

“The Hunting Session”

IEEE SoutheastCon 2004

Hardware Design Competition

1. Introduction

The Central North Carolina IEEE Section will be your host for the 2004 IEEE Southeastern Conference in Greensboro, North Carolina. North Carolina A&T State University and Guilford Technical Community College will direct the Student Hardware Competition. The theme for SoutheastCon 2004 is:

“Engineering Connects”

We live in an increasingly engineered world. People of all walks of life depend on engineers to develop solutions to aid them in their day-to-day life. To produce systems that are truly beneficial to humanity, we must first strive to be connected to the needs of our society. For the IEEE SoutheastCon 2004 Student Hardware Competition, we have sought to develop a challenge that could be implemented in a realistic environment.

“The Hunting Session” will be held inside at North Carolina A&T State University. The starting end of the track will consist of a box, outlined by white tape on the track, where the autonomous robot will remain until the starting signal is given. At which time the robot will drive under a covered bridge to the code station, and receive information, in Morse code, detailing the order in which it is to hunt the targets. Then, the robot will proceed to hunt its targets in the order given, removing a metal ball from each target box. Once finished, the robot will travel to the parking area to deposit its catch into a small cage. Participants will be given 5 minutes to complete these tasks. The robot that can satisfy the requirements of the competition in the least amount of time, and with the fewest mistakes, will ultimately win. These are the current specifications as of September 21, 2003. Subsequent updates and changes will be posted at <http://www.guilfordtechrobotics.org> with the date of release as the revision number.

2. Rules

Description of the competition

For the sake of uniformity, the playing surface will be a 20' x 12' area of indoor/outdoor carpet. The exact carpet used in the competition is available from Home Depot, part number 632-075. The color is Sundance-Pine. There will be white lines on the track to lead the robots to all necessary locations. All lines on the track will be made with Nashua brand 2-inch wide, white duct tape, also available at Home Depot.

The competition will consist of four main tasks, as described below. The four tasks are:

1) “Ready - Get Set - Go ”

Participants will place their robot inside the starting area, which is a 2' x 2' area of the track. The robot will be facing a wooden covered bridge, which will be its “doorway” to the hunting area. The bridge will have a square, inside opening measuring 2' high, by 2' wide. The robot must travel under the bridge, without touching or bumping into it, to successfully enter into the hunting area.

An LED cluster (Electronix Express, part # 08LCR525079), consisting of 20 red and 30 green LEDs, will be used as a starting device to indicate to the robot that it may begin its individual run (the manufacture’s datasheet can be found here: http://www.elexp.com/a_data/08lcr525079.pdf). This will be referred to as the “traffic light”. It will be mounted in the center of the top member of the covered bridge, facing the robot. The height of the traffic light will be 2 feet (from the track to the bottom edge of the light housing). While the robot is to remain stationary, the light will have only its red LED’s powered. When the light turns green, robots will have 15 seconds to travel under the bridge and into the hunting area.

Note: A very similar LED cluster is available from Jameco: part # 150914.

The Robot must have an alphanumeric display unit (LCD, LED dot matrix, etc.) and needs to display the word “STOP” when it is stopped at the traffic light and the word “GO” once it receives the green light. The type of display used is up to you, however, it must be mounted on the top of the robot (facing up, or slanted at a maximum angle of 45 degrees), and its characters must be clearly readable, even in full sunlight.

2) “Get Instructions”

Once the robot has successfully entered into the hunting area, its next task will be to drive to the Morse code station and receive its instructions.

The Morse code station will be a wooden box measuring 2' x 2' x 2'. It will have an Infrared LED (Digi-Key part # QED123-ND) that will transmit, to the robot, the order of the animals it is to hunt. The LED will be mounted on the front vertical surface of the box (facing the robot) at a height of 1 foot. It will be mounted directly above the white line that leads to the Morse code station; ensuring that, as long as the robot is properly tracking the white line, it will be in alignment to receive the Infrared data transmission.

Another traffic light (LED cluster) will be mounted on the same surface of the box as the Infrared LED. The LED cluster will be mounted 2 ½” above the infrared LED. As the robot approaches, the traffic light will be green. When the light turns red, the robot must stop and receive its instructions. A braking tolerance of 3” will be permitted to allow the robot to come to a complete stop. The robot will not be allowed to touch or bump into the Morse code station. Once the traffic light turns red, the data transmission will begin.

The traditional Morse code system will be used. The name of each animal will be transmitted to the robot, in the order it is to be hunted (Example: DUCK, RABBIT, DEER). The sequence of the animals will be transmitted to the robot three times. The robot may leave the station after the first transmission, but before it moves, it must output, on its display unit, the names of the three animals, in the order they are to be hunted. The sequence of the animals will be randomly changed for each individual run.

The sequence will be transmitted in three separate 300 bps standard serial (UART, no parity, '0' is start bit, '1' is stop bit) transmissions, each five or seven bytes long, with a pause in-between each. A dash will be represented by a binary 1 (LED on), a dot by a binary 0 (LED Off). Each transmission will consist of the name of an animal followed by the sequence for full stop (period), one Morse character to a byte, with any remaining bits in each byte filled with the inversion of the last bit in the animal name.

Example: Duck. Deer. Rabbit.

Duck: -..|..|-.-|.-|.-.-

10011111,00100000,10101111,10100000,01010100 (pause)

Deer: -..|..|-.-|.-.-10011111,01111111,01111111, 01011111,01010100 (pause)

Rabbit: .-|.-|...|...|..|.-.-

01011111,01000000,10001111,10001111,00111111,10000000,01010100

This will be transmitted three times.

3) **“Hunting Stations”**

After receiving its information from the Morse code station, the robot may begin to hunt its targets. There will be three hunting stations, represented by three different animals (rabbit, duck, and deer). A decoy of each animal will be placed at its respective station. In order to successfully capture each animal, the robot must drive to the animal’s station, and pick up a 1-inch diameter chrome steel ball (McMaster-Carr part# 9528K33) from a wooden container. Each station will have a different colored metal

ball, and only one ball will be present at each station. The color scheme for the balls is as follows:

Rabbit – unpainted
Duck – blue
Deer – yellow.

The wooden container has measurements of 6”(l) x 3”(w) x 3”(h), and will be sitting on the track, aligned with the white line, at the front part of each station.

The stations will remain in their respective locations for the duration of the competition. The exact locations of the stations will remain unspecified, but will fall within the following tolerances:

- 1) Any of the four stations (Morse code, rabbit, duck, and deer) may lie between 1 and 5 feet from the central line (the straight line that connects the starting station and the parking station).
- 2) Clockwise, beginning at the “Start” (a.k.a. “Traffic Light”) station, the order of the stations will be: Morse, Deer, Parking, Duck, Rabbit.
- 3) The four stations may be offset from each other. In other words, the stations may not form perfect, 4-way intersections with the central line, but may be staggered somewhat. This is done in an effort to add an unknown factor to the competition and allow students to design a system that will adapt to any track layout that falls within the given parameters.
- 4) The central line will be straight, measure 13 feet, and will begin at the “Starting station” and extend into the “Parking station”.

Once the robot captures the last animal, it should display the word “DONE” on its display unit.

4) **“THE END”**

After the robot has captured all of the targets, it must travel to the parking station. This is a 2’ x 2’ x 3” area of the track almost identical to the starting station.

Once at rest and completely within the boundaries of the parking station, the robot must dispense each of the three balls into a cage located at the far side of the parking area. The cage is identical in size to each of the hunting station boxes. The final requirement of the robot is to output

“THE END” on its display unit. This will be considered the end of the individual run.

3. Robot Specifications

There will be only a few engineering constraints placed on the robots to allow students to exercise creativity in their designs:

- 1) Robots must be battery powered. No gas-powered robots will be allowed.
- 2) Robots must not be hazardous to human spectators. This would include expelling fumes, exploding, or running excessively out of control among other things. Robots that are deemed dangerous will be disqualified from the competition.
- 3) Robots must be able to fit within the Start and Parking stations and pass under the bridge. *The size restrictions ONLY apply in these three areas.
- 4) The robot may at no time destroy, damage, or alter any part of the track.

No weight limit is placed on the robot.

Non-compliance with any of the above rules will result in disqualification.

3. Point System

Robots will be judged primarily on the speed at which they finish the individual run, and on the accuracy they demonstrate in accomplishing each requirement of the competition. The robots will be given a maximum time of five minutes to complete an individual run. The criteria for judging points, corresponding to each of the four tasks, are as follows:

1) “Ready - Get Set - Go ”

- Moving within 5 seconds of the traffic light turning green. (+20 pts)
- Moving completely out of the starting box (+10 pts)
- Display “STOP” at red light, “GO” at green light (+10 pts for each)
- Touching, or otherwise contacting the covered bridge (-5 pts)
- Moving after 5 seconds, but before 15 seconds of the traffic light turning green (+5 pts)
- Not moving within 15 seconds of the traffic light turning green (Disqualified for that run)

2) “Get Instructions”

- Get to the Morse code station (+10 pts)
- Stopping within braking tolerance (3”) when the traffic light turns red (+10 pts)
- List the name of each animal on the display unit, in correct order (+10 pts for each)
- Physical contact with the Morse code station (-5 pts)

3) “Hunting Stations”

- Get to each station (+10 pts for each)
- Capture each target in the correct order (+10 pts per target)
- Capture any target out of the correct order (0 pts)
- Display “DONE” after capturing the last target (+10 pts)

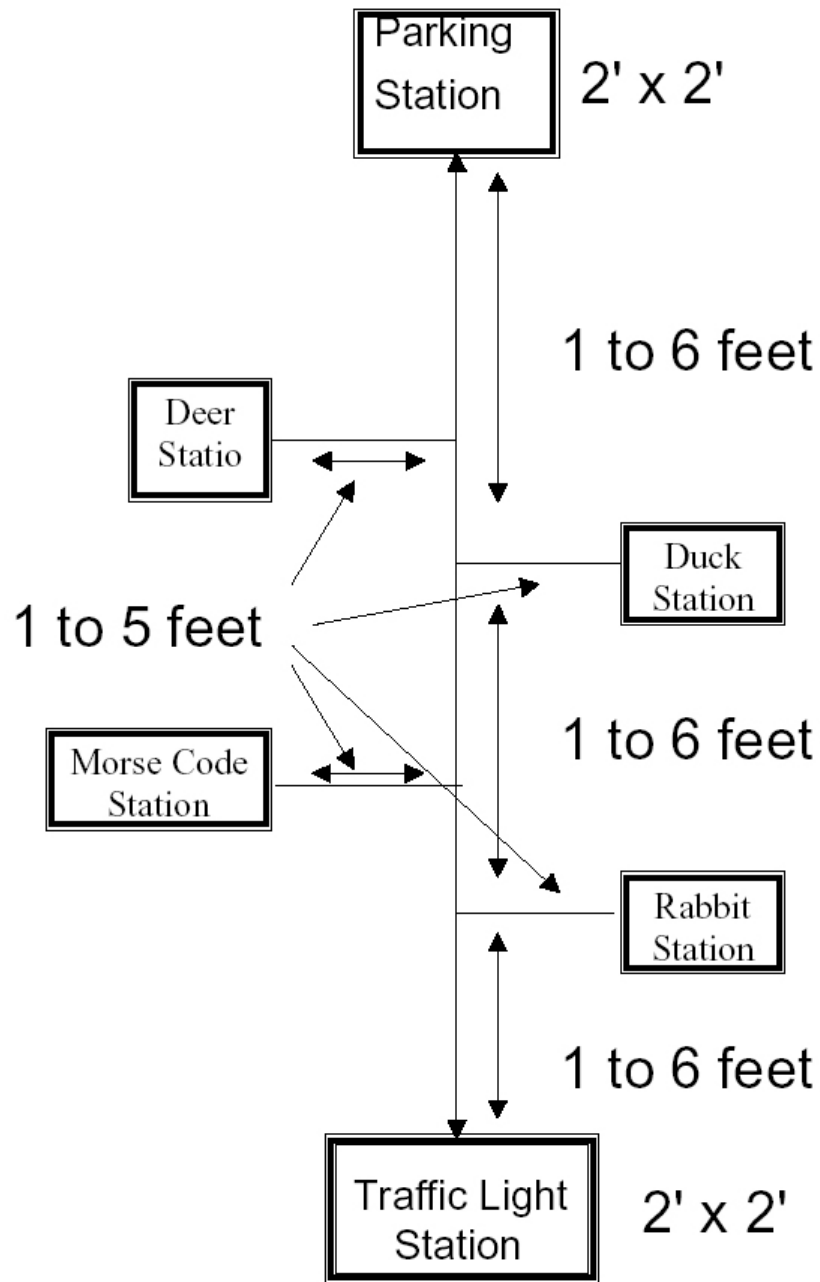
4) “THE END”

- Fitting completely in the parking area (+10 pts)
- Dispensing a ball into the cage (+15 pts per ball)
- Display “THE END” after dispensing all balls (+10 pts)
- Completing the individual run within 5 minutes (+10 pts)
- Remaining time, only if the robot completed the target sequence in the correct order (+1 point for each second)

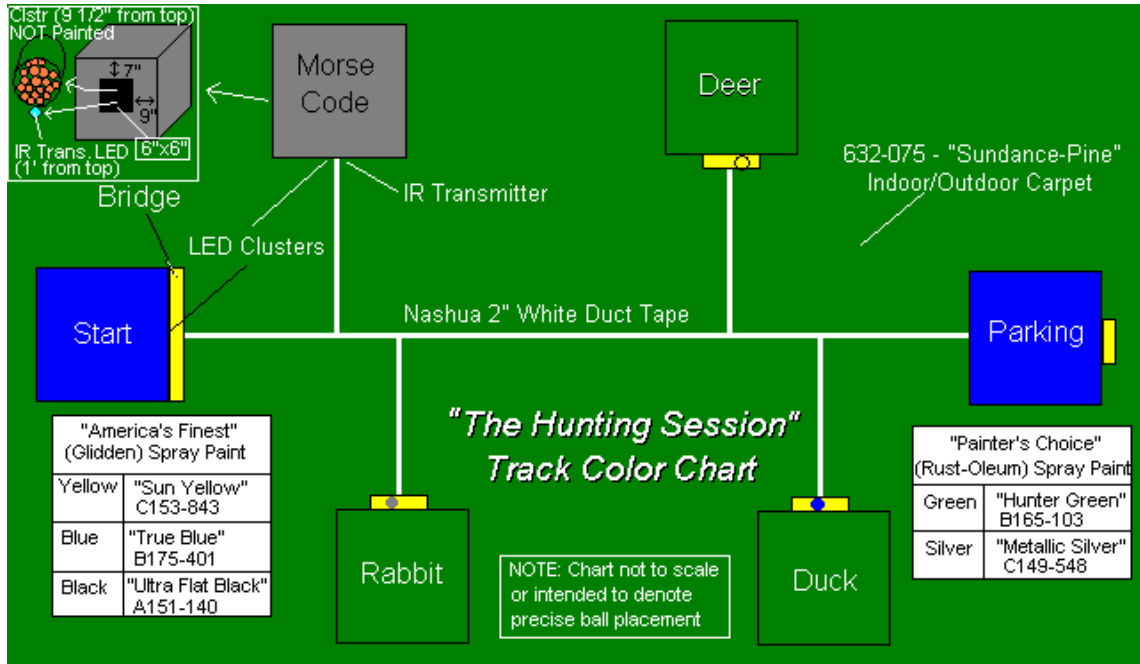
The competition will have three rounds. The top eight teams from the first round will advance to the second round. The top four teams from the second round (based on second round point totals only) will advance to the championship third round. The third round (again based on third round results only) will determine first, second, and third place finishes in the competition. In the first round only, each team will be given two individual runs, with the higher of the two scores accepted as the final score for the first round. Teams will have only one chance each in the second round and championship round. Good Luck!

If you have any questions concerning the competition rules please submit them here: <http://www.guilfordtechrobotics.org/faqs/ask.php>. All answers to questions regarding the competition rules will be posted in the FAQs area at the following web address: <http://www.guilfordtechrobotics.org/faqs/>
For issues that are urgent in nature and require immediate attention please email kateeb@ieee.org.

Track Layout Diagram:



Track Color Chart:



Revision History

09-21-2003

- Added page numbers to document.
- Added revision history.
- On page one under heading “Engineering Connects”, changed first line of second paragraph to reflect that the competition will be held indoors.
- Under heading “Rules”, first paragraph with heading “Description of competition”, part number and color for the indoor/outdoor carpet has been updated.
- Under heading “Ready - Get Set - Go ”, second paragraph, added web address for the manufactures datasheet for the LED cluster. The last sentence, changed “robots will have 10 seconds” to “robots will have 15 seconds”. Added a note for an alternate LED cluster with part number.
- Under heading “Get Instructions”, second paragraph, removed sentence, “The exact specifications and timings...” and added the Morse code specifications and examples in a separate paragraph.
- On page 3, updated first paragraph to include mounting distances for IR LED & LED cluster.
- On page 3, the Morse code example has been corrected to reflect the correct spelling of “Rabbit” there was an error in the spelling.
- Under heading “Hunting Stations”, note 1 changed, “1 foot and 6 feet from the central line” to “1 and 5 feet from the central line”. Also, added 2 more notes.
- Under heading “The End”, changed “This is a 2’ x 2’ area” to “This is a 2x 2’ x 3” area”.
- Under heading “Robot Specifications” changed “There will be only several” to “There will be only a few”.
- Added colored track diagram. Specifies colors to be used to paint the track.

11-23-03

- Morse code example has been updated to include a start and stop bits. Also the “R” in rabbit has been fixed.
- Under “robot specifications” changed note 3 from “Robots shall have a maximum starting size and ending size of 2’ x 2’ x 2’ in order...” to “Robots must be able to fit within the Start and Parking stations and pass under the bridge.”
- Updated contact information at the bottom of page 6.

11-26-2003

- Morse code examples for the the letter “R” in Deer and Rabbit have been corrected.