the competition rounds with only a single heat during the banquet at the end of SoutheastCon. Normal judging and rules will apply. If a tie exists at the end of the final round, a tie breaker round may be added at the judge's discretion.

VIII. **Scoring**

- If the robot moves at all from the starting position, 25 points are awarded.
- For the first correct stop the robot makes at the end of each shooting line (covering the entire blue box), 50 points is awarded, regardless if they shoot or not.
- For the first shot from each correct shooting point, 300 points in awarded if the dart makes through the hole into the net. Successive shots beyond the first one from each shooting point will add nothing, but will not void the successful shot. Note that by making successive shots, you cannot get the dart back to the robot and thus cannot shoot from a later point, however points for stops will still be awarded.
- 25 bonus points are awarded if the robot successfully stops at the end of the main line before the time limit is reached.
- If the robot makes at least one successful shot and has stopped at the end of

the main line, 1 bonus point will be awarded for each second left on the round timer.

- The score of all 3 heats will be added together and used to determine the winners.

IX. **FAQ**

- **Will Darts be provided?**
 - Darts will be provided to each team at the competition however you are encouraged to bring your own to test with.
- **Is there any required order for shots?**
 - The robot must go to the shooting boxes in order of distance from the starting position. If a shot from the second shooting point comes before a shot from the first shooting point, it won't count. If a shot from the third shooting point comes before a shot from the second shooting point, it won't count. If a shot from the first shooting point comes after a shot from any other shooting point, it won't count.
- **Does the robot have to shoot to get points?**
 - The robot does not have to fire any darts at all. Teams will be encouraged to successfully focus on reaching and stopping at the end of the shooting line before trying to shoot darts. Remember that shooting wildly can result in disqualification.
- **Can you clarify how stop is defined?**
 - The term stop (as in stopping at the shooting line or at the endpoint) is defined as the robot covering the firing block for 3 or more seconds. A robot is allowed to move in any fashion to orient itself or make any move to make a shot so long as the robot wheels do not move. When stopping at the end of the course for bonus points, these 3 seconds are counted on the round timer.
- **May I re shoot darts?**
 - Any dart that touches the floor is considered shot. You cannot recover any dart that is shot.
- **How is a “successful” shot defined?**
 - A successful shot is defined as when the dart passes through the circular hole in the target completely. Bouncing off the target does not count as a successful shot.

X. **Changelog**

1. 4/6/13 Initial Release at Southeastcon 2013
2. 7/8/2013 Beta Release
 1. Changed to floorboard to MDF
 2. Clarified LED Remote Start description/drawing
 3. Checked/corrected sizes of wood
 4. Specified paint

XI. **Shopping Appendix**

Nerf Darts:

<http://www.amazon.com/Nerf-N-Strike-Elite-Refill-Darts/dp/B0083TXZVQ>

Bird Netting:

<http://www.walmart.com/ip/Nylon-Falk-Craft-Net-Black/19237855>

Green LEDs (LTL-4238):

<http://www.digikey.com/product-search/en/optoelectronics/leds-discrete/524729?k=%20LTL-4238>