

IEEE SoutheastCon 2007

Student Hardware Competition Rules

Released: Jan 29, 2007
Competition Date: Mar. 24, 2007

INTRODUCTION

The central theme for the IEEE SoutheastCon 2007 Student Hardware Competition will be **BASKETBALL**. To go along with March Madness, the competition will be a modified version of basketball played between two robots, with the winning teams advancing to the next round of competition. The competition will require numerous engineering skills, from circuits to machinery, and from microprocessors to dynamics of systems.

THE COMPETITON BASICS

This will be a double elimination competition with each match lasting five minutes. The court will be divided into two halves with a wall at center court that will separate the two robots from each other. Each robot will start the round in the designated starting point on its side of the court and will be allowed to have three balls in possession for early scoring. Another location on each side of the court is designated as the “ball request zone.” A robot must travel to this location to request more balls. The balls will then be delivered at a third location, designated as the “rebound zone”.

The robots will be required to request balls, catch the balls when dropped, shoot those balls at the hoop to score, and then repeat the sequence. However, a limited number of balls are available and will be shared by both robots. Once these balls are used, no more will be provided, so the two robots are in a race against each other as well as the clock.

Once a ball is collected, there are two ways to score with it; one way is worth more

points than the other. Any ball that is placed over the wall into the large net behind the hoop counts as a score. However, considerably more points can be earned by shooting the ball through the smaller hoop.

RULES AND DESIGN PARAMETERS

Robot Specifications

The robot's dimensions cannot exceed 12" x 12" x 12" at the start of the match, however it can extend 6" in any one direction after leaving the starting point.

The robot can only use energy that is initially stored electrically (e.g. batteries). Use of cylinders storing any liquid or gas under pressure at the start of a round is prohibited.

Use of any flammable or hazardous substance which may pose a safety threat in a robot is prohibited.

Ball Specifications

The balls used during competition will be Nittaku 3-star Premium 40mm Table Tennis Balls (professional grade ping pong balls).

Playing Court

Each half-court will measure approximately 4 foot by 6 foot (size of full court will be 4' X 12', but teams will only need to build their half which is 4' X 6').

The court will be enclosed by a 6.75" high wall. An extra 6" of netting will be added along the side walls, raising the height to 12.5", in order to prevent balls from escaping the court.

Each half of the court will contain three 12"x12" zones defined by 1" thick white lines on the playing surface. The zones will be 12" inner dimension, meaning the distance from the outside of the white lines will be 14". These three zones are:

1. Starting Zone
2. Ball Request Zone
3. Rebound Zone

The floor and walls of the court will be painted black using Rustoleum flat black paint. A 1" white line will run down the center of the court, with perpendicular lines (also 1") leading to the three zones on the edges. These lines will intersect the zone boundary in the center of the boundary edge. The white lines will be painted using Rustoleum gloss white spray paint. The layout of the court is shown in figure A.

The Basket

Each robot will have its own hoop located at its end of the court. Unlike a real basketball hoop, the hoop will be oriented in a vertical plane, and there will be no backboard. The hoop will be a 10" inner-diameter octagon constructed from PVC 1/2" pipes, with an attached net (made from DuPont deer netting, available at Lowes hardware stores) to catch any balls that pass through it.

The hoop will be painted red and illuminated by red LEDs on each vertex to assist in locating and targeting the hoop when shooting. The hoop will be painted with Rustoleum "Safety Red" spray paint. The red LEDs will be Digikey part number 516-1339-ND. These LEDs include an integrated current limiting resistor to ease wiring, and they will be powered at 5V.

Behind the hoop, spanning the entire width of the court will be a net intended to catch any balls that pass over the backcourt wall, but do not make it into the hoop. The net will be a PVC frame (1/2" pipe) with a height of 38" and a depth of 26", covered in a black felt (this is shaped very much like a hockey goal).. The PVC frame will be painted black with flat black spray paint. Balls caught in this net will be worth some points, but less than those caught in the hoop.

Parts required for the Hoop:

- 7 pieces 4" (Lowes Part number = 23811)
- 2 pieces 1.5" (Lowes Part number = 23811)
- 8 bends 45 deg (Lowes Part number = 23757)
- 1 tee (Lowes Part number = 23759)

Ball Retrieval

Each robot will be allowed to start with three (3) balls. These balls will be placed in the robot by team members prior to starting the match. After shooting these balls, the robot can collect more by visiting the ball request and rebound zones.

To get more balls the robot must:

1. Drive to the ball-request zone and get the 3-digit ball drop code from the infrared transmitter there (details below).
2. Travel to the rebound station where it must display the three digit code and sound a buzzer to indicate that it is ready for the balls to be dropped.

Start Zone

The start zone is the 12"x12" marked location where the robot will be placed before the start of the match. In the floor in the center of the start zone there will be a RED LED to signal the start of the match. This LED is the same as that used for hoop, described above.

Ball Request Zone (Get the code)

The ball request zone will consist of an infrared LED (Part #QED123, available at Digikey and elsewhere) transmitting a standard 2400 baud, 8-N-1 UART bitstream. The LED “on” current is set to 100mA. The data transmitted will be ASCII characters representing a three digit decimal number, enclosed by the delimiter “IEEE” before and after. This means the total transmission length is 11 bytes. As an example, if the code is 123, the transmitted sequence would be:

I-E-E-E-1-2-3-I-E-E-E, or in byte values:

0x49 0x45 0x45 0x45 0x31 0x32 0x33 0x49 0x45 0x45 0x45

A logic ‘1’ (high voltage) will cause the LED to be ON. A logic zero means the LED will be OFF. This means that the idle state (when no data is being transmitted) for the LED is ON.

The LED will be located on the side-court wall, above the center of the white line leading to the request zone, 4” above the playing surface.

The transmitter will begin transmitting whenever any part of the robot enters the rebound zone, and will continue transmitting until it leaves. The sequence will be repeated by the transmitter once per second. The transmitted code will change after the current code is used. This means that robots must obtain a new code for every set of balls they receive.

If all of the balls have been retrieved, the ball request zone will transmit the reserved code 999 (e.g. IEEE999IEEE) to indicate that there are no more balls available. However, because the last set of balls goes to the first to sound the buzzer, and not the first to request a code, it is possible to obtain a valid code and still not receive balls when you sound the buzzer at the rebound zone because your opponent has taken the last set of balls in the interim.

Rebound Zone (Get the balls)

Once the code is received, the robot must travel to the rebound station. This station, when triggered, will drop three balls from a 2” PVC pipe overhead. The balls will be dropped from 13” above the court, over the center of the rebound zone square. Before the balls can be dropped, the robot must display the code received from the ball request station **so that it can be read by a judge standing beside the court.**

Although we will not make any hard rules for what teams must use to display the code, it must be clearly visible and easily read. A bright 7-segment display is suggested; however other alternatives such as an LCD may be visible enough. Bigger is probably better here, but use your best judgment. Once the robot is in position to “catch” the falling balls, it must sound a buzzer to trigger the drop. Assuming the correct code has been displayed and verified by the judge, the balls will be dropped within 5 seconds of the buzzer sounding. However, **some part of the robot must be contained within the rebound zone when the buzzer is sounded.** If it is not, the buzzer will be ignored and no balls will be dropped. The code can be displayed any time after it is received, however it should be displayed prior to sounding the buzzer so the judge has time to verify it, and it should continue to be displayed until after the balls are dropped.

There will be a red LED placed on the floor directly below the ball drop in the center of rebound zone. The LED will be flush to the floor, and will be the same part as the hoop LEDs (see above).

Any balls that become loose on the court (e.g. the robot failed to catch them, missed shots, etc.) shall be considered still in play, and may be picked up by the robots and shot. However, any balls that end up outside of the court will not be returned, and shall be considered out of play.

The total amount of balls allowed in a game will be limited to 27, including the 6 balls (3 each) that the robots start with. This means that there are only 21 “rebound” balls available and they are shared between the two competing robots on a first-come first-serve basis. When down to the last three balls, the first robot to sound the buzzer will get them (Assuming it is displaying a valid code and is at the rebound zone).

Scoring

There are two ways to score with a ball:

1. The higher of the two scoring categories is awarded when the ball passes completely through the hoop and is stored in the net behind the hoop. A robot will be awarded 10 points for each ball scored in the hoop.
2. The lower of the two scoring categories is awarded for balls that are caught in the net beyond the wall spanning the entire width of the court. This allows an easier form of scoring, and means that missed shots on the hoop are not completely worthless. Only 1 point is awarded for each ball caught in this net.

In the event of a tie at the end of a match, the winner will be the robot that reached the final score first. In the event neither robot scores, both teams will receive a loss, and there will be a re-match between the same robots. If the same result is attained again, then both teams will be eliminated and their opponents in the next round will receive a bye. If one team wins the re-match, that team will move to loser’s bracket for the next round and the other team is eliminated. The next opponent in the winner’s bracket will receive a bye. There is an exception to this rule: if neither robot scores any points, but one remains in the starting zone while the other moves out of it, the robot that left the start zone will be declared the winner.

Match Description

The match start is signaled to the robots by illumination of the red LED in the starting zone underneath where the robot will be parked. In case of a false start (robot performing any kind of movement before LEDs are flashed) robots will be returned to starting point and the match will be restarted. Each team is allowed one free false start. A second false start will incur a loss for the match.

After the match starts, the robot must leave the “start zone” before attempting to shoot any balls. Any points scored before leaving the start zone will not be counted.

The robots must shoot all three balls before requesting more balls. At no time may a robot possess more than three balls. No balls will be dropped from the rebound zone unless the requesting robot currently has no balls.

The match time is 5 minutes. Any balls leaving the robot (shot) at or after the end of the round signal is given (buzzer) will not be allowed to count as a scoring shot. The referee’s call on this is final. If all balls are out of play (not in a robot or on the court) or both teams mutually declare they wish to end the match, the referee may end the game early.

Qualification

Prior to being allowed to compete, each robot must demonstrate some minimal functionality.

Size Restriction

Each entry will be tested to fit into a 12”x12”x12” box. The robot must be able to be covered completely by this box in order to qualify to compete.

Qualification Round

Every robot will qualify for competition by demonstrating the ability to:

1. Travel outside of the start zone
2. Successfully shoot at least one ball into the hoop or into the base-line net behind it.

Qualifications will be performed on Friday night before the competition, or early Saturday morning. There is no limit on the number of qualification attempts each team will be allowed, except that imposed by available time. There will be a qualification deadline several hours before the real competition begins to allow for finalization of the field and match assignments for the first round on the tournament chart.

AWARDS

Awards will be given for the following fields.

1st Place in competition

2nd Place in competition

3rd Place in competition

Highest Average Score per Round In Competition

DOUBLE ELIMINATION COMPETITION:

The competition will be double elimination. Initial bracket assignments will be made by drawing teams at random for positions. Once all but two teams are eliminated,

these two teams will have a best-of-three final round for the championship.

Notes

All dimensions are accurate to +/- 10% unless specified
The *Referee Chairman's* decision is final on all cases.

Revision History

8/27/06 – Initial Release

10/22/06 - Revision

- Ball retrieval code is only transmitted when robot enters the request zone
- Specification of red paint and LED for hoop and start stations
- Wall height with netting is 12.5", not 12"
- Specify size of net behind hoop as 38", with a depth of 26"
- Fix figure A to be a single LED in start and rebound zones (not 5)
- Specify deer netting to be used for goal netting

1/29/07 – Revision

- Deer netting is replaced with black felt
- Wall height is changed from 6.5" to 6.75"

Top-View of Court

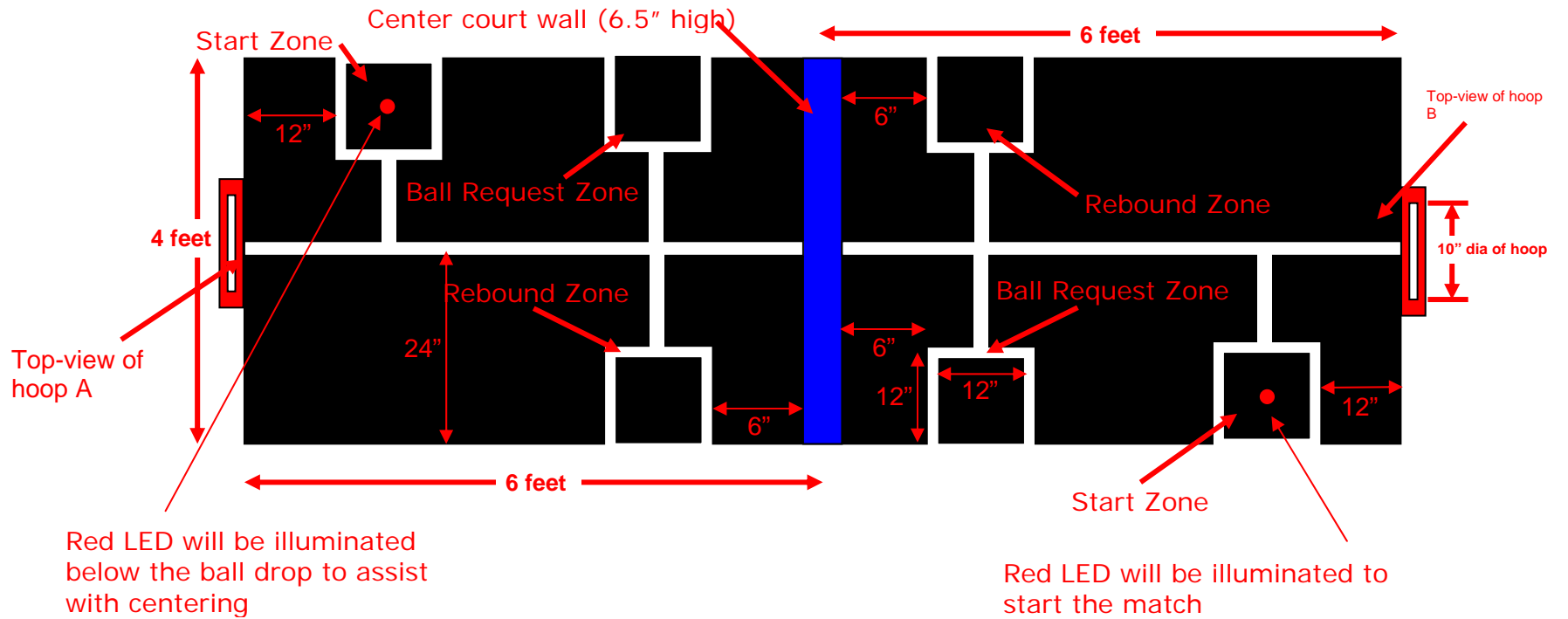


Figure A: Top-View of Court Layout

Side-View of Court

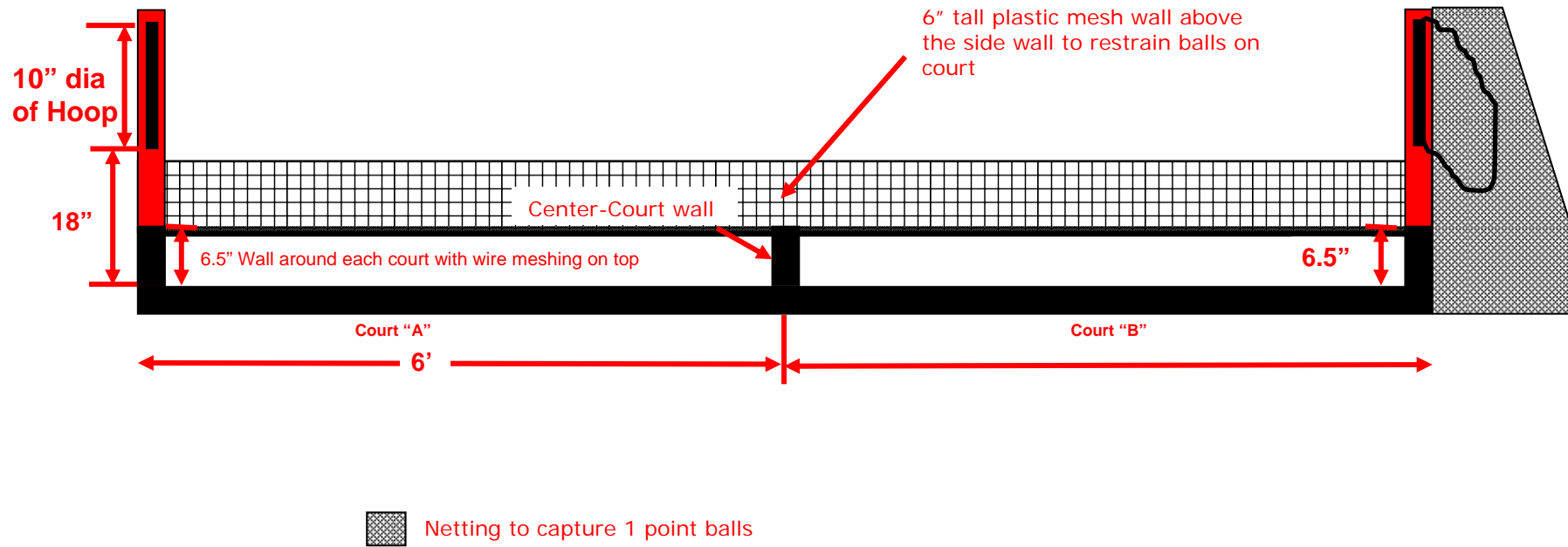


Figure B: Side-View of Court Layout

Hoop & End zone wall

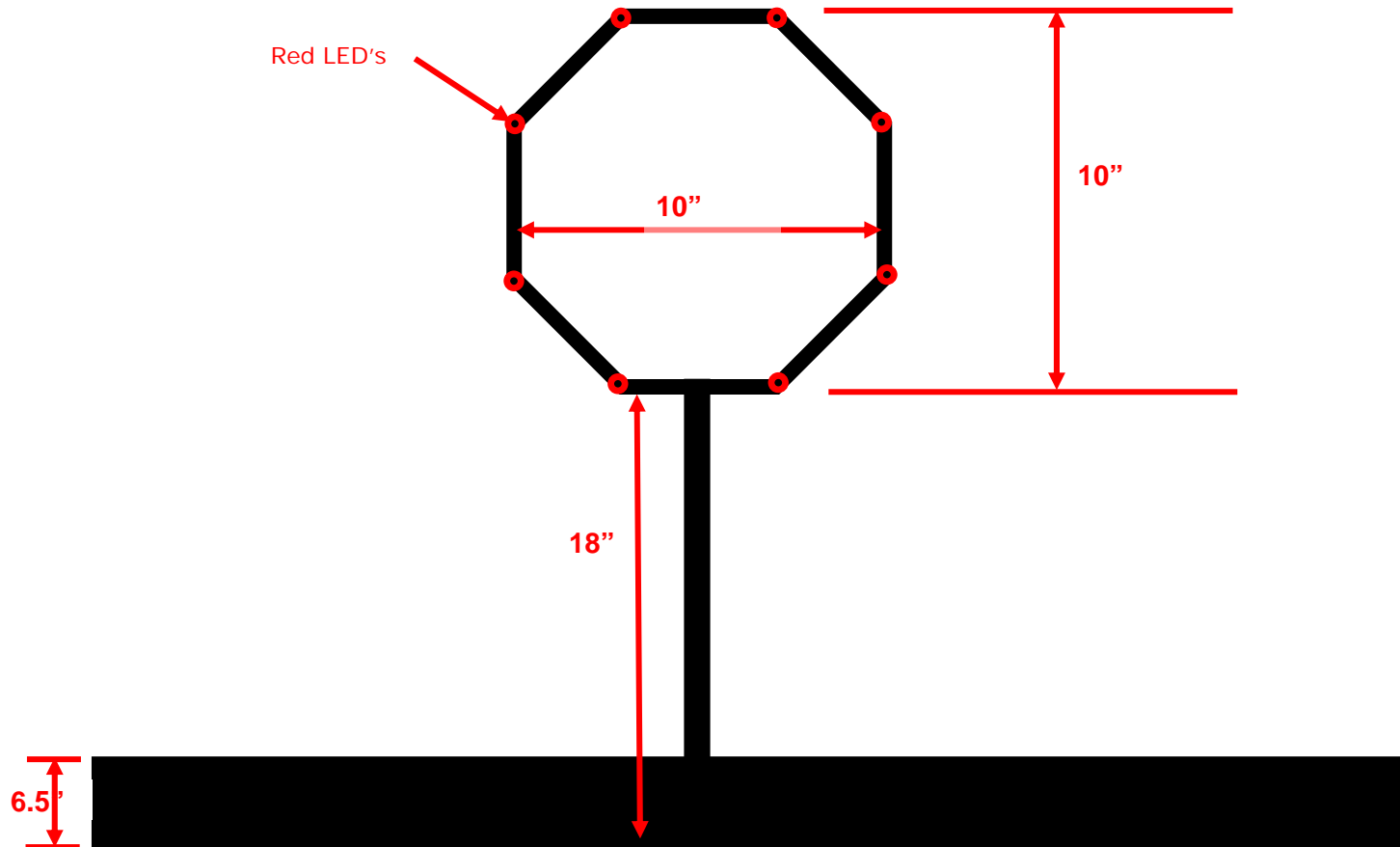


Figure C: Base-line view showing hoop