Robofest® 2007 Game Competition Challenge: "Miner Rescue"

Jan. 8, 2007 v1.31

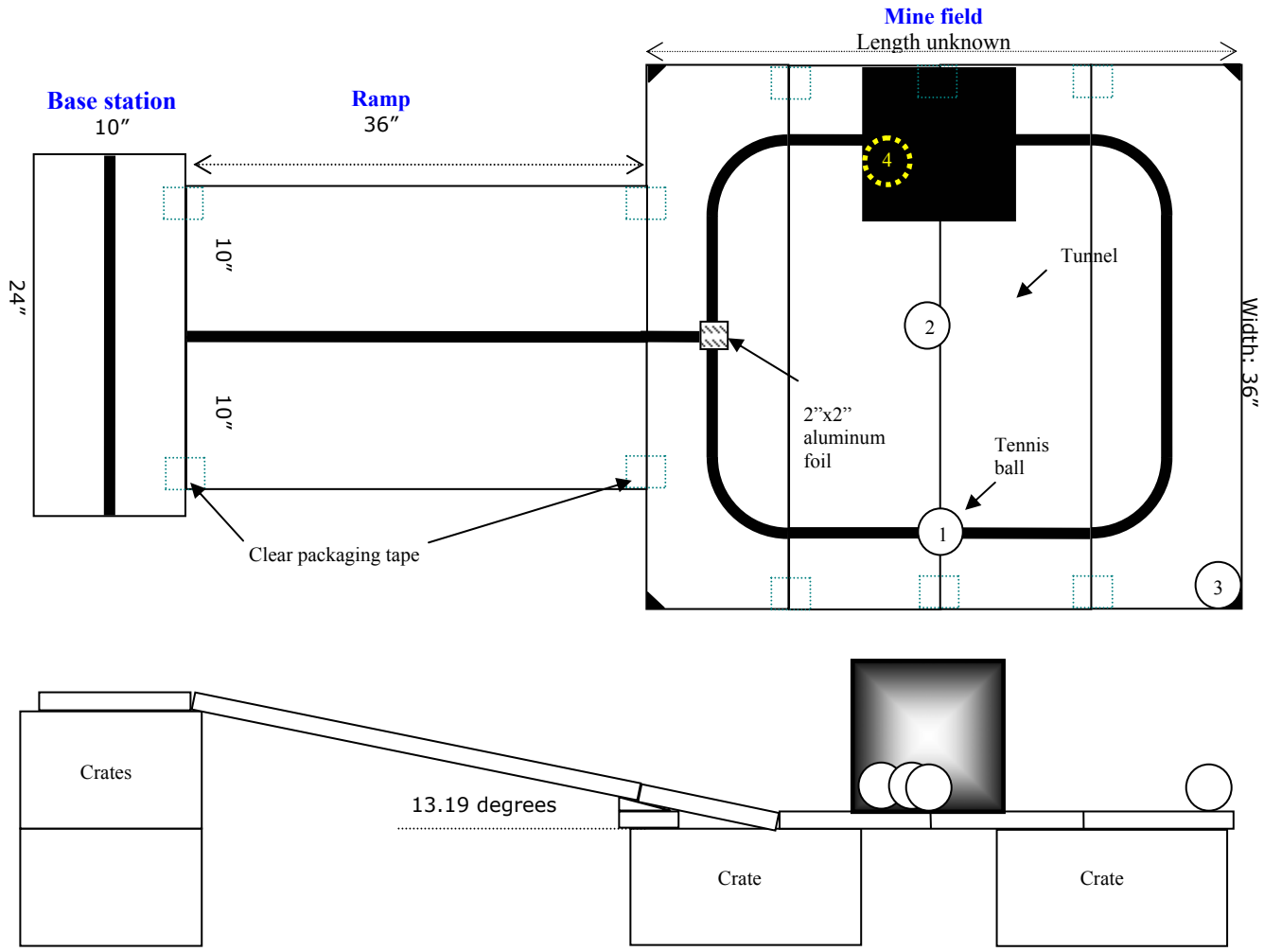

Figure 1. Playing field

I. Game Synopsis and Background

Coal is a very important energy source. 24% of all the energy used worldwide in 2003 was generated by coal. That percentage is expected to increase at an average annual rate of 3% through 2015. (www.eia.doe.gov/oiaf/ieo/highlights.html)

Mining coal can be a very dangerous and difficult job. Mining coal has led to life-threatening situations which are occurring in greater frequency. "Miner Rescue" features two autonomous robots being called to rescue four unconscious miners (represented by tennis balls wrapped in aluminum foil tape) trapped in a deep mine. The robots must find the "miners" and bring them to safety on the ground level base station.

II. Game Learning Objectives

The learning objectives of this game are to design and program robots to sense and search for objects, navigate through a partially unknown path, and to determine exact location of targets by detecting

landmarks. In addition, this game requires building a robot to drag, push, hold, or possibly lift objects and climb down/up a ramp. It would be beneficial, though not required, for two robots to exchange information with each other while executing cooperative rescue missions. Because the lighting condition of the competition area is unknown and lighting condition will change (for example, the dark tunnel), it is required that students master the ability to adjust their programs to work in various lighting conditions.

III. Game Rules and Points

- The successful rescue of a miner (a tennis ball) occurs when the ball touches or passes over the center black line on the base station *with the robot*. No throwing is allowed. It does not matter if the ball falls off board or not. It is recommended, but not required, that the robots stop at the black line.
- Robots can start at the same time and in any order, multiple times. The role of each robot is determined by the team students.
- Robots can be touched and modified by two human players without any penalty only in the base station area.
- If a robot goes crazy, it would be better to stop it to avoid additional loss of time. If the robot is touched outside the base area by the team members, the robot must be restarted from the base station. If the tennis ball was moved by the (crazy) robot, judges must reset the ball close to original location, ***after two robots are back to the base station.***
- Robots may rescue more than one miner at one time.
- One robot may pass miners to the other robot.
- Dropping any part of the robot on the playing field requires a restart. (Dropped part must be retrieved by the team players)
- Any remotes (IR, RF, Bluetooth, WI-FI) cannot be used.
- Communication between robots is beneficial and encouraged.
- The brightness of the competition area is unknown. Students should be able to change their programs or write programs to self-adjust on the fly.
- Anything not specified in this rule document can be decided by the Game Judges.

IV. Playing Field Setup

Tunnel

- Tunnel will be located on the left-side straight line of the mine field from the ramp (the same location as in Figure 1).
- Exact location and the opening/orientation of the tunnel will be unveiled on the competition day (one of 4 possible cases).
- The orientation/location of the tunnel will be fixed for the day of competition.

Balls (Miners)

- Balls will be placed by the Judges right ***after*** the game starts. Exact location of each ball is unknown.
- No. 1 is placed somewhere on the black circle line (not on the curve, but on the straight line).
- No. 2 is placed somewhere in the center of the circle line, not on the black line.
- No. 3 is placed at one of the two corners decided by the game MC. (The ball cannot be placed at the corner on the ramp. <u>*Balls are placed not on the black triangle.*</u>)
- No. 4 is placed somewhere inside the tunnel not on the black line. It is not touching the wall (Junior division).

Please note that the length of the mining field is unknown as shown in Figure 1.

V. Unknown Problem (UP)

- After opening ceremony, each team will be given a sheet with the description for the unknown missions. Sample sheets for both divisions are attached.
- The unknown mission will not be a part of the game missions, but instead it will be a discrete task.
- One of the game robots should be used to show the problem. You will not need to make any mechanical changes to robot, assuming you are using a light sensor facing down and a touch on your robot. (Bring both if you are not using)
- Especially for Senior Division, the unknown mission may be related to math and it will require a LCD to display at least 3 digits. (If the robot has an LED to display a digit, then students must know how to display the number from the least significant digits to most significant digit in succession for at least one second per digit.)
- The score and the rank of this UP will be used for tie-breaker.

VI. Robot Specifications

- There is no size or weight limitation. But the robot must be designed so that it stays alone on the base board with width of 10" before the game start signal is given. Also keep in mind that the width and height of the tunnel is 10".
- You must use only one robot controller (main CPU) for each robot.
- You may use any number of sensors / sensor types.
- You may use any number/type of motors/servo motors.
- You may use any material to construct your robot. You may use tape, glue, bolts and nuts, etc.
- You may use any programming language; we recommend an icon-based graphical programming language for the Junior division.
- One robot must have a LCD display for the Unknown Problem (UP). It must be able to show 3 digit numbers.
- The robot must have a mechanism to store more than one program. (one program for the game, the other for the UP). For any exceptional cases, the team must get permission from the Judge.

VII. Procedures to play rounds

After opening ceremonies and once pit is closed to coaches, each team will be given Unknown Problem Sheet (See attached sample). Each team is given 2 chances (rounds) in which to compete. There is no final match.

First Round

1. If your team has solved the unknown problem, and is ready to do the miner rescue game, line-up. Bring the unknown problem sheet as well as official score sheet found in the team envelop. Teams are not allowed to "hold" a place in line. The team in line must have two robots and two sheets. Computers are not allowed in the waiting line.
2. Give the two sheets to the game Master of Ceremonies (MC).
3. The MC will introduce the team name, ID, and organization name to the audience.
4. Then each team member introduces his/her name and role for 5 seconds. They have additional 10 seconds to introduce features of their robots. (for example, if 5 members, 5x5 +10 = 35 seconds total)
5. The MC will ask a question related to robotics. Sample questions are attached. The team should answer within 45 seconds including team discussion time.

6. Demonstrate and show your output of the unknown problem to the group of judges. However, judges will not tell whether the answer is correct or not. In order to encourage teams to try early in the *first* round, the first, second, and third teams that solve the unknown problems **correctly** will get extra points. Also, the unknown problem score and rank will be used for the tie-breaker.
7. MC will assign a game competition track. Only two players are allowed at the official playing field. At this time track judges will check robot specification. Usually, one minute will be allowed for setup before the game begins. The robot(s) should be placed on the base board. See robot specification.
8. The game play begins by pressing the run button of the robot(s), when MC gives teams start signal. MC needs to decide the location of the 3rd ball, left or right after the start signal.

Second Round

There is no team introduction, question to answer, or demonstration of unknown problems this round. Just line-up, when your team is ready to compete. Track judges will check robot specification again.

VIII. Game Scoring

- Two minutes per round are given to complete the game.
- Additional 5 points are awarded, if all four miners were rescued without any human help during the entire span of a game. (Note that it is OK to touch the robot in the base station area). Only when a team achieves a perfect score (100), completion time is recorded.
- Teams can earn the following partial points during the mission (see the scoring sheet attached)
  - Touching the miner
  - Coming out of the tunnel (only for Miner 4)
  - Moving up to the ramp: if any part of the ball is on the ramp area
- Partial points earned are retained, but cannot be re-earned, when the robots are performing the same mission over again after restart. Partial scores are defined in the attached score sheet.
- Team members are responsible for catching the robot if it falls off the course.

IX. Junior and Senior Divisions

Everything will be the same, except the following:

- Senior Division Unknown Problem will be harder including a math related problem
- The 4 balls for Senior Division will be placed at more difficult locations. For example, at the corner in the tunnel.

X. Game Division Award Rules

- Awards based on performance ranking are based on overall scores. The average of the two scores from two game rounds (70%), unknown problem score (20%), and presentation score (10%) will be used to determine the overall score. The tiebreaker is the rank of the unknown problem.
- Programming Awards will be given solely based on unknown mission scores.
- Presentation Awards will be given solely based on presentation scores that includes team and robot introduction, answer a question answers, and presentation delivery.
- One of the unique features of Robofest is that students may use any robot kit. However, some robot kits are more powerful than others. In order to provide a fair competition, host organizers will consider the type of robot kit being used and present Special Judges Award to those who were successful despite limitations of the robot platform.

- Additional Special Judges Award might be given based on other criteria such as creativity in mission solutions, etc.
- 25% of teams will win Awards. A team will win only one award. The competition organizer will monitor whether a specific robotic platform is winning all the awards or not.

XI. Instructions for Playing Field Construction

As shown in figure 1 and 2, several multipurpose white shelves will be used for the path and the mine. The dimension of the white boards is unknown except for the start board which is 10"x24". Two 10x36" boards are used for the ramp. The angle of the ramp is 13.19 degrees. The size of the collapsed mine area is unknown, but only one board connecting the ramp will be tilted.

Note that the actual width of the bookshelves you can buy from local stores in the USA is slightly less than the specified size. The thickness of the bookshelves is about 5/8". Standard black electrical tape (width of 0.75") will be taped approximately in the middle for the shelves shown in Figure 1 and 2.

The dimension for the curve shape is shown in figure 3. Also, the four corners rectangle area will be covered with black electrical tape as shown in figure 3. In figure 3, a is 9.8" (25cm).

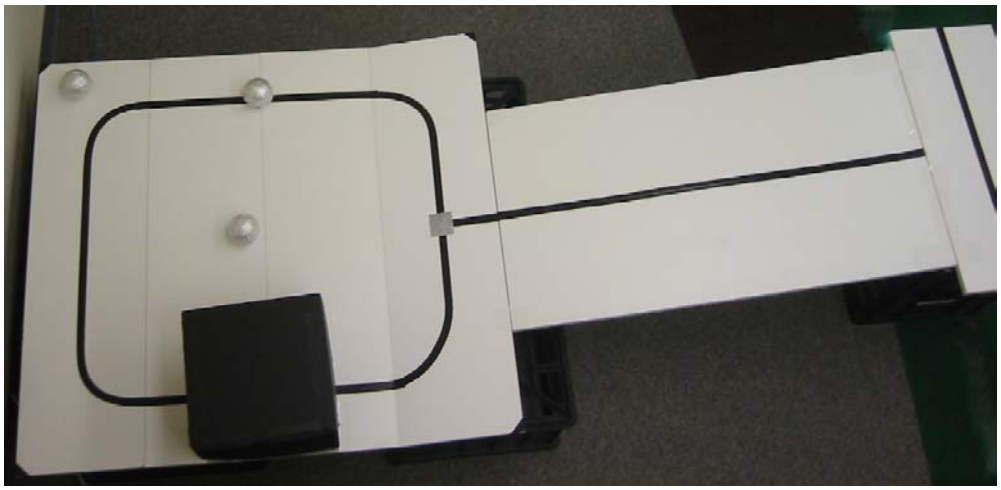

Figure 2. A sample playing field

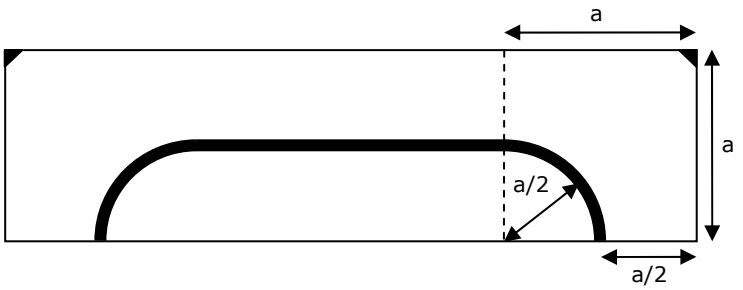

Figure 3. Curves

For imitating unconscious miners, the game will use standard tennis balls covered completely with aluminum foil tape.

The 1.88 x 1.88" aluminum foil tape square will be located on the black line at the intersection of the ramp line and the circle.

Note that there will be wider gaps between the base station board and the ramp boards than between other connecting boards. All the white boards will be taped together using transparent packaging tape (2" width, see Figure 1). If your robot is using skids, make sure they can slide over the tape.
The color of the crates under the first board does not matter. The color of the floor where the shelves will be placed does not matter, but should not be too shiny (reflective).

There will be a 20"x30" black foam board which team players may want to use to prevent sensors from detecting inappropriate light sources. The board, however, should not be used to guide the robot. The board cannot touch any of the playing field. The board cannot be placed over the playing field.

How to make the tunnel:
- 20"x30" black foam board is used (You can make two. see figure 4).
- The tunnel is taped on the board completely. It should not move during play. A judge may need to hold down the mine structure if a robot is too powerful.

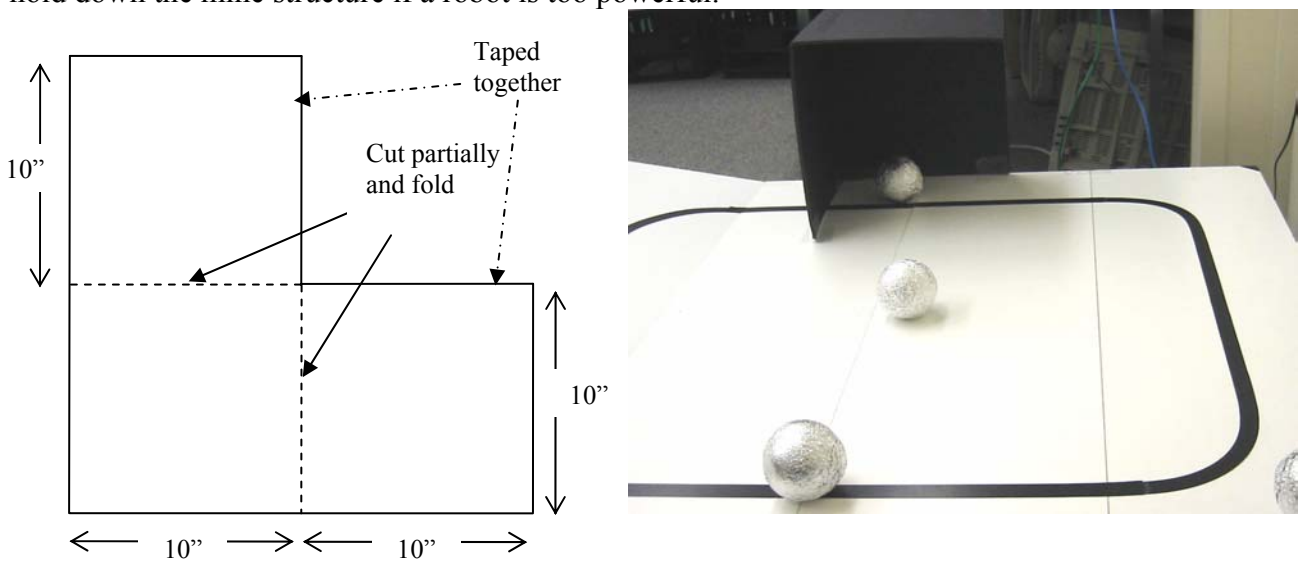

Figure 4 The tunnel (Mine structure)

XII. Suggested purchase list for one practice playing field

Item	Spec. / Description	Quantity	Estimated Unit Price	Estimated Price
All purpose white shelf *1	5/8 thick, Approx. 10"x 36"	6	$6.50	$39
All purpose white shelf *1	5/8 thick, Approx. 10"x 24"	1	$4.00	$39
Storage Crate (*optional*, you may use anything to put boards on) *2	Sterilite, 15 1/4"L x 13 3/4"W x 10 1/2"H, 1692, www.sterilite.com	6	$4	$24
Standard electrical tape	Black, PVC tape	1	$1.50	$1.50
Scotch Packaging tape	Clear, 3750	1	$3	$3
HVAC metal repair Aluminum foil tape *3	1.88 in x 50 yard	1	$6.98	$6.98
Black foam board	20" x 30"	1	$6	$6
Tennis balls	Olympic standard	4	$3	$12
			Total (*4)	**$72.48**

*1- Found at Meijer, Home Depot, or ACE Hardware
*2- Meijer or go to www.sterilite.com/stores.html
*3- Lowes
*4- without the optional storage crates

Note: You may setup the field on the floor. In that case you need only one crate. Most of the above materials will be reused every year.

Robofest 2007 Unknown Problem for Junior Division
(Bring this form to the On-deck circle, Staging Area)

Team (School/Organization) Name: _____ Team Number: _____

Team Name: _____ Robot Type(s): _____

A sample problem

Your robot will be placed on the base station board. Develop a program to go straight forward until it detects the edge of the board and stop. Display the light sensor value of the outside board on the LCD for at least 5 seconds. You do not need to follow the line.

Draw or write the program code below

Test your code and if your team thinks you are ready, take this sheet to the on-deck circle, staging area; Do not forget to bring your robots and a scoring sheet in your team envelop!

Do not write below

Time to test (Hour:Min) / **Rank**		**Test Result (circle one):**	*Worked perfect*	*Almost Worked*	*Worked some*	*did not work at all*
Extra Points (*)		**Score**				

(*) 1st: 3, 2nd 2, 3rd place: 1 when worked perfect

Robofest 2007 Unknown Problem for Senior Division

(Bring this form to the On-deck circle, Staging Area)

Team (School/Organization) Name: _____ Team Number: _____

Team Name: _____ Robot Type(s): _____

A sample problem

Your robot will be placed on the base board. Develop a program to go straight forward until it detects the edge of the board and stop. Then display the answer of the following problem on the LCD for at least 5 seconds. You do not need to follow the line.

What is the remainder when (24 + 25 + … + 9999) is divided by 133 *or* (24 + 25 + … + 9999) mod 133?

Draw or write the program code below

Test your code and if your team thinks you are ready, take this sheet to the on-deck circle, staging area; Do not forget to bring your robots and a scoring sheet in your team envelop!

Do not write below

Time to test (Hour:Min) / **Rank**		**Test Result (circle one):**	*Worked perfect*	*Almost Worked*	*Worked some*	*did not work at all*
Extra Points (*)		Displayed answer			**Score**	

(*) 1st: 3, 2nd 2, 3rd place: 1 when worked perfect

Robofest 2007 "Miner Rescue" Challenge Scoring Sheet

(Bring this form to the On-deck circle, Staging Area)

Division: Junior / Senior Team Name: _____

Team School / Organization Name: _____ Team Number: _____

Round: *Practice* *First* *Second* Track No.: _____

Game MISSIONS		**Point Value**	**Score Earned (only max score)**
Miner 1 (on the line)	Touched by robots	10	
	Moved up to the ramp board	15	
	Saved to the safe zone (Base Station)	**20**	
Miner 2 (center)	Touched by robots	10	
	Moved up to the ramp board	15	
	Saved to the safe zone (Base Station)	**20**	
Miner 3 (corner)	Touched by robots	10	
	Moved up to the ramp board	20	
	Saved to the safe zone (Base Station)	**25**	
Miner 4 (in the tunnel)	Touched by robots	10	
	Came out of the tunnel (completely)	20	
	Moved up to the ramp board	25	
	Saved to the safe zone (Base Station)	**30**	
Absolutely no human help was given during the entire span of a game		**5**	
If the mission is restarted, the score previously earned will not be lost. (Even if a team fails on a particular mission during the second try in a round, they will get the points for the mission **if they succeeded** the first time)		**Total Score Max. 100**	
		Time if score is 100	(sec.xx)