

## 1. Introduction

In Spring 2002, the Midlands Chapter of IEEE will host the IEEE Southeastern Conference (SECon) in Columbia, South Carolina. The University of South Carolina and South Carolina State University will host the student segment of the conference. This document contains information pertaining to the Hardware Design Competition of the IEEE Region 3 Student Conference. The theme for the 2002 Southeastern Conference is:

"Learning from the Past - Innovating for the Future"

We recognize that concepts and inventions from the past inspire many of today's designs and accomplishments. Playing on that theme, the student hardware contest is derived from one of the earliest electronic games - PONG.

Pong was one of the first video games created by the Computing Generation. "Pong" was created in the late 1950's and has since been adapted and modified many times. The console version of Pong, introduced in 1972, is probably the best remembered. The electronic Pong game is itself based on Ping Pong; the goal of the two competitors is to always return an incoming ball. In the original game, a point is scored whenever the ball goes past the opposing player.

In the hardware competition for the 2002 Student Conference, a modified Pong game will be played by robots facing off across a rectangular playing field. This contest will exercise a wide variety of engineering skills, from circuits, to machinery, from electronics to power systems, and from microprocessors to dynamics of systems.

Contestants will be provided with an individually-buffered signal from a video camera that views the field of the playing arena. From that signal, robots can determine the ball position and trajectory and use that information to position the paddle and return the ball. The playing surface slopes from the center towards each side so that the ball will not stop in the middle of the table.

This is the final copy of the rules. Any errata, clarifications, or changes will be available at: <http://www.ee.sc.edu/orgs/Secon2002/>.

### **Description of the contest**

The competition will consist of two robots, at either end of a 4' x 8' long table, volleying a ball back and forth until one of them misses. The table design places bounds on the minimum and maximum speeds at which a competitor can propel a ball across the court to score points. Competitors accrue points whenever a ball ends up in the scoring bin on the opposite end of the table. Note that the game table is deliberately designed so that a ball will bypass the scoring bin if it is returned at too fast a speed.

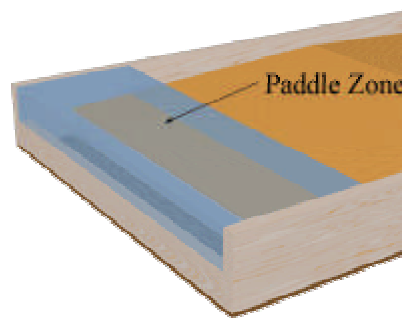
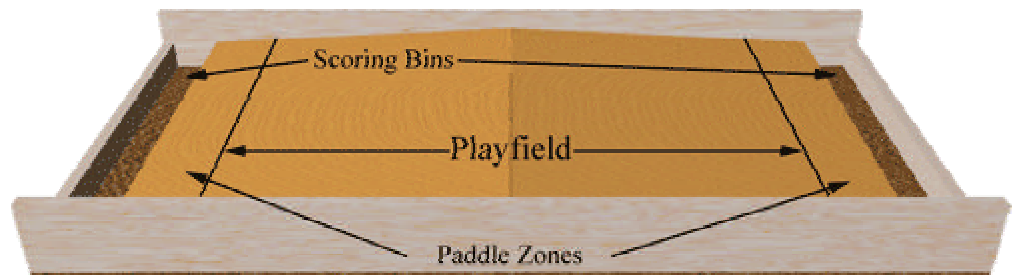
## 2. Rules

## 1. Fundamental Rule

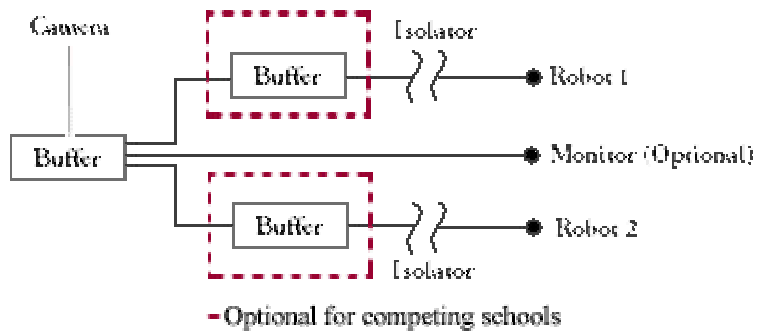
The game is intended to be played in a way consistent with play in the original electronic Pong game; any form of play that changes the basic nature of the game will not be in compliance with this fundamental rule and the infringing robot will be disqualified.

## 2. Competition Arena and Equipment

1. The playing arena is divided into 5 zones: the playfield zone, two paddle zones, and two scoring bins. A paddle zone is defined as the area below the top of the longitudinal court rails and not within the playfield zone. A 2" wide strip of red duct tape whose furthest edge is 10" from the edge of the scoring bin will mark the beginning of the paddle zone. (see diagrams below and [here](#))



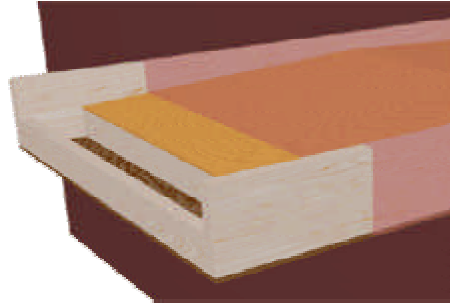
2. A single video camera will view the playfield from above and center. The standard [NTSC](#) video signal from this camera will be routed through a Radio Shack three-output AV Distribution Amplifier ([Cat. #15-1103](#)). One output will be routed to a video display device and the other outputs will be routed one to each contestant through two additional distribution amplifiers\* and through separate 75-ohm output impedance buffers ([Jensen Transformers VB-1BB](#)). \* - Optional for competing schools, but will be in place for final competition to guarantee isolation. (see diagram below):



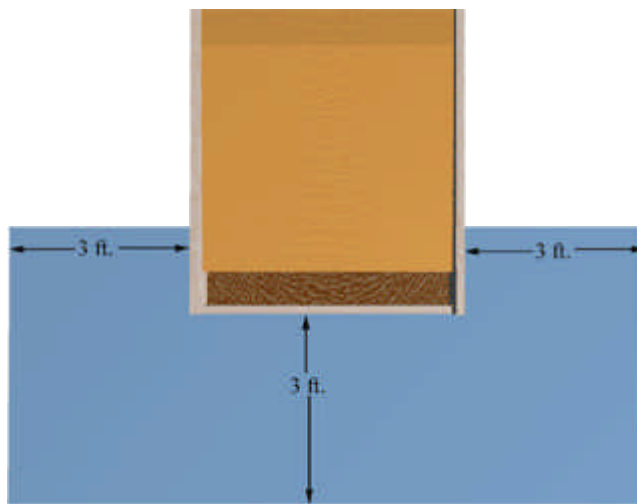
3. Contestants must be aware of and take into account the possibility of small imperfections in the table and variation of ambient lighting conditions (i.e. slight shadowing, etc.). These effects will be minimized as much as reasonably possible during play.
4. The ball will be a plastic practice golf ball (looks like a wiffle ball). These can be found almost anywhere (e.g. Wal-Mart, K-Mart, Target)
5. A power outlet strip will be provided at each end of the table for competitors' use.

### 3. Robot Specifications

1. A robot is any physical system that a competitor places on or near the competition table for the purpose of engaging in the contest..
2. During play, if a robot intercepts a ball, it must immediately return the ball either by:
  - a. Striking the ball, or
  - b. Capturing and immediately ejecting the ball
3. Delaying play by holding the ball is not allowed.
4. A robot must operate autonomously throughout the course of the match. Once the match starts, no further contact with the robot is allowed until the end of the match.
5. Any portion of a robot that exists within the paddle zone can measure no more than 8" between extreme points in the transverse direction.
6. Air tanks will be allowed as long as it is less than 100 psi., the tank is certified safe by the supplier, and the tank has a safety valve attached.
7. No portion of the robot can, at any time during play, penetrate the plane separating the playfield from the paddle zone.
8. No portion of the robot above the scoring bin may obstruct the ball's entry into it.



9. Outside of this area, robots may be of any size, but cannot at any time occupy any space above or on the playfield or extend further than 3' from the outside edge of the table (i.e. the sides and back of the table).



10. Any robot considered by the judges to be potentially dangerous (e.g. explosive) to spectators will be disqualified. In addition, no robot shall:
  1. damage the opposing robot nor hinder, in a manner dissimilar to Pong, its ability to detect the ball (i.e. spin hits are okay)
  2. emit any hazardous substances.

#### 4. Tournament and Match Rules

1. Teams will be randomly placed into double-elimination competition brackets.
2. Prior to the coin toss, the robots will be checked for safety compliance.
3. A coin toss will decide who will serve first. The calling team will be shown on the brackets. The team who wins the coin toss has the choice of either a) receiving the first serve or b) side of the table.
4. Prior to the start of the match, competitors will be allowed 5 minutes to set up their robot. *(This is to encourage the design of a self-contained robot)*

5. Serves, which originate from chutes at the center of the table, will always alternate from side to side on a fixed schedule regardless of which team scores.
6. The match will end once one of the following occurs:
  - . A 5 minute time limit has expired.
  - a. The 10 ball serving supply has been exhausted.
  - b. A robot has been disqualified or otherwise forfeits the match.
7. At the end of the match, the robot with the most points is declared the winner.
8. In the event of a tie, refer to section 2.5.2
9. A robot has 3 attempts to return the ball across the centerline of the table, if a robot fails to do so, the ball will be removed from play and put into its bin. If the ball cannot be removed from play (e.g. stuck inside a robot) then that robot forfeits the match.
10. A robot will forfeit the match for entering or extending over the playfield (i.e. penetrating the plane separating the playfield and paddle zone)
11. During play a robot will be disqualified if it does any of the following:
  - . Causing damage to any part of the table or arena electronics
  - a. Intentionally causing damage to the opposing robot
  - b. Altering the video signal provided to the other robot
  - c. Altering the ball in any fashion
  - d. Throwing off the camera calibration (i.e. any action that requires the camera to be recalibrated)
12. Flash photography is strictly prohibited during the matches.
13. Appropriate school identifications and IEEE logos are permitted on the devices, but sponsorship identifications are prohibited.
14. The Judges shall enforce the spirit of the rules in addition to specific rules.
15. Decisions of judges are final.

## 5. Scoring

1. Match Scoring  
Robots will receive 1 point for each ball in its opponent's bin. The robot with the most points at the end of the match is the winner.
2. Tie-Breaker Scoring
  0. In case of a tie at the end of a match, a two minute sudden death overtime period will be played. A coin toss will determine who receives the ball first.
    1. First team to score during sudden death will be declared the winner.
    2. Until a point is scored in sudden death, an additional ball will be added to the table every two minutes from the beginning of the sudden death round.

### 3. Table Description and Construction Information

The table is broken up into three major segments: the base, the playing arena and the camera tower. The list of materials and necessary steps for building each segment will be in the following sections of this document. All of the parts that are needed to construct the base, playing arena and the camera tower can be purchased from your local hardware/electronics store (Lowe's, Home Depot, Radio Shack, etc.).



Figure 1 – Top and Side Profile of Table

#### 1. Base

A base will be constructed to raise the playing surface off the floor. The base will consist of six legs and will support the weight of the playing field. Instructions on how to build the base can be found [here](#).

#### 2. Playing Arena

The playing arena is 8' x 4'. It consists of two robot areas on an angled playing field and two scoring bins. The playing field has a slope of roughly 2.5 degrees. Instructions on how to build the playing arena can be found [here](#).

#### 3. Camera Tower

The camera tower will be mounted above the center of the playing arena so that

the digital camera can be held motionless to obtain data. The camera will rest approximately 80" above the center of the table. It will be adjusted to view just the playing field, which is 5' x 3'9". Each robot will be given a direct video feed from the camera. More information on the camera tower is available on the [Camera Tower page](#)

#### 4. Camera and Adjustments

The camera used in the competition is the [Everfocus ET100AE](#) ordered from [Global Technologies](#). The camera specifications are shown on their website. This camera is offered at a discounted price to schools participating in the hardware competition. To obtain the discounted price follow [these instructions](#).

For the competition, the camera needs to be aligned and focused so different tables have standardized outputs for the robots. Instructions for adjusting and focusing can be found with the tower instructions.

#### 4. Contact Information

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