NO BARRIERS LEFT: CREATING WITH TECH AND CURIOSITY

What once took months of trial, error, and expert help can now be solved in minutes—by a student, from a desk, with the right technology.

While working on my project and research, it suddenly struck me how much of a role modern technology tools have played in my journey. If I had wanted to read research papers a decade ago, I wouldn't have had such easy access to them as I do today. The boom of the internet has made such information readily available—right at our fingertips. With resources like Google Scholar, I could read about different kinds of robotic grippers, soft robots, etc., which helped me evolve my design for my project—a continuum gripper that can adapt to different shapes and sizes of objects and grip them with minimal programming and human interference.

But just reading those articles wasn't enough. I had so many questions regarding why a specific design was chosen, the limitations and advantages of different designs, the working of mechanisms, etc. I found that there were hardly enough articles on the internet that even discussed these topics, let alone resolved my doubts. And any information that was available was scattered across multiple sources. That's when LLM models like ChatGPT came into the picture. Suddenly, information synthesis and analysis became a lot easier. In seconds, I could get summarized information from various resources along with in-depth analysis and comments. Moreover, when asked for feedback on a technical design or help with debugging a piece of code, these models provided good suggestions and future directions to pursue. This experience almost made me feel like having a personal expert on demand, guiding me through my research project.

For a student with limited access to resources, technology has opened up a whole new world. And it's not just about virtual learning—technology has brought a dramatic shift in how we create physical prototypes as well. Just a few years ago, a person would have had to rely on pre-made parts or go through the tedious process of manual fabrication or factory production to build custom prototypes. Today, with the help of 3D printing, rapid prototyping has become much easier and more effective. We can visualize our designs using Computer-Aided Design (CAD) software, fabricate them quickly through 3D printing, and then actuate them using motors, sensors, and microcontrollers to create actual working models. Without large investments of time and money, we can now test the viability and effectiveness of our ideas. When ideas fail and assumptions break—which happens in every project—these tools help with rapid iteration.

When I built my own gripper, I needed gripper parts with very specific dimensions and requirements. With the help of a 3D printer, I could quickly realize and improve my design over several iterations. A task that would have taken weeks earlier, had I

outsourced the production of all these iterated parts, could now be completed in a few days with the help of 3D printing.

In the end, I had gone from a research idea to a functional robotic gripper which could adapt to objects of different shapes, sizes, and hardness in a month. Looking back, I realize how fortunate I am to be born in this era of technology—where so many powerful tools are accessible to us. With no barrier of entry left, all we need to bring is a bit of curiosity, passion, and initiative—and with that, nothing is impossible.

- Avni Mahajan XII-A