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Sociotechnical Synthesis
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Many recreational activities have too high of a barrier. Enabling people to partake in hobbies in adulthood could be an important part of mitigating the mental health crisis in many first-world countries. However, many people get their hobbies from friends, family, geographical location, or other happenstance. While some natural amount of randomness with regard to what someone is exposed to is to be expected, given their benefits, activities like skiing and gardening should be as accessible as possible to as many people as possible. The sociotechnical problem and technical problem I address both pertain to the accessibility of recreational activity. The sociotechnical problem addresses the sustainability of skiing itself, and the technical problem uses mechanical engineering to help students begin gardening and garden more frequently.

The sociotechnical problem is that the United States has been hemorrhaging small ski areas in favor of destination resorts, and many think that is an indicator of skiing itself becoming unsustainable. I analyzed academic literature from North America and Europe, books written on the issue of skiing's sustainability, interviews with industry leaders, and raw data from advocacy groups such as the National Ski Areas Association. The result was that there were three main risks to skiing's sustainability that ski industry leaders could take action on: employee living conditions, high barriers to entry for non-skiers, and environmental destruction.

The technical problem was to use a UR10 industrial robot arm to automatically sow trays full of Bok Choy seeds to be germinated. Students could order and pick up a tray of germinated seedlings. The solution used a magnetic tool exchanger that coupled the robot arm with multiple customized tools. We also built an environment of analog machines built to dispense dirt and seeds, arrange finished trays, and replenish new trays. The logic and electronics of the system were all isolated within the UR10 so that our analog machines would be cheaper, more maintainable, more durable, and easily iterated. Important findings included the benefits of rapid prototyping, the importance of geometric tolerances, and best practices for dispensing mechanisms.

While making recreational activities more accessible is a limitless task, we successfully built a prototype of a machine that could make gardening more accessible to students. The next stage of any prototype is a refined and industrializable product, and future researchers similarly interested in student gardening should continue our work by iterating on our prototype until it is industrialized. For the *GrowBot* (the name of our capstone), an industrializable solution would include machined aluminum or steel parts rather than the 3D-printed ABS due to higher ductility, strengths, and precision. In my sociotechnical problem, I identified specific problems with the sustainability of American skiing, many of which were linked to the growth of destination ski resorts over local ski hills. This contributes to solving my General Research Problem by showing skiers and ski industry leaders the areas where they can work towards making skiing more sustainable and therefore more accessible. I believe the importance of my diagnosis of the problem is stronger than the prescription for how to make skiing more sustainable, and I'd encourage any reader to contend my proposed solutions with stronger, more sustainable, or more achievable ones. I also suggest that future research into skiing's sustainability could take my work further by triaging the individual issues to decide the relative danger of each of them. Quantifying risk is daunting because it requires precedent, and this issue is relatively unique.

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