

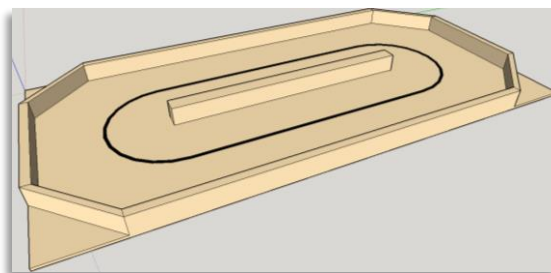
Robotics Design Challenge: ITE Camp 2015

Overview

The 2015 Introduction to Engineering camp had a “Design Activity and Competition” portion that provided an opportunity to complete an extended, multidisciplinary engineering project which culminated in a camp-wide competition. Camp participants were also required to give a short presentation at the end of the week describing their design, program, and a brief overview of challenges they may have faced during the course of the project. Specifically, the campers were to build and program a robot to complete as many laps around a two-foot by four-foot wooden “racetrack” as possible in a two-minute period. The robotics kits used during the project were LEGO Mindstorms NXT Education kits.

Track Specifications

The racetrack was built out of inexpensive, lightweight materials. The track surface is comprised of a ¼-inch two-foot by four-foot oak sheet. The border walls (and center divider) is constructed out of 1-by-2s. The border walls were screwed, not nailed or glued, into the sheet to increase the track’s durability. The angled corners form 6” right, isosceles triangles.



The two-foot long center divider is constructed from two 1-by-2s placed side-by-side and screwed into the base sheet.

Finally, black electrical tape was laid equidistant from the border wall to the center divider to form a line that the robots may follow.

Necessary Equipment

There were 51 camp participants involved in this activity. The UVa Computer Science Department supplied 15 computers and 14 LEGO Mindstorms kits, but only 11 computers and 12 kits were used in this camp. Participants were divided into 11 groups with one kit and computer per group. One kit was held in reserve to compensate for missing pieces.

It is recommended for all camp participants to save their programs on Google Drive or some other cloud storage service--ensuring a team uses the same computer every day of the week requires too much effort and it is *possible* for the laptops to wipe themselves on shutdown.

It is strongly recommended to have at least two race tracks as described above—three would be better. Constraining 11 teams to prepare and practice on only two tracks was a bit “cramped.”

Location

This camp was held in Wilsdorf 101 and 103. These rooms work well, but it would be nice to be in a similarly-sized room with speakers that may be connected to the computer. This would allow the presenter to show some robotics-related videos, as well as enabling music to be played during the lab/activity time (this was requested during the camp, but it was impossible to do in the Wilsdorf rooms).

If there were speakers, the instructors would have opened a survey for song suggestions and used Spotify during the activity time; this would make the campers quite happy.

Olsson Auditorium in Rice Hall (Rice 120) is a really great option; the folding tables, power outlets, and wide pathways make it ideal for such an activity.

Example Schedule

The Design Activity was allocated time during each of the 5 days of camp. On Monday through Thursday, one-and-a-half hours were allocated, while two hours were allocated for Friday's competition. The format used was similar to that of a standard science laboratory section; every meeting started with a 15 minute (or less) introduction to the topic at hand, then the students proceeded to work independently and ask questions of the instructors as needed.

	Monday	Tuesday	Wednesday	Thursday	Friday
Introduction	Project Intro What is a robot?	Importance of Sensors	Explanation of line following	Presentation goals	
Activity	Build Robot "Moving Forward and Turning"	Programming with Sensors	Competition preparation	Competition Preparation	Competition

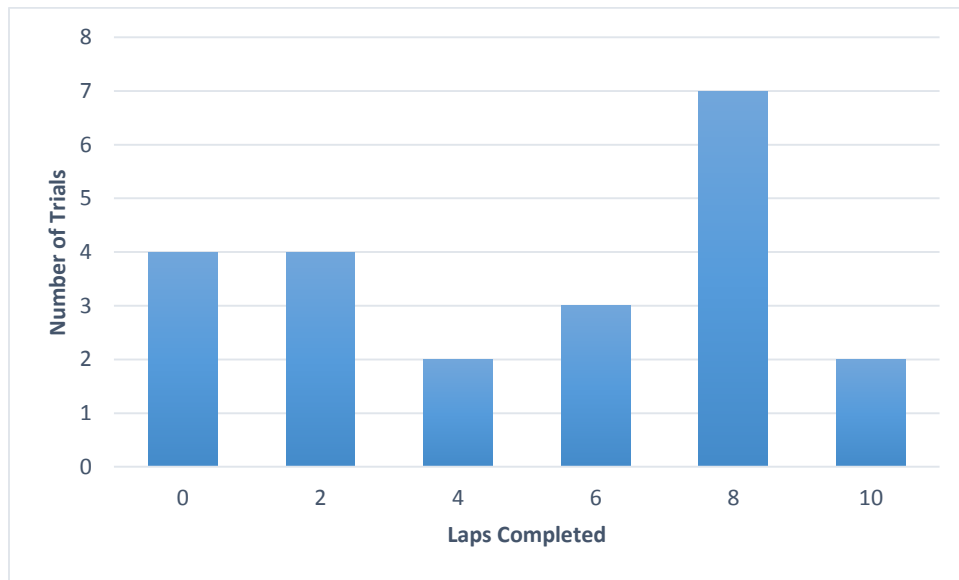
For both Monday and Tuesday, the instructors provided PDF handouts that walk students through some examples and provide some exercises to be completed. However, it appeared that these PDFs were not used or referenced by the participants. Instead, participants made use of online tutorials and the documentation built into the software.

All camp materials may be found on the Design Activity webpage and the associated GitHub Repository: <http://apnorton.github.io/ite-camp/>.

Competition

The competition was held on Friday morning before the end-of-camp banquet. Each team was given two attempts for their robot to make as many laps around the racetrack as possible in two minutes, and then given five minutes for their presentation. Because the CS Department needed their computers back, the presentations had no visual aids or PowerPoint presentation. Most presentations lasted about two minutes, so the competition was able to finish quite early.

The run results are below; each team was allowed two attempts:



Teams were scored based on the number of half-laps completed (quarter-lap granularity would be better) and ranked based on their best performing attempt. In event of a tie, the average number of laps completed was the secondary sort. Certificates were printed on bordered paper and presented to the first, second, and third place teams.

To prevent confusion, students ought to complete a form or sign a piece of paper at the start of the week with a team name and all of their teammates' names on it. Then, counsellors can transcribe names directly from that sheet to the certificates.

Improvements for 2016

If an undergraduate student is to be in charge of this section of the camp, offer them the option of being a full counselor.

It should take at least a full month to prepare material for a camp of this scale. Although it was pulled off this year with just three days' notice, an instructor should be secured earlier.

UVa currently does not have enough NXT robotics kits to run two robot-focused camps at the same time. Maximum team size for participation is around 4 or 5; anything larger and people start to get bored and rowdy. If one wants to run two such camps, they should either be staggered or reduced in size.

The newest version of the LEGO Mindstorms kit is the EV3 (not the NXT). If this new kit is being considered for the 2016 camp, two things are mandatory: First, everyone must have the same kit—it is *not* an option to have half of the camp work with the NXT and the other half work with the EV3. Although they are both LEGO robotics kits, they are substantially different in both construction and programming. Second, enough kits must be purchased to keep team size at or below 5 people per team.

Towards the end of the week, the participants should be asked to fill out a survey on how to improve the design activity for the next year. This would allow feedback in case the activity is just too hard for a single

week, or if everyone has already worked with LEGO Robotics and they find it boring. Bribing responses with candy will be effective.

It would be nice to have the end-of-year banquet in a room with a projector, screen, and sound system. This would allow the counselors to display a slideshow of pictures taken during the week, and would help amplify voices when handing out certificates and awards for the top teams in the competition.