# Individual Reflections

## ENGR110/210

## Perspectives in Assistive Technology

## Winter 2024

This document consists of twenty-seven Individual Reflections from students who worked on assistive technology projects in the course. Teams consisted of two, three, or four students.

The names of the students, their team names, their project names, the names of the project partners (also known as community partners, project suggestors, or users), and the names of service animals have been redacted to protect their identities and maintain their privacy.

Any questions about these Individual Reflections, the projects, or the course can be directed to me.

The course website can be found at http://engr110.stanford.edu

David L. Jaffe
Course Instructor
davejaffe@stanford.edu

Reflecting on the journey through ENGR 110/210: Perspectives in Assistive Technology this past quarter has been both a challenging and promising experience. Our project team, "Accessible Basket Solutions for ▮▮," aimed to develop a storage solution for ▮▮▮▮▮, a wheelchair user with cerebral palsy. This experience has offered a comprehensive view of not only the design process, from initial background research and interviews to prototyping and user feedback, but also the personal relationship we were able to build with ▮▮. Each phase brought its unique value to the project, contributing significantly to our final design, and what we were all able to take from the course.

Interactions with ▮▮ and his family were integral to our design process. Engaging directly with ▮▮ and his brother ▮▮ provided invaluable insights into the daily challenges faced by individuals with cerebral palsy, particularly in terms of accessibility and independence. Guest lectures and discussions with professionals also greatly helped my engagement with the course, as they broadened my perspective, and offered new angles and considerations for the work we were doing. The brainstorming sessions within our team, with Dave, and of course with ▮▮ were pivotal in refining our ideas and steering the project in a productive direction. Among these interactions, the feedback from ▮▮ stood out as the most rewarding. Seeing him interact with something we had made for him and provide personal feedback meant much more than the typical sort of review engineers typically go through.

Looking back, one aspect I would approach differently is the prototyping phase. Our initial prototypes, though innovative, did not fully account for the complexities of ▮▮'s daily use. More iterative testing with ▮▮ could have provided earlier insights, allowing us to refine our designs more efficiently. Additionally, while the support from the teaching staff was invaluable, a more structured framework for user testing could have enhanced our design process. Perhaps a structured plan could be built out early in the quarter, similar to the ME170 capstone course, to help students ensure they're staying on track to meet their goals.

To future students considering Perspectives in Assistive Technology, my advice is threefold: immerse yourself fully in understanding the user's world; embrace iterative design and testing as foundational, not supplementary; and value each team member's unique perspective. The diversity of thought and relentless pursuit of improvement are what drive truly innovative solutions. The course is what it says it is; it offers new perspectives. Really take time and effort to consider and empathize with the new ways of seeing the world you'll be presented with.

Our project underscored the importance of a multidisciplinary approach to design, the need for direct user involvement, and the value of continuous iteration. Despite the challenges, the process was incredibly rewarding. It highlighted the potential impact of assistive technology on improving the quality of life for individuals with disabilities. Going forward, I would emphasize even greater user involvement throughout the design process in order to build something custom and unique to the user.

This course has been a profound learning experience, reinforcing the notion that at the heart of engineering is the desire to solve real-world problems and improve the lives of real people. The journey from concept to prototype has not only taught us about design but also about empathy, collaboration, and the resilience needed to turn challenges into opportunities for innovation.

ENGR110 Individual Reflection
March 18, 2024

I decided to take this course because for as long as I can remember I've been interested in how the social structures that shape the world impact people. I've primarily studied this along racial and gendered lines but not fully considered the social structures that make life more difficult for people with disabilities. It was amazing not only getting to hear engaging intellectuals speak about their engineering solutions for people with disabilities, but also to truly help understand and the solve challenges faced by another person. I didn't expect the level of depth in knowledge our team, ███████, was able to learn through the quarter. Collectively, we really got to understand the difficult situation ███ faces in her life due to the inequitable world around us. In regards to our team dynamic, a lot was very effective about how we engaged in our work. We didn't speak over each other and listened with an open ear for suggestions and comments. We were all engaged and respectful when meeting with ███ and diligent with work. Our group did often find it difficult to find a time to meet ███, often struggling to balance the schedules of a four-person team of upperclassmen mechanical engineers. A few of us felt that we were taking to many difficult classes at once to engage in the work as deep as we would have liked, but due to elective major requirements had no choice but to push through.

Another difficult was navigating the course website. The weekly summaries were very helpful to navigate the page for upcoming deadlines, but without clear navigation tabs it was hard to find what I needed otherwise. I'm very grateful for the opportunity to take this class. Ultimately, this class has made me interested in other ways to help people with disabilities. It seemed that engineering only provided some of remedies for people with disabilities and often cost and market constraints made a lot of solution infeasible and restricted. Monroe Kennedy III bionics sensor project, for example, even if successful would be too significant a cost for the average person with paralysis. I am quite curious in how we can spread awareness of how inequitable social structure affect people with disabilities through education to make inclusiveness a center point of our culture. But that's a more difficult challenge that engineering alone can't fix.

Instructor: Dave Jaffe
ENGR110
25 March 2024

## Individual Reflection

This past quarter, I spent a significant amount of time working on both my project and my understanding of assistive technology as a whole. I felt that during this process, what provided me the most value was collaborating with the ████████████. Olenka, ██, and ████ welcomed us with open arms and took the time to meet with us at least once a week, reviewed our ideas, provided feedback, and even introduced us to other experts in the community (like Barbara Butler). For me specifically, I learned so much about the amount of thought that goes into creating an accessible environment and how high the design standard should be. From ████, I learned about the importance of differentiating chronologically young people with mentally young people, and how many standard playground environments may only cater towards chronologically young people (children). From ██, I learned about the importance of creating activities that are engaging, fun, and educational. From ██, I learned about the importance of incorporating the nearby community into designs in order to maximize engagement.

Interviewing people for the project was also incredibly rewarding. I definitely had to muster up a considerable amount of courage in order to approach strangers at the ████████████████, but it was worth it to hear valuable feedback from both children and parents on our prototype. I also had the pleasure of interviewing ████████ from the Morgan Autism Center, which was an incredible experience. He brought a lot of refreshingly constructive criticism when looking at our prototype, and fairly evaluated how he saw the design fitting in at his schools. He walked us through how a student at the center might interact with our design and pointed out which parts could be triggering or overstimulating, and which parts could definitely attract engagement and productive learning. This was my first-time interviewing someone who was a professional in the autism community, so I felt that the entire experience was extremely valuable.

This was the first class where I have had the opportunity to work in the PRL. As a Symbolic Systems and Computer Science major, I have not had much experience with prototyping. However, I felt that this experience was honestly a necessary component of my college journey. I learned so much about laser cutting, CAD modeling, safe habits and precautions around tools and materials, clamps and saws, and much more. There was something about sitting down and actually creating something with my own hands that made me so much more proud of the final results.

If I were to go back and go through this process again, I would have told myself to explore all of my resources earlier on. I wish I had talked to ████████ earlier on, even as early as during the need finding phase so that we could have been more productive with what was great about our prototype and eliminated what was not so great earlier on. I was productive with starting the actual design process early, but I specifically wish that I would have started interviewing and connecting with experts earlier. In terms of course support, I worked closely with Henry, our class TA. He was absolutely amazing; he checked in with us either over email or over Zoom every single week, and even offered to provide preliminary comments on practice runs of our presentations. He was always extremely responsive over email, kind and friendly, and was overall just such a wonderful person to work with. One piece of advice that I would give to future students is to plan a schedule out in advance for the quarter! This helped my

group a lot. We set mini deadlines/milestones for ourselves so that we would stay on track throughout the quarter and not fall behind or get surprised by any big due dates.

I decided to take this class because my concentration in Symbolic Systems is self-designed and titled "Accessible Technology". While this is different from assistive technology, I felt that there was certainly a lot of overlap, and I learned a great deal about disabilities, accessibility, and assistive technology in general. My expectations for this course were that we would all end up with some sort of looks-like prototype by the end of the quarter. I was really impressed to see that many, if not all, groups were able to produce a device that actually functioned and could be used by their community partner. This class has stood out in the way that it actually focuses on working with and helping the community partner, and the community partner does not walk away from the quarter with empty hands.

Reflecting on the teamwork that happened this quarter, I felt that our team worked extremely well together (me, ▮, ▮). We had a great diversity of majors, skills, and interests, yet we all had the same passion for our project. We were specifically incredibly organized and communicative, which I believe are two of the most important features of working in a team. One challenge that we had was that there was just such limited availability in our schedules to synchronously meet, especially when all three of us wanted to work in the PRL together. We overcame this challenge by scheduling our team meetings and work sessions far in advance so that we could mold the rest of our schedules around our synchronous meetings. I would recommend that future students set up a recurring schedule for the quarter such that there are no surprises when a team member has conflicts.

Overall, I have felt that this course contributed greatly to my academic interests, but also my general knowledge and well-being as a citizen of the world. Moving forward, I know that I will be much more conscious about making inclusive, informed decisions, both in my everyday life and my professional career, and will continue to strive towards learning more about assistive technology.

Perspectives in Assistive Technology
David L. Jaffe

## Individual Reflection of ENGR 110: Perspectives in Assistive Technology

### Course Reflection

Participating in this course opened up a world of discovery and innovation that I was previously unaware of. Throughout the course, guest lecturers provided invaluable insights, but it was sessions with Joanna Weakley discussing exoskeletons, Erin Michelle Kunz on Brain-Computer Interfaces for Communication, and J. Kenneth Salisbury, Jr. showcasing The Third Arm Project that truly captivated me. Their expertise illuminated the boundless possibilities of assistive technology, growing my passion for this type of innovation.

One standout moment was the assistive technology fair, where I had the opportunity to engage with inventors and entrepreneurs who had assistive technology startups. The fair was a great combination of creativity and ingenuity, offering firsthand encounters with groundbreaking and forward-thinking solutions. It was a great experience to converse with individuals pushing the boundaries of assistive technology and first-hand witnessing the impact of their innovations.

### Team + Project Reflection

Working with the ███████████████ and ████████████ was an enriching experience. Growing up having worked on some of ████████████ playhouses made contributing to the playground feel nostalgic and filled me with a sense of purpose and fulfillment. Furthermore, ██████'s unwavering support and accessibility made the collaboration seamless.

While I would say that we had a successful project, our project journey was not without its challenges. Initially, our team lacked clarity, leading to several iterations of our project idea. This uncertainty resulted in a rushed concept development phase. Furthermore, the dynamic within our team posed its own set of obstacles. While Maria's proactive approach drove progress, it occasionally hindered collaboration and stifled creativity. Her assertiveness often dominated decision-making, sometimes without consulting the team.

Despite these challenges, our team excelled in communication, proactively testing and refining our ideas. █████ and █████ played pivotal roles in facilitating discussions and maintaining group cohesion. █████'s creativity injected flair into our project, enhancing its overall appeal. Nejat was a great support throughout the duration of the project.

Side note - I'm grateful for the presence of ████████ and ██████ in the course. Although they weren't directly involved in our project, their contributions as resources and sources of inspiration were invaluable. Their feedback and positive energy propelled us forward, fostering a supportive and more energetic learning environment.

In retrospect, ENGR 110 has been an enriching experience, shaping my perspective on assistive technology and collaboration. The course not only broadened my understanding of the field but also instilled in me a deep appreciation for the intersection of innovation and accessibility. As I embark on

future endeavors, I carry with me the lessons learned and the connections forged, eager to continue making a meaningful impact in the world by designing and creating with accessibility and "assistiveness" at the top of mind.

ENGR 110
04/21/24

My interests in this Perspectives in Assistive Technology were initially catalyzed by seeing this class as an elective for my major in Science, Technology and Society. To me my degree means to approach and see the world as a field of opportunities for skilled action explored with an interdisciplinary lens. And this class presented an opportunity for me to learn about the world at large through a different perspective to me, through the perspective of humans with disabilities. This is a lens very close to my heart. Growing up with an uncle with down syndrome, it is important for me to intentionally learn and educate myself on the lives of those with disabilities and how to be the best ally I can.

During the class where we heard from the different speakers of project collaborators for the quarter, I was immediately drawn to the ████████████████ team. I grew up in Nigeria, in an environment where people with disabilities are shut out from the crux of society and looked down upon. And so, the thesis to build a space where all humans, regardless of disability, age or size, can feel welcome, really resonated with me. When we would take my uncle out to play or for different activities in Nigeria there was not a space in which we all felt included and equally treated.

"████████████████, a non-profit organization headquartered in Palo Alto, California, creates multigenerational playgrounds, parks, and programs for more inclusive communities. In addition to a turnkey design-build model, licensing opportunities ensure the ████████ brand, designs, and programs are catalysts for kinder and more inclusive societies everywhere. ████████ invites you to join the movement toward a brighter future where inclusion means everyone."

During our class session with Gayle Curtis, he walked us through the process of creating assistive technologies by understanding the problem. We begin by interviewing and talking to people, some key tips here were to: ask about goals & what's important, avoid leading questions and finally to ask them to show as well as tell. We must also be careful not to generalize and to take into account that what people say is often different from what they do.

On our first visit to the playground the first thing we noticed were the pieces of cardboard laying around the park. My group and I were immediately fascinated by what people were using these pieces of cardboards for and why they were being used? After interviewing some of the users of the cardboard at the playground, we concluded that they were being used to slide down the metal slides and grass mounds and that they were bringing in these pieces of cardboards to the playground from their home.

Then we went into observing, Gayle Curtis, encouraged us to observe actual activity, approximate the design target, immerse ourselves in the context and to: shadow, record, review whilst collecting a rich description of the activity. And so on that same day we observed lots of children go down the slides on the cardboard, we went down the cardboards ourselves, we felt the cardboard, took pictures and spoke to the ████████████████ team on how they felt about having these pieces of cardboard around the park. Our key takeaways were that: the kids were using the cardboards to go down faster; the parents felt the burden of bringing the cardboard to the playground and the ████████ did not appreciate the aesthetics of the cardboard around the playground.

Following these observations, we began the process of prototyping, during this we followed the design thinking process of empathize, define, ideate, prototype, and test. We iterated from using pink foam to

EVA foam for the following reasons: the pink foam was not flexible on bumps and was also slow, the handles were fragile, there was excess friction from vinyl and finally we also realized we would need to design a strategy to slow down and stop material at bottom of the slide. We also had an initial thesis to have a cart that would include members of staff from Ada's Café but after testing our cart in the playground we concluded that there was low attraction and attention to the cart and so we decided to focus on the slide idea.

It was an incredible experience to collaborate with the ████████████████ team, being able to learn from all their expertise and generosity. I am excited for their expansion in Singapore and into New Zealand.



Final version of our *Magical Mat*

And beyond the scope of our Dreamcatchers project I learnt so much about different assistive technologies and how to scale them.

For example, during the Assistive Technology Faire in Week 7 I was fascinated by the 911 Finder Cellular Watch - 911 Tracker presented by Chuck & Susan Roedel. The product offered was a watch which uses a patent message for a three-way call between a caregiver, the watch and 911. Some of the features include a watch that can detect a call and a caregiver decides if they need the help of 911 to determine whether to generate a three-way call, the watch calls to the nearest caregiver. And so benefiters would include people with Alzheimer's.

And also hearing from Sha Yao about the product she founded called Eatwell it was interesting to understand how to take a product to market and how to think about partnerships with distributors.

I was also very inspired from our session when we heard from members of the Stanford community with a disability: Sydney Barta and Bhavya Shah. Learning about their experiences at Stanford and how they have made the best with their contexts was very powerful.

Overall, in my recent endeavor to enhance my understanding of assistive technology, my exploration ventured beyond the conventional classroom setting into the playground of experimentation as well as community-based learning. With a fervent commitment to delving deeper into the subject matter, we embraced a culture of rigorous testing and the exploration of various materials. We were sufficiently guided by the unwavering support of our dedicated teaching staff, Henry and Dave, who provided invaluable resources such as weekly check-ins, accessible office hours, and comprehensive website instructions supplemented by slides and lecture recordings. Through this immersive experience, we gleaned profound insights into the intricacies of assistive technology, embarked on a journey of research exploration within the field, and gained invaluable perspectives from personal encounters with disability, debunking common misconceptions along the way. This class has truly been a beacon of enlightenment, fostering not only academic growth but also empathy and understanding for humans with disabilities, thank you so much.

Last summer, my friend said she had an idea: build an all-terrain wheelchair for her uncle. We were excited about the possibilities, especially making it fly like a hot air balloon. She also told me about a class where teams build devices for accessibility, and we decided to take it together. Months later during course enrollment, she told me she couldn't take the class this year. I decided to go ahead and enroll. I had already gotten excited about the new fabrication techniques I could learn in this class, and I wanted to see it through.

Initially, I was reading through the possible projects, and I was interested in the ████████ ████████. For years, I've been wondering how we can make playgrounds more fun for people of all ages. When I was younger, my family traveled a lot, and I saw how other countries were doing much better than the US in this respect. Last summer, I accidentally discovered ████████ while walking around the park, and it immediately caught my attention. It was spacious, colorful, and had activities that anyone could engage with.

Then, the day came to email Dave with my chosen project and list of teammates. A student came by my table and said most people had already emailed, and we needed to decide in the next few minutes. She wanted to do a creative expression project. I assumed ████████ was a popular choice, and given the situation, I agreed to join her team for creative expression. Thus, began our journey to find a project suggester in the area.

We met with the Bing Nursery School and two adult wheelchair users. Our team talked about building rotating easels, paint dispensers for wheelchairs, devices to limit the need for fine motor skills in woodworking, and many more ideas. Then we found ████, a Stanford student who uses a wheelchair. We asked her about her day-to-day life, and she shared that the most useful thing we could make would be a new catheter bag. This was disappointing news for me. I wanted to build something! Something with moving bits that required lots of CAD and looked "science-y". That's when I reminded myself that the main idea of the class is to assist someone. Our priority needed to be meeting their needs, not ours.

While all of this was happening, I was learning from guest speakers about their careers and lives with assistive technologies. I learned how to use language that destigmatizes people with disabilities and how to imagine a world designed for everyone, not just the majority. I learned about cutting-edge research as well as small adjustments that are making massive differences. I learned about why some new technologies are able to work for people while others are forgotten in the back of the closet. I was determined to make a bag that would actually be usable.

The weeks that followed were full of challenges. Based on ████'s requests, I knew the bag should be black, able to hold weight, fairly rigid, and easy to open. I had some sewing experience but nothing to this extent. Prototype 1 followed an online pattern and taught me how bags are sewn. I explored around and found the Textile Makerspace next. The employees there helped me refine my pattern design and think through the order of what to sew. Prototype 2 was exactly what I wanted it to be: functional, camouflaged, and big enough to hold a laptop and jacket. I went to proudly show it to ████. This was when I learned another major lesson. Sylvia said it was much bigger than she needed, it was still too flimsy, and the lip needed to cover the bag significantly more. I had assumed she would want the biggest bag that could fit under her armrest, but Sylvia wanted it to be unassuming and simply fit her catheter. I realized I had been designing for myself again and reoriented my mindset to meeting Sylvia's needs. I also loved how Sylvia was willing to be upfront about how we could improve.

Another challenge was taking on the sewing by myself. My teammates were interested in sewing but had no experience, and we agreed it would be easier to have one person sew instead of coordinating to transfer the bag of sewing supplies between us constantly. After a few weeks of this plan, I could tell I had learned a great deal about sewing neatly and quickly. I could also feel the strain of squeezing in sewing time between my other obligations and projects. It would have been nice to have teammates more involved, even if only one of us could be physically sewing at a time. Being able to discuss ideas and have company in makerspaces always improves project experiences. I am grateful I got to improve my planning and sewing skills so quickly however, and my teammates did a sufficient job preparing the majority of presentations and keeping us on track with assignments.

If I could repeat the experience with what I know now, I would have been more proactive about finding a team who wanted to do ████████████████. Although I am now grateful for getting to work with ████, I know I generally need to improve my willingness to take initiative for my interests to be prepared for the workforce. On the other hand, I also see how finding our own user was a growth experience. We learned how to match our abilities and project constraints with a real-world gap and got practice reaching out to places we saw potential. I actually think finding a user would be a fantastic experience for everyone taking the class in the future, although it did mean that we had a lot of prototype work to do near the end of the quarter. We're still finishing up the last touches, but I do think it would have been possible to finish on time with better teamwork and time management. I definitely could have spent more time sewing as soon as we decided what to do for ████. I tended to trade efficiency for neatness while making lower fidelity prototypes that don't require perfection. When I explained the 3D printed connections designed to look like film cameras, most people said it sounds cool but had a hard time imagining it, including my own teammates and ████. Having better design sketches is something I want for future projects.

A common conversation starter in Room 36 is "What are you making?". People tended to be more interested than I expected in our bag. My friends also heard a lot about this class and were always excited to see the finished project. My family came to town the last week and loved coming to class and seeing everyone's presentations. My younger sister in particular said we all inspired her to change the world with one small thing for one person at a time. I like to imagine a world where we all do the same.

## Individual Reflection

I heard about this course through a friend when I asked about recommendations for a course that could help me fulfill requirements for the STS major. I'm especially drawn to human-centered design and social impact, so I knew I wanted to contribute to working on helping others through assistive design in ENGR 110.

I was pleasantly surprised by the range of diverse projects, companies, and careers that were involved with supporting assistive technology as I heard from various guest lecturers this quarter. The panel featuring fellow Stanford students who depend on assistive technology resonated with me the most as it helped show a more detailed look into the experiences and lifestyles of those with a disability.

It was a new and challenging experience for me to design with one specific user in mind at first but it was especially rewarding to see how we could make a direct impact by focusing on the needs of one person who would be using our product. I appreciated the process of working with an individual user to identify an issue and iteratively revising a product through feedback & testing with the same user who the product is intended for. My team and I are especially grateful for the funding that makes this course possible because like many other teams, we had to purchase materials that were key to creating an improved prototype. I think it was especially helpful to work with community organizations like the Haas Center or ███████████████████. They have many connections and resources that could be very helpful to students, but we also learned a lot from their work as case studies.

With my team, I had never worked with the members before and I didn't really know them before this quarter. I've always been anxious about working with people I'm not too familiar with, but it was very gratifying to collaborate with new people and engage with fresh perspectives. Overall, I think my team members were good at communication and being proactive about seeing through whichever tasks they were responsible for. It helped my team's progress to meet often with our user for feedback and we prioritized incorporating their suggestions as best we could. Moving forward, I would want to interview our user more often to better understand how a prototype could be improved.

Our project's focus on creative expression and accessibility was an exciting one that I knew I wanted to pursue since I'm passionate about the arts myself. However, it was challenging given that the prompt was more open-ended, and we had to do our own research into looking for a user. It took us some time to identify a user who would be compatible with the scope of this project which, unfortunately, may have set us back compared to other teams who were already working with a specific user from the beginning. In the future, I think it would have been valuable to work with an organization already involved in this area so there is some preexisting scaffolding to work with. Setting that aside, being able to support other people's creative passions and make art more accessible was truly an enriching and unforgettable opportunity for me. Often, art is overlooked despite its correlation to positive mental health and power to help people explore identities and stories It was inspiring to learn about how people's creative drives still shine through in the face of adversity. I learned a lot from Sylvia as well as the research process since I hadn't been aware of how the marketing of a catheter is predominantly aimed toward a male demographic. Although I spent significant time with user need-finding one-on-one, I also learned a lot about what it takes to market these projects and consider what scaling them for a wider range of users would look like.

Dave Jaffe
ENGR110
March 18th, 2024

Individual Reflection

I heard about this course when looking through the Mechanical Engineering BS electives. I wanted to focus my electives in design, and the CARTA reviews made it seem like an amazing opportunity. I was attracted to the course as it's a rare chance to explore accessible design in mechanical engineering and also to satisfy my curiosity in biomedical device design. My expectations of this course were to work on a project with my team, produce a high-quality item, and leave with a better understanding of what designing for accessibility looks like. All of my expectations were met, and even surpassed! I have left this course with an eye for inaccessible design. When walking in SF, or even on campus, I notice all of the curb cuts that are not well done and would pose problems to wheelchair users. I also began thinking about places like the PRL and how inaccessible that space is. It seems like you would be unable to do courses like ME103 if you were a wheelchair user, which makes the majors of Mechanical Engineering and Design inaccessible as a whole. Which leads into the overall message I've gotten from the class and that is that accessibility is much larger than just an accessible physical space, and that assistive technology is everywhere, and we all benefit from it, like those curb cuts.

Focusing in on the teamwork aspect, team meetings and allotting tasks seemed to be the most effective thing we did as a team. I think that not being able to visit ▬▬ frequently was quite ineffective, because every time we met with her, we better understood what she wanted out of the bag and understanding sooner would've saved us a lot of time. I really wish I could have gotten to meet and talk with Abby more, her perspectives and accomplishments, even beyond accessibility were truly interesting and will stay with me beyond this course.

In terms of our design process, I think that the most valuable aspects of this course were interviewing our project partner, background research, and fabricating/testing our prototypes. Interviewing Abby gave me a lot of perspective on not only what our project was aiming to assist with, but also the difficulties in navigating the world as a person with a disability due to the design and the lack of consideration designers gave to wheelchair users in this specific case. Unfortunately, I found that hearing from different professionals and users had a minimal impact on our design due to the 10-week nature of the course, but if this were something we intended to take to market, it would have been quite helpful. Even though the different interactions in the class seldom influenced the results of our design, one phrase from a speaker earlier in the quarter rang throughout our project: and that was to not overcomplicate a simple solution. Throughout our ideation and prototyping we wanted to keep this in mind and continuously asked ourselves if there an easier way to solve this?

If I were to go through this process again, I would have begun practicing sewing from the get-go. Outside of our prototyping, learning to use a sewing machine would have greatly reduced the stress our team felt toward the end of the project, and it would have also produced a higher quality product. Also expediting our timeline so that we could have shown Abby our final product and receive feedback before our presentation would have been ideal.

Then fast-forwarding to the end of the course, I think I felt that I had made a positive difference when we were at our project demonstrations and a member of the community expressed how much they

admired our product and the attachment mechanism that we used. I think I felt this way because having our work recognized by someone outside of the course, let alone a professional in the field, validated the hard work and proved how close we are to becoming professionals as well! I found that when relating this course to outsiders, the first step was explaining what assistive technology was, which was an active demonstration of my course takeaways. I received positive reactions and even a bit of admiration from outsiders, and some of my classmates in other classes seem interested in taking it next year!

Lastly, I think that one thing that would have been helpful in this course is the integration of work time into the class session, even if it's only 30 minutes. I think that it would exponentially improve the final products that teams produce and get more RESNA Student Design submissions! Additionally, providing reimbursement for transportation would help as teams without cars could visit their project partners more often if they are unable to come to campus. My advice to a future student taking this class would be to make sure that work is evenly distributed among team members and to stay consistent with meeting times, also try to visit your project partner as much as possible.

David L. Jaffe
ENGR 110
14 March 2024

<p style="text-align:center">ENGR 110: Individual Reflection</p>

This quarter has been a rewarding journey. I've gained many invaluable insights from my team, classmates, the teaching team, and the Magical Bridge Playground community. Our Wonder Wall project has been a significant learning opportunity, where the challenges we faced not only strengthened our team's friendship but also taught us important lessons.

Our weekly meetings with the ██████████ team were especially beneficial. Their profound understanding of the playground and insights into potential areas for improvement significantly helped our design process. Engaging with the community members underscored the importance of empathizing with the user, highlighting the necessity of conducting thorough research without holding preconceived notions.

Utilizing Jamboard as a digital log was a great move, and I would use the same platform for future team projects. It served as a journal for our progress, meeting notes, and design ideas, allowing us to reflect on our initial questions and the advancements we've made. Conversations with our course assistant, Henry, were particularly rewarding, given his support and his own experiences with the ████████ ████████.

Effective team communication was pivotal. Our group chat facilitated daily exchanges, fostering a strong camaraderie. Moreover, our thrice-weekly meetings—one with Henry, one with the ████████ team, and one amongst ourselves - ensured transparent and honest communication. In hindsight, optimizing our time together through structured agendas would have been beneficial, allowing us to focus on tasks without managerial distractions.

The thoughtfulness of Dave's course structure is commendable, especially considering the amount of time and effort put into its development. The diverse array of guest speakers provided a rich source of inspiration as well. However, enhancing the auditory experience in the lecture room could improve engagement, as the room's large layout often made it difficult to hear. Incorporating interactive activities and fostering peer interactions could also make the lectures more compelling.

A highlight for me was the "science fair" when different founders and companies visited to showcase their assistive technologies. This facilitated a deeper, more personal engagement with the creators and their products. This interactive learning experience was not only memorable but also prompted me to consider integrating more compassion into our designs.

For future students, setting clear expectations and establishing well-defined roles within the team is crucial for balancing workload and maintaining organization. I admire my teammates' diligence, particularly under the quarter's busy, often rushed demands. Leveraging individual strengths - like assigning CAD model design to our technically adept team member while I focused on user interaction and relationship building—proved to be effective. Being intentional about time management and interpersonal interactions is key to maximizing the learning experience.

Dave Jaffe
ENGR110
March 17, 2024

## Personal Reflection

I came into this course having engaged in small scale engineering projects for other required classes as well as projects for large companies. Never in my time as an engineering student have I had the opportunity to create something for the direct benefit of another person. At the beginning of the course, we were introduced to the idea of changing the world if we could help one person. I came to realize the meaning behind this sentiment over the 10 weeks of working with ▮▮▮ and ▮▮▮, understanding what her day to day life is like, and working to incorporate her preferences into a KibbleCaddy.

Within the major and in industry, I think there is a push to pursue "high tech" solutions. Guest speakers, whether it was a speaker talking about low retention rates of assistive technology devices, or a mother discussing how low tech, everyday products like a high chair were life changing for her daughter with down syndrome taught me that high tech solutions are not always the best option. Visits with ▮▮▮ showed ▮▮ and I how some of her favorite gadgets were low tech, simple items, whereas some of her most expensive devices were obsolete after batteries died out or they became overly complicated for everyday use. This led WANI to pursue a simple mechanism for the Treats for ▮▮▮ dispenser. We wanted something that ▮▮ could rely on everyday rather than something that could easily break and sit on her desk collecting dust.

While conducting market research, it was eye opening to see that nothing exists on the market that fully fulfills ▮▮▮'s needs of portability, clicker integration, and ease of use. Especially considering how big the pet product market is, specifically the clicker training method, it became very important for us to make this novel item as useful as possible for Abby.

During visits and testing, Abby continuously told us that KibbleCaddy could be useful in many households with service animals. This got me thinking about a discussion in class about how assistive technology is used by non-disabled people too, and how it has the power to enhance anyone's life. Making the market for AT larger also increases scale and lowers costs, thus making products like these more accessible for those who really need them. Lectures that discussed limitations with insurance and the high cost of assistive devices like wheelchairs, prosthetics, and even the cost of the dinnerware set, further inspired Team WANI to make this simple to fabricate and low cost.

Going into ENGR110, I expected to work on a project team of 4 students with an engineering background. Ultimately, it was just ▮▮▮ and I, and although I was the only one with fabrication experience, it was very rewarding and fascinating to get insight from someone with a "fresh set of eyes." I think sometimes I limit myself as an engineer when I think about manufacturing constraints or the difficulty of pulling off a certain task, but ▮▮▮ and ▮▮▮ helped push me creatively and we were able to think outside-the-box to produce a very functional and beautiful design. His math and user interview background were very useful as we had to optimize angles and tolerances for the dispensing knob, as well as gather lots of information from Abby during initial meetings.

Ultimately, the different perspectives encountered during ENGR110 have made me a more compassionate, curious, and thoughtful engineer. I am grateful for the opportunity I received to hear from so many talented guest speakers, visit ▮▮▮▮▮▮, and most of all, to meet ▮▮▮, a truly

inspirational and accomplished person. As I go into future engineering courses and my career, I hope to carry the different insights, lessons, and skills I have learned in this class with me. I genuinely feel that the combination of humanity, compassion, and challenge to achieve both function and elegance in our designs is a critical aspect of an engineering curriculum that was missing so far in my time at Stanford. I am so glad I chose to take this course and I hope someday something like ENGR110 may become a required experience for all engineering students!

Individual Reflection

Designing and fabricating an automatic dog kennel opener for ▮▮▮ has been a very enriching and formative project over the past ten weeks. It encompassed various stages, each integral to the project's eventual success. Throughout the process, we engaged in research, user interviews, brainstorming sessions, prototyping, and testing, all playing crucial roles in shaping our final design.

Before this class, I had never really been exposed to a person with cerebral palsy to that degree. In high school, I volunteered and helped with special education programs for Boy Scouts but never really worked with people who had disabilities that required the need for constant care. Due to my lack of experience, I found the interviewing process extremely enlightening and helpful. This stage served as the foundation for our project. Understanding Danny's unique needs and challenges enabled us to approach the problem clearly and empathetically. Direct interactions with Danny and his community resulted in us gaining a deep understanding of his daily struggles and preferences. These insights were instrumental in tailoring our solution to effectively meet ▮▮▮'s specific needs. We were able to establish specific requirements and constraints that would influence our design decisions. One example of this was that Danny loves to use Alexa at home. Since he is familiar with this type of assistive technology, we made it our goal to integrate Alexa into our final product.

Brainstorming sessions and collaboration within our team and with Dave fueled creativity and innovation. Through open discussions and the exchange of ideas, we explored a wide range of potential solutions and refined them iteratively. We came up with multiple electronic actuators to unlock the door and open the door automatically. We all researched what the best kind of technology would be best to use. This helped teach me the importance of doing background research. One example is how we used a stepper motor to open and close the door. We went with this motor mainly because it wouldn't harm Danny's dog if the door began to close on her before she was entirely in the cage. The stepper motor would keep running, but the gears would keep slipping, unlike if we used a DC motor. This collaborative approach towards our research and design ensured that our final design considered various possibilities and incorporated all of our requirements.

Prototyping and testing were critical steps in validating our ideas and refining our design. Building and testing our prototype allowed us to identify potential flaws and make necessary adjustments. Testing the device multiple times to ensure consistent functionality resulted in a few adjustments we mentioned in the paper.

Our interactions with different stakeholders were instrumental in shaping the outcome throughout the design process. Engaging with ▮▮▮ and his community provided real-world insights and grounded us in the user's perspective. Guest lectures and professional guidance introduced us to new technologies and best practices. I observed processes used to develop assistive technology, which helped me and my team design our solution for ▮▮▮'s problem.

The most rewarding interaction, however, was witnessing the impact of our design on ▮▮▮'s life. Seeing how our device improved his ability to care for his service dog reaffirmed the importance of our project. Seeing ▮▮▮ and his family's reaction to our final product convinced me that something like our automated dog kennel opener should be on the market. Danny's father even approached us and said that we had changed ▮▮▮'s life for the better to a degree that we couldn't even imagine. Having

someone say this to us as a result of what we were able to produce for them was extremely rewarding, and I believe that this project could seriously change the lives of many people with service animals.

Reflecting on my experience, there are areas where we could improve if given the opportunity to go through the process again. We would emphasize even more extensive user engagement from the outset, ensuring continuous feedback loops throughout the design journey. Additionally, incorporating some higher-fidelity encasings could help with the aesthetics of our project. We plan to resin print the covering for the stepper motor and the base for the button at the beginning of next quarter to provide Danny with a product that functions and looks good too.

One thing that I found interesting was that we couldn't find any existing aftermarket electronic dog kennel openers that could be installed. During our research phase, we found that 500,000 people in the USA have service animals, with a significant percentage needing assistive help around the clock. To me, this seems like a huge market that is being ignored. While the support from the teaching staff was commendable, integrating more real-world case studies and hands-on workshops focused on user-centered design principles could further enhance the learning experience for future students.

I would advise future students to create a relationship with the person or people you are helping. My group went to dinner with ▮▮▮▮ and his brother and had an amazing experience learning about ▮▮▮▮'s life. As I said above, this was my first real interaction with someone with cerebral palsy, so I am extremely happy and grateful to have met Danny and to have gotten to know him. On a different note, I would also advise incoming students to prototype early. We designed our prototype robustly but didn't have a physical prototype until later in the quarter. I would recommend starting this process earlier in case they run into any unexpected problems.

Overall, I had a great experience in this class and am so happy I took it. Being exposed to the assistive technology field not only piqued my interest but also exposed me to things outside of my comfort zone. I would strongly recommend this class to future engineers to learn about a field that isn't necessarily talked about very much.

This quarter in many ways has been really eye-opening to me. I remember in my application to this course that I talked about my experience with a disabled person with muscular dystrophy named ███ ███. He opened my mind to the kind of difficulties that people with disabilities struggle with every day and what they can achieve with the right help. Since then, assistive technology has been a big interest to me. I even applied and got into the biomechanical engineering co-term so that I could work in the field as a professional. Meeting the presenters in class and hearing their stories as well as the functionality of their products was very interesting and humbling. There are so many things that I do every day that I take for granted. Even something as simple as eating. I remember one lecture where you showed us the devices that people have where the utensil is brought up to their mouth. I honestly thought to myself "Man that must suck" and I gained a newfound appreciation for that simple ability in my life. So first I want to say, that I can't thank you enough for this class it has been my absolute pleasure to be a part of it.

Furthermore, talking about our project sponsor ███. I have known ███ and ███ for a while as they are an active part of the Stanford community. After sitting down and having dinner with them one day I realized the scope of difficulties ███ deals with and how amazing it is that he can live the life he does. Every time I walk up to Danny, he always seems to recognize me and say my name, so I was so surprised when ███ told me that ███ is legally blind and recognizes people off their gait cycle. I thought that was so cool. Getting closer to ███ and ███ also reaffirmed my passion for assistive technologies. I just couldn't believe that there was so much that could be done for one person who already seemed they have a good quality of life given the circumstances. I thought well if Danny has all these needs that haven't been addressed yet, then imagine the struggles of the general population.

In terms of our specific design, I am very proud of how it turned out. Obviously, all of us having such a close relationship with Danny motivated us to make the absolute very best project that we could. I think we met all of ███'s needs and then some in a way that was both creative, intuitive, and respectful of his personal wishes. I do think that this is more of a ███-specific solution than a general one. We touched on in our final report how to make a commercialized version which would be awesome, but personally, I think the reality of price would be a prohibitive factor.

Next quarter as part of a personal project. I want to make an injection mold that can mass-produce a plastic adapter for crate latching mechanisms. I know that it is a rather lofty goal, but I am very passionate about getting this issue solved for as many people as possible. My stepdad in fact has a service dog. Although his disability does not limit his dexterity, he has age-related tremors in his hands so operating our dog's crate is even more difficult for him. I think if I can accomplish this goal, I will have Stanford patent it and then I will create a website where I can sell them at cost. Maybe all even work with ███ and the Canine Companions. Overall, I'm very excited about this class and when I come back for my master's maybe you'll let me TA for it :-)

**Individual Reflection -** ▓▓▓▓▓▓

I had a lot of fun this quarter and really enjoyed my time in taking ENGR 110 this quarter.

I first heard this class through a teammate of mine. I remember her taking the class last winter working with Danny and Korey. The opportunity to take this class came when I was figuring out which classes to take towards my major. I saw this class among the list, and I was really excited with the opportunity. I decided to take the class as it seemed like a unique opportunity to make a difference in one's life and to be a rewarding experience.

I honestly didn't know what I was expecting from this course. I knew we had to carry out a project, but I had no idea what the lectures would look like. I really enjoyed all the guest speakers; they provided a lot of insight that was useful to use towards our project. This course really did exceed all of my expectations, and I really glad that I took this class. It was such a cool opportunity to work one on one with ▓▓▓▓ to find a solution that was best for him.

Meeting with ▓▓▓▓ nearly weekly to receive feedback directly for our ideas and prototypes was so fun and I think what made me feel like I was making a true difference, using his real feedback in real time to create something that he will be truly happy with and be able to use it.

In forming my group for this group project, the biggest challenge as a team was trying to find a time to meet. We all had very busy schedules and were never all free at the same time. It was good that we figured out the possible times we could meet early. We all knew we could meet at 3pm on a Wednesday for a few hours and a Sunday in the afternoon. We started to meet as a team from the very start which I think was very effective in our progression of the project. I felt like we were always on top of things. Towards the end of the quarter there was a week where we weren't able to meet so we had to find another time to meet. What worked for us was having a period of time on a certain day, where we could all go to a location as soon as we were free. What ended on happening is, we weren't all there at the same time but were working in groups of three or twos, to be still making progress towards our goals.

I think I was really lucky that my group was really easy to work with and all got along. We were all very open to each other's ideas and always wanted to hear each other's opinions, positive or negative. I was also able to learn a lot from ▓▓▓▓ and her experience as a CA. I had had experience with the machines and tools in the PRL and Room 36 but had never spent much time in the Wood Shop. I now feel very comfortable working in the wood shop with any other projects I may have. Learning how to use the CRC router was really cool, and I hope I may have another project with the opportunity to use it.

Being from another country, I am always talking to my family back home and keeping them updated with what I am doing. I was always sending them photos of my prototypes and work in the wood shop. They all thought it was so cool and an amazing opportunity to help Danny out. They thought it was fascinating that I got this opportunity at college to do this. My dad is also a build and he loved hearing about the different tools I was using in the Wood shop.

My roommates would always go surfing on Sunday and I could never as my group would meet during this time. My roommates loved seeing our final prototype as they knew how much time I spent with my group working on the project.

One of my favorite lectures for this class was having a bunch of guest speakers come speak to our class. They all offered a unique perspective on their disability and in life. I am someone that loves sport and thought Sydney's chat was very inspiring. It's crazy how many different legs she's had and what she can achieve with them. Technology has made so many advancements, but I thought it was interesting how she still couldn't really take her leg to the beach to use. Also hearing the perspective of a woman who had to be in a wheelchair in Germany for a bit was very eye opening. Hearing about her experience going from being an abled bodied person to being in a wheelchair and hearing how it changed her interactions and experiences was shocking.

Overall, I think the guest speakers opened up our eyes to the process of brainstorming ideas and working with them to becoming porotypes and products to use. I learnt how no solution is really that simple and there are so many other considerations to be made.

A highlight of the class for me was going to the ███████████████, it was truly amazing to see. I'm was also so happy to see this project expanding worldwide, and even to New Zealand.

I would like to thank you Dave, for an amazing quarter and an amazing class. I am so grateful that this class was on offer. The opportunities to hear from so many amazing people were amazing. I know you have put in a lot of time and organization of this and again, thank you.

ENGR 110
3/21/2023

Individual Reflection

I love designing! This is clear through my choice to be a Product Design major but is solidified in every design-based course that I take, with this course being no different. Each step of the design process, whether that is versing oneself in the material, interviewing a user, or actually fabricating a product is so valuable for many reasons, but this is how that manifested in my experience this quarter.

When it came to hearing from different professionals and users, this was a very important part of this class. I came into this class knowing very little about assistive technology aside from a few things that I had researched pertaining to my mother and her disability. That being said, getting well-versed in this material was so important to succeeding in this course and creating something that my group's community partner would be happy with. One of the most important interactions I remember from a class session was when one of the lecturers told us to design something for them, not you. Although this seems obvious, it really stuck out to me because as a designer, it is often easy to get caught up in the ideas that you think will work for someone, but you are not living their experience. Because of this, the user and their opinion always comes first, and this was something that my group tried to embody throughout our project.

This smoothly transitions into how valuable interviewing with our community members and partners was. If it weren't for them, these projects wouldn't exist, so everything should be based on what they want. Interviews were an amazing way for our group to get to know our community partner, Abby, whether that was learning more about her life and the many conferences she speaks at, or just understanding her sense of style through her favorite bags and such. In my opinion, connecting with the user makes designing for them much easier and getting to know and design for ████ was the most valuable part of this class for me. Background research was also very important to this process. ████ knows what she wants and needs, so we knew that if a solution was out there, she would have had it by now. Because of this, it was very important that we understood what was already out in the world, and why those didn't work for her. From there we were able to use this guidance in our iterating and prototyping.

Another thing that was helpful was brainstorming with Dave. He has been teaching this class for a very long time and is obviously knowledgeable in assistive technology. He has also seen the innovation that has emerged throughout the years of this course. These reasons and many more meant that his pointers and suggestions for our project were things to keep in mind. I clearly remember our meeting with him where he suggested using magnets as closures, something we had not come up with in our own brainstorming session. This was one of the closure types we used in our final design which shows how valuable it was to work with and brainstorm with Dave.

Fabricating and prototyping the device was another critical step that our team had to take. We fabricated three different prototypes that featured a single sided, double sided, and looped design. Creating these prototypes first gave us an idea of how long it took and gave us a sense of the order of operations we would need to follow in order to smoothly fabricate the final prototype. This was the time when we could smooth out the bumps in our design process. Once we settled on a final direction, which was the looped design, we continued to prototype this method with materials that were similar

to what our final material would be. This proved to be beneficial because it let us practice our sewing skills on something that was not the final bag. Of course, all of the steps mentioned greatly contributed to the design process, but, this step of fabricating and testing the prototype was another one of the most valuable.

If I were to go through this process again, there would only be a couple of things that I would want to do differently. The first thing that I would want to do is meet with our community partner in person more often. ▮▮▮▮ was extremely kind to let our team come into her home and she showed us many of the devices that she uses, or no longer uses. We met with ▮▮▮ in person two times because it was a struggle to get our team out to Mountain View more than that. Each time we did meet with her, however, she gave us irreplaceable advice. Because of this I wish that we would have met with her more. Something else I think we did well was establishing a weekly meeting time at the beginning of the quarter for our group to work. Unfortunately, our group didn't always stick to this meeting time, so I wish we would have continued this throughout the quarter rather than letting our busy schedules overtake us.

Regarding support from the teaching staff, I think the one thing this course could benefit from is in-class time to work on the project. This would not only be beneficial to staying on course with the project but would also be a great time to ask questions of the teaching team or even other students in the class. When it comes to advice, the main thing I would say to future students is to create a weekly meeting time that works with everyone's schedules and stick to it throughout the quarter. This helps the group stay accountable and carves out the time necessary for the project. Also, start early! Our community member, ▮▮▮▮, was set on meeting with our group very early in the quarter to get our process started and I would recommend that all future students do the same. I am very thankful for my group and I really enjoyed working with them and the teaching team throughout this quarter.

## Quarter Reflection

This quarter I was part of [REDACTED], one of two teams who worked with the [REDACTED] Before this class, I had never worked in the assistive technology space. Most of my product realization classes tend to focus on optimizing a mechanism or showcasing your manufacturing prowess. So, it's safe to say that this class pushed me to think heavily about the user experience more than anything else. I also enjoyed the speakers that came into class because it exposed me to the world of assistive technology.

I remember a speaker talking about exoskeletons and how these could help people with limited mobility. I had never considered Iron Man's suit to be for someone who needed it - I'd always associated these kinds of technologies with aficionados and bored rich people. But, exoskeletons, I learned, are huge in the assistive technology space. The most interesting speaker for me by far was the one who spoke about the brain attachment that can interpret your brain signals and connect to a computer that can either speak your thoughts aloud or operate itself with your brain commands. This is especially interesting for those that can't speak or move because you could in theory move the cursor or be heard by others. It would give autonomy to these people living with disabilities. This presentation really blew my mind because the technology is beyond anything I had ever seen or heard of.

Regarding our project, it was a pleasure working with [REDACTED], [REDACTED], and [REDACTED]. They were very responsive and supportive all throughout the quarter. They gave us constant feedback and took us to the playground several times. In the beginning, we were advised by the teaching team to make sure we land on an idea that the [REDACTED] really likes. So, our team made sure to do a lot of research and idea brainstorming in order to come up with an idea that [REDACTED], [REDACTED], and [REDACTED] would love. Conversing with them was an important part of the design process because it encouraged us to iterate and ask lots of questions. As I mentioned before, this project was heavy on getting to know the user well. In order to design good assistive technology, you have to really understand who you are designing for. And, what makes things even more challenging is that as a designer you can't generalize your target users since everyone has a different experience with their disability.

If I were to go through this process again, I would've spent more time on the ideation phase and crafting a problem statement that was reasonably scoped. Although we did land on a problem that the [REDACTED] was interested in solving, we didn't scope it well. Our team originally tried to build both a cart and slider mats, but we soon realized that it would've been too much. We decided to focus our energy on the slider mats. This was much better scoped (maybe a bit under scoped).

My advice to other students is to pick your team wisely. Because there are people coming in from different majors and backgrounds it can be challenging to get on the same page. So, make sure to discuss with your team what your goals and priorities are. By doing this, hopefully you'll have a better understanding of what to expect from your teammates.

Overall, my experience in ENGR 110 has been positive. I enjoyed learning about assistive technologies as well as getting the chance to build something that improves people's lives.

Dave Jaffe
ENGR110 Perspectives in Assistive Technology
March 18, 2024

## Individual Reflection

I was a part of the team working on a lap tray for a community member with cerebral palsy. Throughout the quarter, our team met with ▮▮▮▮ about once a week, in class and at the Product Realization Lab to discuss his needs and improvements we can make in our prototypes. By the end of the ten weeks, we produced a functional lap tray of pine, hardware, and 3D printed brackets.

As we developed and built our high-fidelity prototype, we realized the importance of balancing two important aspects of product realization: understanding the problem and building the solution. The problem was not cut and dry - ▮▮▮▮ was very kind to honestly point out where we could improve our designs every step of the way, and each week began with new considerations. In many other project classes, the prompt is clear, and the rubric is static. However, for this real-world project that aims to meet the very real and dynamic needs of our community partner, there were many considerations we had to juggle. We quickly realized we would not be able to meet every one of our requirements, so we would have to prioritize certain considerations, mainly promoting Danny's independence, stability, and comfort. As we navigated the process of consistent feedback and changes to our design, we also had to figure out how to build out our solution. We went through many iterations and materials, each seemingly simple task taking many more steps than anticipated. There were many ideas that were easy to discuss, but more labor intensive to act upon.

Different interactions throughout the quarter also informed our design process. It was a process of learning to design for someone else, rather than what we thought was best. It was especially illuminating to hear from guest speakers with their own disabilities who have found ways to improve their quality of life when commercial solutions did not meet their needs. Learning about their process of figuring out what works and what does not work was very insightful to implement their design process into our own. Many speakers talked about products already on the market that do not actually fit their needs.

A great takeaway from the speakers was that an over engineered solution may be very impressive, but that does not make it the best solution for the users. If something is very expensive or limited in its functionality, then it is limited in its efficacy. I tried to remember this principle when working on our lap tray. Brainstorming was fun because we could explore wildly creative or imaginative ideas, but we ultimately returned to our priorities list to remember we are designing for ▮▮▮▮, not ourselves. We tried to design clever ways to utilize the functionality of the laptray within the constraints of the wheelchair. Every time we tested our prototypes with ▮▮▮▮'s manual wheelchair, we considered the mechanical properties of our design, but shifted our focus to how it would function for ▮▮▮▮ to meet (or not yet meet) his needs. Reminding ourselves to shift to the mindset of designing for Danny rather than designing for the project was a very important lesson.

If I were to go through this process again, I would produce more prototypes more rapidly than we did this quarter. Up until the midterm report, many of our ideas were conceptual and we had produced a few very low fidelity prototypes. We described our ideas to Danny and the teaching team and were met with enthusiasm. It was only after our second full prototype that Danny tested over the course of three

days did we more fully realize the practical limitations of our design. We learned the most from the failures of this second prototype when fabricating our final prototype. If I were to redo this process, I would try to give ▒▒▒▒ a functioning prototype around week 6 or week 7 rather than week 9 to give more time to incorporate more rounds of direct feedback and help him practice activating and storing the lap tray.

At the beginning of the quarter, I was very nervous that I would not be able to contribute much to my team. I felt that everyone else in the class was much more experienced than I was in terms of mechanical engineering knowledge and fabricating in the PRL. However, as we worked as a team, everyone settled into their own strengths and contributed as much as they could give the week. We all contributed equally for ideation and prototyping. We divided up the prototyping tasks based on our knowledge and taught each other skills we had learned in other classes. We evenly divided up sections to write for our report and to speak about during our presentations. Spending a quarter together, navigating the PRL and the challenges of designing a fully functional prototype was very fulfilling. I am very grateful for my team.

David L Jaffe
ENGR 110/210 Perspectives in Assistive Technology
18 March 2024

## Individual Reflection on Class and Team Experience

Perspectives on Assistive Technology was a course I took to count as an elective towards my concentration in product realization. Without knowing what I could expect from this class, with guest speakers, project structure, and course content, it really fulfilled the intersectionality between the need for assistive technology and the realization of (in this case assistive) products.

This might have been the making class with the most freedom in decisions I have taken at Stanford. I appreciated the pitching style of the project introduction, and that the teams could be freely chosen after reading about other people's interests and background. While Dave emphasized from the beginning that it might become important to have fabrication knowledge for physically making a technology, I did not realize how useful these skills were until we started the actual development and manufacturing process. In this process we could independently develop our design without interference from teaching team or users. I really enjoyed that set up, but it might have been valuable for people with less experience in physical making to get feedback on a manufacturing and design strategy.

It has been especially beneficial to work closely with our user. ██████ and ██████ were easy to communicate with in person or on the phone and luckily available whenever we needed them for measuring, introducing designs, or brainstorming on our prototypes. They also let it up to us in what direction we wanted to take our design. This mainly regards the mechanism to attach to the wheelchair, material, and shape and size of the table. Nevertheless, it was helpful to work closely with them when we developed our second prototype (the one before our last, high-fidelity product). They gave us valuable feedback and we could directly react to most of ██████'s concerns. This experience made me appreciate once more how valuable a prototype can be. No matter how often you try to explain your design intent with words, measurements, or sketches, nothing is a better demonstration tool than a physical prototype. For a user-centered product, prototyping becomes more than just a tool to test a subassembly, which is common in a lot of project-based classes that I have taken. A prototype becomes a way of communication. And I think in this way prototyping was our most valuable way of communicating with ██████ (and ██████) throughout our design journey.

The reoccurring element from class that became helpful for us was the emphasis on user interviews, needs, and testing when developing an assistive device. The assistive technology fair was interesting, as you could ask about the development process of a certain product, and a common theme that came up was user-centered design. The guest lecture on the development of Eatwell was another example on a clear presentation on the journey of product development. Even though we will most likely never commercialize our laptray, it was great to hear the steps towards making and remaking a product that at some point is so great and specialized that it really should be mass produced. Generally, the guest lecture style, in which there was always time in the end to ask how the development of one's product started or progressed was from special value from me and I learnt a lot.

If I would go through the making of our project again, one thing I would change is frontloading the physical manufacturing. Luckily, one of our team members wanted to get done with the manufacturing as early as possible, leading to us meeting more often than originally intended. Nevertheless, we had to

backload our work towards the end of the quarter to finish our final assembly by the deadline. In the physical making and design, it was especially helpful that ▇▇▇ had experience in the Product Realization Laboratory processes and access to the lab outside of normal hours. To rate our making journey overall, I think we started strong with mechanism and existing product analysis and brainstorming. While I think we could have identified the concept we wanted to pursue a little earlier so we could have had more time for design and testing. In general, our group was very functional as a team. It was easy to find times to meet, and while these times were not always used in the most efficient ways, it was often very helpful to all meet up at the same time. ▇▇▇, ▇▇▇, and ▇▇▇ were great teammates I can only recommend to anyone taking classes with them.

Similarly, I recommend the course to anyone who is interested in making, problem solving, assistive technology, or need based design in general.

## Reflection

I think it was really interesting to hear about all the different projects that people do in the world and how they have helped other people with their assistive technologies and how creative they all were. Their stories were so interesting, and it made me realize how we often overcomplicate the idea of making something with your own hands. You don't have to be a professional or experienced to start you just need to do your research really well and at a place like Stanford we have all the materials we need to try to make a difference. It was also really nice that we were meeting with community members to hear their opinions and that this was the model of the class because oftentimes at Stanford, we neglect the needs of the community and aim to make products that make the most money rather than benefit the community the most so it was a really nice shift. It was also very enlightening to talk to community members and the engagement felt very meaningful and definitely helped motivate our work further. I imagine large company jobs don't give the same satisfaction, so it's definitely given me food for thought in regards to what I want to do in the future, maybe not the near future but it made me rethink what type of job I want when I want to settle down.

Brainstorming with Dave and Henry was a lot of fun but also very interesting. Their perspectives were fresh and drove our ideas further and helped us make our project feasible and made sure it aligned with what our partners at ▮▮▮▮▮▮▮▮▮ wanted. Doing background research was interesting because it made me realize there is so much more to the problem we were looking at than I had initially imagine and it also helped me broaden the scope of our project because I started to see the different working pieces and how we could connect what we were doing to further meet other needs in the community. For example, when we realized doing art on the sliders might be harder for us than professional artists and then after doing further research we realized we could probably hire artists from the community of people living with disabilities to do the job for us, meeting another job need in the community while also solving our own problem). We also asked around about whether sliders were made for the playground we were looking at and learned some things about California policies in different cities and how Palo Alto doesn't really allow sliders to be sold/rented/given out. I also learned a lot from previous projects done for the ▮▮▮▮▮▮▮▮▮ such as the kaleidoscope and also just by looking at the features already incorporated into the ▮▮▮▮▮▮▮▮▮ such as the Kindness corner and the Hideaway Huts.

I had a lot of fun with the whole process of fabricating and testing the product. I never realized that making the product could be so simple (for our medium level prototype) and it was really fun and interesting to test it out, have the kids test it out and learn what to fix for our design. I really liked thinking about the different features to fix and taking input from the adults and kids that tested it out. For example, the bend we implemented to the front of the slide was because of a suggestion from a Stanford alumni that happened to be at the playground that day and the decision to add a handle in the front was taken from how sled work but originally we were going to make it from string but decided not to due to a warning from Kris that that might cause issues of strangulation for kids and adults with autism. We had also got a suggestion to add a bit of rubber in front under the bend so that in case it goes too fast the kids could just push the front down a bit to slow down the slide but we didn't have a chance to implement that. We also learned to make more slides that were bigger since that made more sense for bigger kids and adults and just made things more stable. So, the whole process was really fun to prototype and painting the slides was pretty fun as well. Talking to community members were clearly very crucial to our process and on that same note so was the fabricating and testing process.

I think one thing I would change if I went through the process again would be to better plan out the fabricating process. I feel like oftentimes we would just decide we need to work on it this week before this day but we didn't really detail what needed to be done and I think it could've been helpful to divide each sort of the process between people instead of trying to find a time each week where everyone in the team could make it so that we could've progressed faster if we did the work maybe in pairs. I think what was really helpful from the course was the ability to buy materials without using our own money which really simplified things. I think another thing that could've been more helpful from the teaching staff was feedback about the materials and design that we were doing, how feasible it seemed and if it was the direction we should be going in. I only say this because at the end of the quarter, I realized what was stopping us from using actually sustainable materials like we said we wanted to implement in the future. I know we said it was a problem of cost, but we had funds from the class and if we want to implement this in the future anyways we could've just tried it out during the class.

## Individual Reflection

Participating in ENGR 110/210 this quarter has been a very interesting experience for me. I've had many discussions with my family and friends about disability in the last few years. With various diagnoses and experiences, many people in my community (including myself) have wondered about our positionality with regards to the disabled community. This wondering is one of the reasons I was drawn to this course.

As a designer and engineer, I want to make sure that I am keeping the disabled community in mind when innovating and building. Failure to do so by many engineers can cause, and has caused, very real harm to many people. I hoped that taking this course would help to expand my understanding of inclusive design. While this course is focused on design of assistive technology with the intent of being used by one individual or specific group, the overall experience of hearing from so many individuals with such varying life experiences has grown my knowledge of inclusive design.

Unfortunately, I cannot say that every lecture was impactful. There were several where I struggled to stay tuned in to the speaker's words. Unfortunately, the nature of being bored during a lecture means that I can't remember what those lectures were about to discuss here. Some of the lectures, however, were incredibly interesting. I thoroughly enjoyed hearing from Sydney about her experience as a Paralympic athlete. This lecture with her and the three other presenters was my favorite of all the lectures this quarter. The story format and shorter length helped to keep me engaged the entire time. Erin's presentation on brain-computer interfaces was also very interesting. I also loved talking to Ali about her product Tina at the assistive technology fair. Tina is a product that I believe should have existed long ago, but I am grateful that Ali is making it available now. So often the care of women and other vulva-owning individuals (especially those who are disabled and/or fat) is not a priority. I really enjoyed hearing more about how Ali brought the product from a concept to prototypes to a marketed product. I would have liked to have had a lecture by Ali about her experiences with this journey. Sha Yao did have a lecture about a similar topic; however, I didn't find her presentation presence as engaging. Perhaps next year that lecture could be a split between Ali and Sha discussing their experiences.

My project experience was mostly a good one. I really enjoyed designing and fabricating something in collaboration with and directly for the user. It was incredibly motivating to be able to see the direct impact of the work I did with my team. I do think that the relationship we had with our project suggestors was an interesting power dynamic. They were so grateful to us for working on the project, profusely thanking us for doing the project at every meeting, in a way that didn't seem to acknowledge the fact that we were getting something out of it too (course credit, a grade, experience, learning, etc.). This intensely grateful response also made them not want to hurt our feelings with critical feedback. I found this very frustrating as a designer. When we would discuss our ideas, they would tell us it was up to us as it was our design rather than giving us valuable input since they would be the end users. We tried many times to prod them for more feedback but didn't have much luck. It wasn't until week 9 that we got constructively critical feedback on our design, at which point we felt rushed to implement the design changes. I believe that our design would have been much different (and likely much better) if we had gotten this input earlier on in the quarter.

It was also interesting to work with a team of both undergraduate and graduate students from different academic backgrounds on a design and fabrication project. While I have worked on several projects with a similar structure before, it was the first time for some of my teammates. I felt that we were able to spread the work out amongst the team during the first half of the quarter where the focus was mainly on design. However, this experience gap did cause some significant imbalance as we moved on to high fidelity prototypes. There were times where I felt like I was doing almost all of the fabrication work for the project. This was partially due to me having the most experience, thus it would take significantly less time for me to do a task than to first teach another teammate how to do it, partially due to some of my other teammates being busy or having limited time in their schedules to prioritize the work for this project, and partially due to my having off-hour PRL access. I was grateful to one of my teammates for stepping up and putting a lot of work into the report as well as showing up to learn and help with fabrication where she could. However, I was still frustrated by my other two teammates' lack of work (at least that I could see) towards this project. Had this been a longer project, I would have been motivated to communicate this frustration more and to understand their point of view. However, since this was really only an issue in the last two weeks of the quarter, I felt like it might do more harm than good to bring up this conversation. I learned from this experience that it is a good idea to discuss roles and responsibilities as well as set standards and pathways for clear and open communication within the team early on in the project.

Overall, I'm pleased with the product we have made. I do wish there had been time to refabricate it since there are some less-than-beautiful parts of the make. However, I'm glad that our project suggestors like it and will use it to improve the user's autonomy. I enjoyed showing our work at the end-of-quarter class celebration, and I look forward to showing it again at this quarter's Meet the Makers.

ENGR 210
3/24/2024

## Reflection

I was very excited to take this course this winter since I have had some experience prototyping assistive technology in the past, and I've found the process to be extremely rewarding since its application is tangible and meaningful. To create a successful product, especially in the 10-week time frame given that most students are juggling other classes, I think it was very important to follow the process reviewed in class, brainstorming, background research, fabricating + testing, interviewing, and reiterating.

Starting with the brainstorming process, I was intimidated at first and was very tempted to sketch something rough and quick to get it out of the way, but I realized the most progress I made was during the time I spent thinking about the problem and the resources available. I was a part of ▮▮▮▮'s storage solutions, and I found that fully describing the connections between the pouch I conceptualized and the structure below the wheelchair, helped me gain confidence in the process. Since we wanted it to be lightweight, I wanted a very free structure made of fabric and I spent a good hour thinking about how gravity, slack, and tension would play a part in defining the shape of the pouch since it wasn't rigid, and how I would prevent items from falling out.

Before we started the construction process, I really enjoyed everyone making a rough prototype, since sometimes as a listener, you don't get a full understanding of the product until you can see it in person. Adding on to that, making a Pugh chart, based on a customer interview, and weighing the relative potential for value of each product made it a lot easier to move forward with the best solution, or in our case best two solutions, since one was made for accessibility and the other for functionality. After meeting with my team, I found value in identifying the backgrounds and strengths of the people I was working with, for example Tomi taught me how to use the sewing machine, Calvin had good conceptual analysis with CAD and thinking of mechanical solutions to problems we encountered during prototyping. By the third time we were working in the PRL, we felt comfortable helping each other out, and working effectively. It was also beneficial to start creating as soon as possible (while not rushing the conceptualization process) since after the first iteration, our team found issues such as structural support for pulling the zipper, accessibility issues with the size of the zipper and size of the container, (things that would not have been so obvious before creation) so just seeing and feeling helped me a lot.

I found the guest lecturers to be very insightful as well, most of them were very good speakers and had clearly spent most of their lives with accessible technology. Since no one had worked on storage solutions, there weren't any direct takeaways, but relative to the design process I realized a sense of excitement, passion, and ambition that had to do with meaningful creation. Many speakers had portfolios of dozens of projects, too many to talk about, some that had failed due to commercialization price or supply chain issues, and others that were extremely successful such as da Vinci surgical system, and regardless of the outcome you learn from the experience and move on to the next project.

In retrospect I wish I had been more ambitious with the project by pushing myself to learn more tools, and not been as afraid of failure. We used 3D printing and sewing, but I wish we had used the laser cutting to get precise measurements and a cleaner look. I wish that our group had been open to reaching out to the PRL staff more often and invested in the time to learn how to laser cut or ask for a fabric material that would better fit the task, since our material ended up being very difficult to work

with and ended up losing us a lot of time. Overall, we had some great ideas, just wish we had more time to execute.

## Individual Reflection

Reflecting back on this quarter, I am extremely thankful that I took this class. Coming into the quarter, I really did not know what to expect from ENGR 110 and only knew that I would be hearing from various speakers and doing some sort of final project. After exploring the course website and attending the first lecture, I became very excited to get a project and start working on it because I appreciated the opportunity to make a tangible difference for someone in our community. As a mechanical engineering major specializing in product realization, I have made countless projects for class, work, and personal reasons. However, almost all of those projects were for myself or a specific task in a larger system and I wanted to finally make something that was a full, finished product for someone else in need.

After getting paired with ▇▇ and ▇▇▇▇▇▇ to create a crate that could be fully actuated by ▇▇, an adult living with Cerebral Palsy, I immediately started brainstorming with my team on different ways we could make an electronic or mechanical solution to the problem. Our first meeting with ▇▇ was likely the most memorable moment of this course because it was extremely eye-opening to have an extended conversation with him and better understand how he interacts with the world around him. Additionally, we learned that he is a truly incredible person with positions on multiple boards related to disability and an incredible sense of humor. This experience helped me fully realize what an incredible place Stanford can be when we fully utilize the variety of perspectives in the area. I would not have ever had the opportunity to get to know Danny without this course and it has inspired me to be more open to unstructured interviews and conversations with community members going forward.

As I reflect on this quarter, I realize that the most valuable aspects of this course were the ones related to the group project because it was where I was able to see the concepts we heard about in class applied in meaningful ways. In particular, I learned a great deal about prototyping a design for someone with different abilities than my own. We were intentional in learning what Danny liked about the tools he uses in his daily life and were careful to incorporate those to ensure that we did not accidentally create a device that was hard for him to use. The most interesting part of the design process was considering the failure modes of our design through the lens of accessibility and ▇▇'s needs. We wanted to ensure that the crate could not create new problems that made Danny less independent in the event of a failure. This consideration informed our design significantly, motivating us to use a stepper motor that did not involve a hard-to-move gear ratio for the main door actuation.

Beyond the group project, I learned a great deal from some of the guest speakers in the class. It was extremely interesting to hear about new emerging technologies and I likely never would have learned about them without this class. Some lectures were certainly more engaging and relevant than others, but all of them offered some new perspectives that I had not heard or considered before. My favorite lecture was the one about brain implants and current research on faster ways to recognize text and speech. I was astounded by the progress made on the subject and also was shocked that it was not discussed more widely because it seemed like such groundbreaking technology.

As I complete this course and reflect on my experience, the only thing I would change would be starting the project sooner. My team spent multiple weeks discussing the design, researching components, and planning rather than beginning to make physical prototypes because we wanted to be sure our design

was viable. However, in hindsight, it would have been better to buy components faster and begin the development of the electrical hardware sooner because we were eventually bottlenecked by finishing the electronics before we could test our whole design. This delay was not significant enough to affect the final product in any way, but it did stop us from testing the finished project with ▮▮▮▮ before presenting it. Fortunately, Danny loved our design when he tested it after our presentation, but it would have been good to ensure that before we presented the project as a finished product.

I am also extremely thankful for my specific team for the group project. Our four-person team, consisting of myself and three other mechanical engineering students, exhibited exceptional teamwork and dedication throughout the entire design and fabrication process. From the initial brainstorming sessions to the final presentation, each member contributed their unique skills and expertise, ensuring an optimal solution. Despite all having the same degree path, we all offered different areas of experience that made each member of the team uniquely valuable. My team's ability to seamlessly integrate diverse perspectives and seamlessly navigate challenges exemplified the true spirit of engineering collaboration and innovation. As a result, our final product demonstrates the power of teamwork and the profound impact that engineering can have on improving the lives of others.

In conclusion, I am extremely proud of what I learned and built during the course of this class. The teaching team did a fantastic job of keeping us engaged and on track and I truly could not have completed this project without the help of them and every member of my team.

ENGR110/210: Individual Reflection
David L. Jaffe
03/21/2024

## Cheers to ENGR110/210: Reflecting on My Experience

The first time I heard about ENGR110 was when I met with my advisor, Dr. Sheri Sheppard, during my junior year. I met with her to go over my 4-year plan and to get some recommendations on classes I should take based on what type of path I was trying to take. After speaking with her, she recommended me ENGR110 with little to no description of the class other than "it is a great, impactful class", or something along those lines. It piqued my interest and I read all about it from students' past experiences. I decided to apply for it and take it this year. Thankfully, I was admitted into the class.

When learning about disabilities, sometimes I can feel a bit overwhelmed with emotions as I have a hard time accepting their existence. I was never this way really, I used to learn or hear about them, even see them in real life and did not feel a surge of emotions. However, as I got older, I became disabled myself and so did my father. Having gained my own personal experience with disability completely changed my perception of the world. This happened to me at age 18. Prior to that, I had lived my life in what I am grateful to deem as great physical shape. I was in sports and found myself always being physically active. When I felt stressed from school, down and out over a girl, or just feeling unmotivated, I found my haven in physical activity. However, after I became ill in 2017, I really went from knowing what it was like to feel fine to having to experience pain daily that inhibited me from my prior favorite activities. This changed my perception of the world for the better. Even if it was a hard time for me. Even if it brought me to some of my lowest points, it made me realize the reality of the world we live in. At some point, no matter who we are and how we are born, we will become disabled and thus we need to be cognizant of that and create a world that is as well.

The first week of classes was particularly heavy for me in the sense that it brought my lived experience to the classroom. I had not been in any class that talked about the topics we do. If a class mentions accessibility, it is always in an engineering sense, but it never delves deeper than that. This class made me feel seen and heard in my own experiences, validating me. I learned to better separate my emotions with the school throughout this course.

Working with my team was an enriching experience. I had never worked directly with someone that was a wheelchair user and had CP. ▇▇▇▇ welcomed us with open arms and was so open and honest with us throughout the process. This quarter was particularly busy for me because I missed half a week of classes to go see my brother get married and upon return, I unfortunately caught COVID. It took me a whole 7 days to test negative again and thus I missed a lot of class and project working time. For this reason, I was unable to devote as much time to fabricating our project for ▇▇▇▇ during weeks 5-7. During the last 3 weeks of class our team began fabricating our storage solution in the PRL. We managed to get feedback from ▇▇▇▇ at the end of week 9 but by then it was a bit too late to create any turnarounds or pivots in our project that would help us better create a solution for him. This was something that weighed a bit heavy on me because I did not want ▇▇▇▇ to think that we did not care for him or our project, when in reality we just had a lot of unprecedented circumstances this quarter.

After talking directly to ▇▇▇▇ and ▇▇▇▇ about these feelings I was having, they reassured me about how they felt and that they were still grateful for my honesty and presence. This made me tear up and

we all had a heartfelt conversation. I felt like I got closer to them, maybe more closer to them than if I would have not had that conversation with them. I am grateful for their advice and for the experiences I had this quarter. I look forward to continuing this class in independent study if possible. Thank you, Dave!

I really enjoyed my time this quarter taking ENGR 110. First, some thanks are in order. The best part of the experience was working with Iris and Emily for 10 weeks - it's been a joy to be on a team working on a project together that fulfils a social purpose. Their dedication, creativity and fun spirit has been a highlight of the quarter. I also deeply appreciated all the support and encouragement from ████, ██, and ████ from ██████████. Their kind welcome, enthusiasm and feedback really made the class experience feel collaborative while giving us the freedom to explore different ideas. Lastly, the mentorship and teaching from Dave and Henry was excellent - from the quality and experience of the many guest lecturers to giving us advice on the minute details on how to improve our presentations and reports, the level of feedback was essential to the growth and learning students gain in the class. Addressing the specific questions:

*You have spent the past quarter hearing from different professionals and users, interviewing community members, brainstorming with your instructor, doing background research, looking at prior art, fabricating and testing a prototype device, etc. Please comment on the relative value of the different parts of this process toward your design.*

What I really liked about the class was that it gave us students a real freedom to design and execute our own process for brainstorming, iterating, and fabricating our prototypes. Of these, I found the brainstorming and learning from community members and our project sponsor the most important and informative. Prior to the class, I regrettably had not had much exposure or interaction with those from the disability community. I had no real insight into their lived experiences apart from anecdotal stories in the media and from friends. Through our trips and engagement with The ██████████, chats with children at the playground itself and interviews with ████████ from the Morgan Autism Center, I believe we developed a much deeper appreciation for the challenges and opportunities that our project would seek to address for people in the disability and autism communities.

After gathering information and feedback from our background research and interviews and narrowing our brainstormed concepts to the Wonder Wall design, the biggest challenge was how to go about fabricating and testing a prototype. What was helpful was the mid-term presentation and report focusing us on creating a low-fidelity rapid prototype using foam core. Seeing the brainstormed design assume physical dimensions and conducting rudimentary testing on its core elements was essential towards evolving our own design thinking and for gathering feedback from our users. The process of turning that prototype into our final higher- fidelity prototype displayed at the final demonstration was the most complex engineering challenge - but doing CAD to iterate dimensions for our laser cut pieces was useful to working through those engineering questions (for example, how to hold up the roof securely or how to hold up the wall frame). Lastly, the process of presenting and explaining our design choices at both presentations was useful to demonstrate our learning and growth through the project. How did the different interactions in the class (with users, community members, guest lecturers, professionals, etc.) contribute to the results of your design? Was any particular interaction especially rewarding or helpful? Why?

Aside from our weekly feedback sessions and updates with The ██████████, I felt our most profound chat was with ████████, Director of the Morgan Autism Center. First off, he was so kind in giving up part of his Saturday afternoon to speak with some Stanford undergrads. Most rewarding was his description of the children with autism he works with, their struggles and how he and his staff approach their education and development and the lessons he wanted to impart to us and the wider

world about how society can better support those with disabilities. He also gave us useful feedback on our design. Josh was able to give precise suggestions such as including a goal for the puzzle and a timing device and helpfully contextualized these with anecdotes from the learning experience of supporting his students. In developing from our first low fidelity prototype to our final design, I would say that this conversation was among the most crucial towards improving its functionality and suitability for our target users. If you were to go through this process again, what would you do differently? Was there support from the teaching staff or course content that was helpful or that you felt was missing? What advice would you give to future students?

As I reflect on our design and fabrication process this quarter, especially the time crunch at towards the end, there are a couple changes I would make if we were to go through the class again. The first is that I feel that we as a team could have been even more proactive in reaching out to our target users directly and to gather their input on our design. Hearing from them before we narrowed down our brainstormed concepts would have been useful and could have informed the criteria and weighting on our Pugh Chart. Second, I would have liked the opportunity to conduct direct user testing with our prototype at the ▬▬▬▬▬▬▬▬▬ - we unfortunately did not have the time to do this but seeing our users playing and interacting with the Wonder Wall would have both been instructive and a wonderful culmination of our entire design process.

In terms of the teaching team, my main piece of feedback would be that it would be helpful and even reassuring for there to be clear published rubrics for scoring on assignments. Throughout my time at Stanford, I have found that the classes I were able to learn and perform the best at have had very explicit specifications for not only expectations for assignments (which Dave publishes in extensive detail on the course website), but also what the expectations are for how the teaching team will assess student work. I think at least descriptive rubrics not only help students to better align their work with the teaching team's expectations, but also help teachers in their grading by ensuring that more subjective assignments such as group presentations can be judged in a standardized way.

For future students, my advice would be to first choose the project that speaks to you the most, and the project sponsor that you're able to establish a good connection with. I also would suggest to them that the brainstorming and initial ideation process is the most important - the process of narrowing down to a final design needs to be well thought out and that input from many sources - users, the teaching team, the project sponsor, and even other classmates will be of essential use towards deciding on your final design. I also think it's important to ensure that your team has a balance of skills -both engineering and design and those who can plan projects and present well.

As I said at the start, ENGR 110 was a fun class - allowing students to explore their design process and iterative skills by pairing them with a project of real social and assistive purpose. In my view, the best classes at Stanford are those in which students come away with a tangible sense of progress at having accomplished hard things - and this class through brainstorming, applying design thinking and fabricating a working model helps to instill a learning-by-doing mindset in students.

**Individual Reflection**
ENGR110: Perspectives in Assistive Technology
Winter 2024

Throughout the past quarter, my journey in ENGR110 has been marked by various activities and interactions that have contributed significantly to my understanding of the design process, particularly in the context of creating solutions for individuals with disabilities. Reflecting on these experiences, I have identified key aspects of the process that have been particularly impactful, areas for improvement, and valuable advice for future students embarking on similar endeavors.

One of the most crucial components of this course has been the opportunity to listen to inventors and individuals with disabilities share their insights and experiences. These interactions have provided invaluable perspectives, helping to establish a framework for designing solutions that truly meet the needs of the end-users. Understanding the daily challenges faced by individuals with disabilities is paramount in developing effective and empathetic designs. For instance, comprehending the intricacies of how a blind person completes tasks is essential before devising tools to assist them. Additionally, conducting background research on various disabilities and existing solutions has been instrumental in gaining a deeper understanding of the problem space. This research serves as a foundation for informed decision-making throughout the design process, allowing for more targeted and effective solutions.

A standout aspect of my experience in ENGR110 has been the opportunity to design for a single user, which has been both rewarding and enlightening. Tasked with focusing on creative expression, my group embarked on the challenge of sourcing a user who resonated with our project theme. Despite initial challenges, we successfully connected with ████, an artist, whose passion for our project enriched our design process. Designing for one person allowed us to create a solution tailored to their preferences and needs, fostering a deeper sense of connection and fulfillment. Engaging with Sylvia throughout the design journey, from interviews to prototype testing, not only enhanced the quality of our solution but also forged a meaningful friendship. Furthermore, the collaborative dynamics within our group, facilitated by these personal relationships, bolstered our communication and problem-solving abilities, ultimately contributing to the success of our project.

Looking back on the design process, there are areas where improvements could be made to enhance the overall experience for future students. Firstly, establishing user profiles earlier in the process would streamline the user sourcing phase and ensure a more seamless integration of user feedback throughout the design journey. While the autonomy granted in selecting our user was beneficial, additional support from the teaching staff in facilitating user connections could alleviate potential challenges.

Moreover, incorporating a more comprehensive exploration of the disabilities experienced by the designated user group, such as ████ and ████, would enrich the educational aspect of the course. Dedicated lectures to delve deeper into their lived experiences could foster greater empathy and understanding among students, thereby informing more empathetic and inclusive design solutions.

Another aspect that I think could be improved is the incorporation of AI. Our extra credit assignment was to use ChatGPT to come up with potential solutions, but I thought this activity was not well-integrated with the rest of the class. There was no deadline for this assignment either, so when we were supposed to do this was also unclear. Was this activity meant to be done before we started prototyping?

Additionally, while the topic of AI was briefly discussed in some lectures, it might be interesting to learn about other ways AI is being used to help individuals with disabilities.

In offering advice to future students undertaking similar design projects, several key insights emerge from my experience. Firstly, when selecting a user, avoid choosing children, as their communication and feedback processes may prove challenging. Secondly, in group settings, it is essential to navigate disagreements with assertiveness and empathy, fostering an environment of open communication and collaboration. Finally, ensuring alignment between the project scope and user expectations is paramount for project success. Clear communication and mutual understanding between the group and the user are essential for navigating potential challenges and ensuring a harmonious collaboration. In addition to the previously mentioned insights, there are further considerations that future students may find beneficial. Firstly, maintaining a flexible mindset throughout the design process is essential. Unexpected challenges and changes are inevitable, and adaptability is key to overcoming these hurdles. Embrace ambiguity and view setbacks as opportunities for growth and innovation.

In conclusion, my journey in ENGR110 has been characterized by a blend of insightful interactions, hands-on experiences, and collaborative teamwork. Through engaging with professionals, users, and fellow students, I have gained a deeper appreciation for the importance of empathy-driven design and user-centric solutions. I was extremely moved by the experiences some of my peers endure daily and awed by the technology being developed by labs here at Stanford! I loved the variety of classes (i.e going to see the ▮▮▮▮▮▮▮▮ and watching a movie), and I appreciated Dave's dedication to the course and his students by always having cookies and other snacks (another potential area of improvement is the snack selection ... but that is just being nit-picky!). By reflecting on my experiences and sharing valuable insights, I hope to continue using my engineering capabilities to help others go through their lives easier and more accessibly.

ENGR110
19 March, 2024

**Individual Reflection**

Over the course of the quarter, I learned a lot as I heard about the complexities of designing solutions to enhance the lives of individuals with disabilities from all of the guest speakers. As an engineer, the presentations about emerging, cutting-edge technologies are the most naturally appealing to me and it was very interesting to hear about these systems as they are a very different field from the aerospace projects I am generally familiar with. The group of users and priorities is very different and being exposed to this was very beneficial for me. However, I also learned a lot about how these technologies are designed with the intended user in mind. Seeing how important it is for the designer to speak to the users and understand what their needs really are helped our team tremendously while working on the automatic kennel for Danny as we were able to understand his needs and design a solution to meet them.

A pivotal component of the course was the series of guest lectures featuring experts and practitioners from various domains of assistive technology. These sessions served as windows into the evolving landscape of assistive technologies, showcasing the latest advancements, innovations, and best practices. From brain-computer interfaces to assistive robotics, each lecture offered a glimpse into the transformative potential of technology in empowering individuals with disabilities. However, alongside the promise of progress, the speakers also underscored the pressing need to address the inherent limitations and disparities that persist in the field. This nuanced understanding of the opportunities and challenges in assistive technology would stick with me while working on the group project and beyond the course.

One of the most impactful experiences of the course was our engagement with Danny, the end-user of our team project. Spending time with Danny and gaining insights into his daily routines, challenges, and aspirations was a profoundly humbling experience. We spent a lot of time with ████, aside from our interview for the project we also had a dinner with ████ and ████ where we got to hear a lot about ████'s personal life and hobbies. It was a strong reminder of the human impact of our work, which helped us maintain our commitment to quality throughout the design process even as we got busier toward the end of the quarter. As we listened to ████'s stories and talked to his family members, we were confronted with the realization that our design decisions held the power to profoundly influence his quality of life. This connection with ████ would become the cornerstone of our project journey and we are very happy to call both ████ and ████ good friends.

Our team project, centered around the design of an automated dog kennel for ████, presented a myriad of challenges as integrating with the kennel was challenging given is uneven dimensions and the ease with which it would warp and twist. Collaborating with my teammates, we worked very hard on the prototyping and testing, guided by the principles of user-centered design we heard from the guest speakers.

Reflecting on the project process, I realized the profound impact of user engagement and iterative feedback in shaping the trajectory of our design. Through ongoing dialogue with ████ and ████, we gained invaluable insights that informed our design decisions and pushed us to deliver the best possible product we could for ████. From choosing to automate not only the lock but also the door, to placing

the button in a location where Danny can easily access it, every iteration was guided by a commitment to enhancing usability and inclusivity.

In retrospect, I would have started the development of our hardware sooner to allow for more extensive exploration and refinement of our design, however, the prototype we delivered works very well and we are very satisfied with the result in the end. I am immensely proud of our team's achievements and the collective journey we undertook. This class has been an excellent experience, that has not only expanded my technical skills but also enriched my understanding of empathy, collaboration, and the profound impact of assistive technology.

Perspectives in Assistive Technology
Individual Reflection
███████████
March 22, 2024

I had no previous knowledge of Perspectives in Assistive Technology before enrolling in the course. Instead, I found it in the materials science & engineering program sheet as it was listed at the bottom of approved electives that were outside of the major. After reading some more about the course and having my initial meeting with Dave before enrollment, I looked forward to the outcomes of the class. In writing this reflection, I maintain the course did not disappoint. Through the lectures and the demonstration and evaluation of my group's final project, I have gained insight into different approaches to designing meaningful products to help people who are most in need.

One of the most important aspects of the course and perhaps my most favorite included the impressive list of guest lecturers that Dave assembled to present in nearly every lecture within the quarter. The guest lecturers all brought valuable insight into how they've interacted and/or developed different assistive technologies, commenting not only on how these technologies have altered their functionality but also in other parts of their days including interaction with friends and family. I was then able to understand that, unlike some products for able-bodied people, in a well-designed assistive technology product, directly improving the quality of life for the user is paramount. In designing any future product serving as an assistive technology, it would be useful to remind myself of minimizing any tradeoff between aesthetics and functionality, or comfort and durability.

During the class I was able to experience the process of connecting with an individual with a disability, discuss with them and clearly identify at least one problem area, prototype several designs and compare them among my group members, and test and fabricate the prototype. Meeting with █████████ and identifying an area of improvement in his daily life was crucial to understanding the scope of our project. While Dave had made suggested projects on the course website, we were able to pursue an idea born out of our conversation with ████████, which was just as relevant and important as the suggested topics. Sharing and comparing different prototypes among my group members was an important and effective way for each of us to understand each other's thought processes in designing a product and it allowed us to identify strengths in different areas when fabricating the prototypes. Fabrication of the initial and final prototypes within the course came with unexpected challenges, particularly in properly scaling different parts, working with an interface of 3D-printed parts and soft fabric, and striving for aesthetics within the prototypes. While we were able to address most of these challenges, given more time - or had we allotted more time for the fabrication process - the finalized prototype would simply be better. In addition, we would need to give more time to testing the product with ████, as this would've allowed us to have a better understanding of his mannerisms and subtle biomechanical challenges, such as rolling his hand along one axis. Looking back at this process, one challenge my group needed to overcome is the tendency to fall back into thinking about our design from our, able-bodied perspectives. In developing an assistive technology product for the first time, I believe it is important to have someone, with a disability that accurately reflects the product, weighing into the design and fabrication process at multiple stages though the product's development. I believe that this is also true for any human-centered design process.

More than any other aspect of this class, I most enjoyed its emphasis on multiple dimensions of learning. Unlike many other engineering courses that have a starting point A and move linearly towards a final learning goal B, the combination of guest lecture and hands-on project work made for a wonderfully flexible learning environment. For example, instead of additively learning one specific topic, which can be narrow, the talks from different professionals and AT users provided a broad set of perspectives which better reflects the diversity of the AT field itself. I loved hearing from students about their Stanford experiences, engineers about their approach to accessible design, roboticists about cutting edge assistive AI, and filmmakers about how they move through the world - no class was like another. Moreover, the self-guidance of the class project allowed us to shape our own experiences and learning goals. Having no previous experience with mechanical fabrication, I learned a great deal about the CAD and 3D printing process which has always been an interest of mine, but depending on their interests and projects, other students learned woodworking, or sewing, or electronics skills. It's quite beautiful that students can all enter the same class and come out with such vastly disparate and personalized learning.

When I elected to take ENGR 110, the hands-on nature of the course stood out to me, and I was most excited to try fabrication. In retrospect, this was the wrong focus to start the project process. I now feel that fabrication is an easily acquired tool that can be learned anytime. The most unique valuable hands-on experience was in working directly with a user. In my opinion, the skills that are hardest but also the most important to cultivate are the interpersonal ones that I strengthened and actualized through collaborating with ████ and ██████. While many engineering classes will just present you with a strict problem formulation, I loved going through the interview process and learning a personal problem at a deeper level. In the real world, problems need to be understood before they can be solved. Moreover, problems are never solved on the first prototype and require continuous feedback and testing from the user - which was an aspect of the engineering process I underappreciated before the class.

One of my biggest reflections in this class regards solving a problem vs truly helping the user; I was surprised by the number of medical devices that "worked" but did not match the true needs or aesthetic desires of the user. I enjoyed talking to ████ about her experiences with different AT devices and hearing stories about what worked, what didn't, why, etc. As a CS MS/BS, I've had many opportunities to build 'real-world' products, but as is common with software projects, the products are often geared for "scale". Designing and building for one individual, and getting to know that individual in the process, was a far more special experience in comparison. Abby is such a sweet human being, and it was tremendously pleasant to visit her and Nathan, and to be welcomed into their home.

As my initial exposure to the AT space, this class has encouraged me to explore AT far more within my domain of expertise. Towards the end of Winter Quarter, I joined Stanford's first ever AI and Disability HAI affinity group where we work towards improving AI accessibility for all. I was motivated to join the group by the guest speakers: after hearing Bhavya's story about using multi-modal AI models to assist with his perception of the world, and after learning about the fantastic (and futuristic) work Professor Monroe Kenney does with the ARMLab. I've since brought a lot of perspectives I learned from this class on 'individual design' etc, to the affinity group, and I've greatly enjoyed exploring the intersection of AT and software. Most recently, when visiting ████, we had a lengthy discussion about blind accessibility in digital slides and documents. Since that conversation, I have begun a side project working on a multi-modal AI copilot to automatically add alternative text to images and help users build more screen-

reader friendly presentations and documents. I greatly appreciate this class for showing me that my skills can be employed to make the world more accessible for others.