



2008 ASME Student Design Competition

Smart Robotics Challenge

Coordinator: Najib METNI, Ph.D.

Automation in construction is a new emerging field related to Robotics. Engineers, everywhere, are searching for new ways and techniques to automatically and efficiently transport bulk construction material through hostile environment and rough terrain.

You are challenged to design a small robot collector-transporter that could be guided by one person and could deliver moderate amounts of gravel from a specified loading area. You must demonstrate your design concept using a small working model of your device.

To prove the concept you will design a prototype system that will be used to collect gravel from a loading area and transport it through a pre-specified course and up a stair setup shown in Figure 1 and empty as much gravel as possible into a receiving container within a ten-minute time limit. In this ten-minute period you will setup your device and run as many trips as possible, and you can only empty it into the receiving container at the end of the track. To make multiple trips, you must return to the loading area through the same track. At the end of the trial, the gravel in the receiving container will be weighed and the team with the most gravel carried minus the penalties will win.

Constraint and Design Procedures

1. The device must be powered by readily available, over-the-counter batteries. A maximum of eight “AAA”, “AA”, “C” or “D” type (~1.5-Volt) batteries and a maximum of two “9-Volt” type batteries are allowed, for a total of ten batteries. If you use rechargeable batteries, then the number of batteries will be a maximum of two “9-Volt” batteries and ten “1.2-volt” for a total of twelve batteries; this way the total number of possible volts is the same. We will not get into whether they are in series or parallel. Either you use all rechargeable batteries or all standard batteries. There is no mixing. No other sources of energy are permitted; e.g. preloaded springs, charged capacitors, compressed gas canisters, etc. The use of rechargeable batteries is encouraged. No other types of batteries can be used. Battery packs are allowable as long as they are made up of the batteries above and the judges can verify this.
2. All devices must have a readily accessible and clearly labeled master shut-off switch.
3. The device must be controlled either through a transmitter/receiver radio link or through an umbilical cord. An umbilical cord controller may not contain any batteries. As an exception to the battery rule, a radio transmitter may have its own batteries, which are not included in the above battery restriction. The transmitter/receiver radio link may be any commercially available model

controller. All radio controllers will be impounded and shut off at competition, except during the team's run.

4. Mechanical forces on the umbilical cord may not be used to help propel or control the vehicle. The umbilical cord must be detachable from the vehicle using a commercial connector. The umbilical cord may not be a part of the supporting structure of the device. The umbilical cord may only be used to transmit the commands from the controller. A penalty of 15 percent will be assessed any time the umbilical cord is used to apply mechanical force to the device. If you are using multiple devices, you may have umbilical cords between them as long as all are controlled from a single controller.
5. Before the trial begins the device must fit inside a box 30cm x 40cm with a limited height of 30 cm. The device must be fully assembled as it comes from the box. However, there is one allowable exception: antenna wires may "spring up" on their own and remain upright without penalty, even if they extend beyond the size constraint as long as the device is controlled by a wireless radio transmitter/receiver pair.
6. Before the first bump, a square starting area measuring 80cm on each side. The starting area will be marked off by masking tape where the inside edges of the tape define the boundary of the area. The team members can work with their device in this area only. Before the trial the entire device must be completely within this area (except for any control umbilical cable and controller or antenna). Teams will be called to set up their device and will have ten minutes to place their device into the starting area, the device should be able to load the gravel from the loading area and deliver it to the receiving container as many times as possible.
7. If you touch your device, you must place it back in the starting area and a penalty of 15 percent of your total weight transported will be assessed for each incident. If for any reason the device falls off the bumps or stairs, this counts as a touch and is subject to the same rules.
8. The receiving container is located on the opposite end from the starting area, and is a 30cm by 15cm, and is 15cm high box or container.
9. The ten minute countdown begins as soon as your device is set into the starting area.
10. During the trial, the device must be completely controlled via the radio or umbilical controller; no other contact, interaction, or influence is permitted. One team member must control the device (either via wireless or umbilical) throughout the trial. When umbilical cords are used, additional team members are permitted to use poles or rods to guide the umbilical cords during the trial.

11. Throughout the trial, no team member is permitted to touch the track or the receiving container. If the team wishes to repair their device, they must do so in the starting area.
12. The cart is to climb the stairs by placing its weight successively on sequential stair treads. At any time after leaving the base surface (floor) the weight of the cart may not be supported by more than two stair treads. The stairs may not be bypassed by going directly to the top platform or dumping directly into the receiving container.
13. There are no guard rails or curbs on the track.
14. Practice runs will not be allowed on the actual contest track at the competition sites.
15. At the end of the trial, the gravel in the receiving container will be weighed and the team with the most gravel carried minus the penalties will win. In the event of a tie, the lightest device will win.
16. All clarification of these rules will be posted via the Q&A webpage (<http://studentsections.asme.org/ndu/smartrobochallenge.html>.)

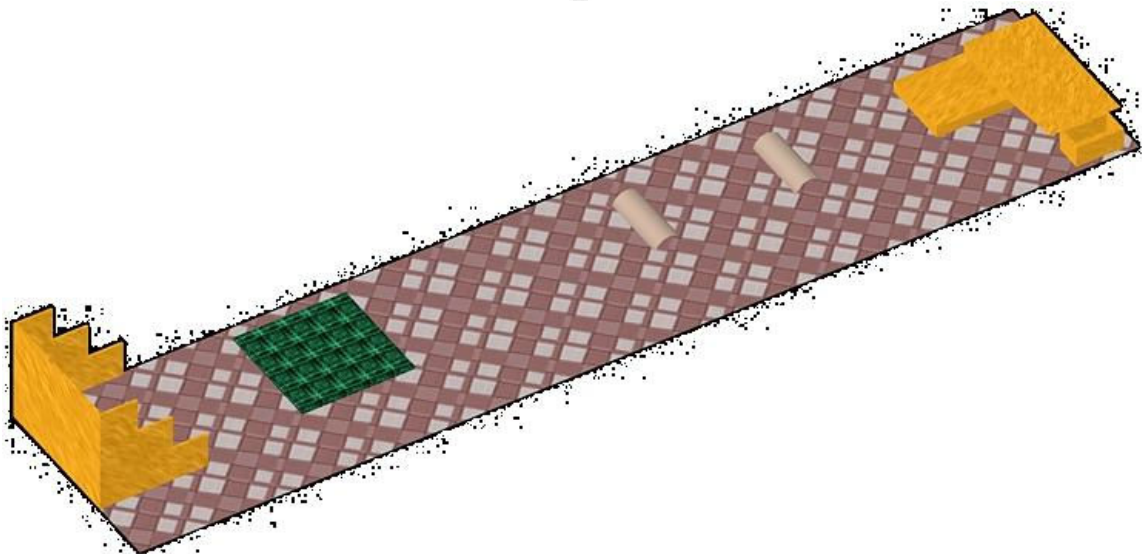


Figure 1: Track Main Design

Stair Dimensions: 50x50x8 cm – 2 stairs (as shown)

2 Main bumps: 20 cm wide by 8 cm high

The green area represents the starting area (80x80)

Tolerances are +/- 1 cm for the obstacles

Organization Procedure:

1. Teams can be formed of a maximum of 4 mechanical engineering students enrolled at any of the three universities (AUB, LAU, or NDU).
2. Participation fees are as follows:
 - a) 20\$ per participating team
 - b) Free participation fee for ASME student members
 - c) Non-ASME members have to apply for membership at their local student section and pay the required fees.
3. Every team will be given a hardcopy of the rules of the competition upon registration. Teams are also required to log into the competition's website for frequent FAQ updates. Every change in rules will be announced on the website.
4. Registration deadline is on April 11th, 2008; no team will be allowed to participate after this deadline.

The event will be taking place at NDU-Main Campus on Friday May 30th, 2008 at 10h30am

The Prizes are (per team): ***1st place: 2000\$***
 2nd place: 1500\$
 3rd place: 1000\$
 Best Design Award: 500\$
 The Prizes are offered by Smart!

Good Luck! May the best team/university win!!!