ESAP

Three Weeks tha

by Hodaya Propp

In my freshman year of high school, I had a great time competing on my school's *FIRST* Tech Challenge (FTC) team. When the season was over, I wanted to keep going, so I started thinking about summer programs. My two older brothers had participated in the robotics program at the Engineering Summer Academy at Penn (ESAP)—formerly known as SAAST, Summer Academy in Applied Science & Technology—a few years before, and one of my teammates from school had gone more recently. They all thought it was a great program and encouraged me to apply.

After reading about the program online, I thought it would help me hone my skills in electronics and coding in particular, while gaining more experience in robotics design and engineering in general. I applied and learned of my acceptance about a month later.

When I arrived at the University of Pennsylvania in July, I found myself among a crowd of people who were just as excited about robotics as I was. One of our teaching assistants gave us a tour of the campus and showed us where we would be working for the next three weeks. Her eyes lit up as she described the things we would be doing and learning, and the excitement in our group was palpable. I knew I was in the right place and couldn't wait to get started.

Learning in 3D

The next day, my robotics classmates and I went straight to work. In the morning, our main instructor, Dr. Jonathan Fiene, gave a lecture focusing on CAD (computer-aided design), mechanical design, mechatronics, and electronics. In the afternoon, we got to apply what we learned: using SolidWorks, a CAD program, we each laser-cut a luggage tag. This was a typical routine for the next week: a lecture in the morning and a hands-on project in the afternoon, which we completed with the help of our teaching assistants, who were all Penn students. In the evenings, we sometimes studied for quizzes or completed problem sets, all of which reinforced what we'd learned and provided the foundation for what we'd do next.

Our projects each emphasized one aspect of robotics. For example, a project focusing on programming required us to program a small car to follow a line (which might sound simple, but, even with the help of the teaching assistants, it still took most of us until the evening to get our cars to operate perfectly). For a project focusing on design, on the other hand, we used CAD and a 3D printer to create a small race car that met certain design specifications. We had a printing time limit of 30 minutes, so we had to consider different elements such as the infill of the design and the number of layers used for the car's body to create a design that was both viable and fast to print.

Putting the Wheels in Motion

About halfway into the program, we were assigned our major project that included challenges in electronics, programming, and design. We were separated into teams to create a tank that would fight the other teams' tanks by firing shells at them or score points by firing at beacons. We had access to the laser-cutting machines and the 3D printers to build our tanks, which had to be functional within a certain size limit. My teammates and I decided to divide the responsibilities: Daniel would focus on the electronics; Eyan, on programming; and I handled the hardware.

We decided to use flywheels to shoot our shells. We figured out that smaller flywheels, which spin faster, could shoot the shells farther. Ini-

t Jump-Started My Future

tially we used flywheels with teeth, but we changed them to circles without teeth when that design gave us better results. We programmed the flywheels to spin and stop spinning when we flicked a lever up and down.

In addition to designing our tank, we had to solder our own electronics boards and create our own wireless controllers. We ran into problems early on after we soldered the whole electronic board only to find that when we used it, the board started smoking. This setback cost us an hour or two to fix, but we managed to replicate and re-solder the board properly and continue with the construction of our tank.

To allow our tank to sense the infrared beacons at which we needed to shoot, we positioned a few infrared sensors in a line with some space between them. Then we programmed our robot to scan the field back and forth until it sensed the beacon, which proved to be a successful plan. Though we changed the proportions of our robot as we progressed in our work, we worked together constructively and managed to complete all the tasks in the allotted time. In fact, we were the first group to have a functioning robot, the day before the tank competition.

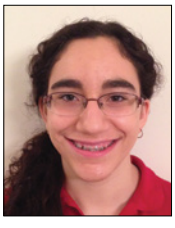
Unfortunately, our robot "bricked" on competition day, which meant it did not execute our programs and ceased working. Nevertheless, it was a great learning experience, and watching our robot function perfectly the night before was enough for me.

Going Forward

Participating in ESAP Robotics gave me a more extensive knowledge of robotics, but it also gave me an experience beyond academics. My peers and I glimpsed college life on Penn's campus as we lived in a student dorm and took advantage of the campus by playing tennis, exercising in the gym, or swimming in the university's pool. And on the weekends, we went off campus to enjoy outings such as a trip to a New Jersey beach and a tour of Philadelphia. All these activities gave me great memories with my new friends.

Fortunately, I was able to bring a lot of what I'd experienced home with me. Back at school, I contributed my enhanced programming and electronics skills to my robotics team. Not only did I create a SolidWorks assembly of our robot, but I was able to collaborate more effectively on the programming and just more confident with my skills overall. Our team made it to the FTC state competition and won two awards, and I felt that what I learned at ESAP helped us get there. It also inspired me to keep going. I spent this past summer interning at the Computer Science and Artificial Intelligence Laboratory at MIT, where, using my coding experience in C and C++, I designed a bipedal (spring-loaded inverted pendulum) model of human walking and running motion.

There is no question that the ESAP robotics program solidified my interest in pursuing robotics in the future. No matter what I do next, I know that I will continue to value ESAP as an important turning point that set me on this path. ■



Hodaya Propp is a junior at Gann Academy in Waltham, MA, where she competes on the math team, sings in the a capella group, writes for the newspaper, and is active in the drama club. She is also co-captain of her robotics team, co-head of the Yachad club (an organization promoting inclusion of individuals with disabilities), and assistant editor of her school's literary magazine. Hodaya's other hobbies include playing the piano, reading, and writing poems.

Learn more about the Engineering Summer Academy at Penn at www.seas.upenn.edu/esap.