Mobile 3D Printer: EECS Executive Summary

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The goal for this interdisciplinary design project was to produce a 3D printer capable of printing in an effectively unlimited area, as well as on non-planar/horizontal surfaces. While traditional 3D printers are capable of producing many useful parts, they struggle to produce larger parts and some more specialized parts require a lot of support material which creates a lot more waste. They are also generally incapable of printing onto existing constructions or surfaces that are not a flat print bed. This project worked towards a solution to that problem, by designing a 3D printer that could handle printing on usual surfaces and multi-step constructions. The EECS team was tasked with designing control systems that could effectively move and operate the printer, and providing an interface for controlling the printer from a computer. A mechanical engineering capstone team was responsible for creating the physical design of the printer and its various moving parts.

Our initial design process was slow to start, due to mechanical design decisions needing to be made before we could finalize any of our own decisions. But there were a few things that we knew we would need, such as motor controllers, a power supply, a microcontroller, and inverse kinematics. Our efforts in the early weeks of the project were focused on researching 3D printing and various related technologies, as well as selecting and designing components to handle the project needs we had identified.

As the mechanical design progressed and approached a finalized state, we were able to refine some of our earlier design choices, as well as make more of our own final design choices. A central PCB to link together various components was designed, and test software was written to verify printer functionality as more parts of the physical printer became operational. By the end of the second term we had all of the major hardware components in place for the project.

During our final term of the project, we no longer had the undergrad ME team, but we still had the graduate students to help with adjustments to the mechanical portion to the project and other tasks such as enclosure design. Most of our work during the final term was comprised of software, creating a single, comprehensive firmware for the printer that could perform all of the functions required to verify the requirements we defined earlier in the project. Many smaller test programs built to exercise certain functionalities were absorbed into this firmware, retooled to fit their role in the larger operation of the device. This period also involved a lot of wiring work to get motors connected and electrical hazards isolated.

With our involvement in the project coming to a close, it's important to take stock of the progress we've made. As outlined more thoroughly in our project document, there are a lot of lessons we learned in doing this project, and some specific technical recommendations for future teams. Communication was of utmost importance in this project, and our team was always most successful when we were communicating well. Defining a reasonable scope early is also important, as we had to make the decision to cut down the scope of the project to be able to manage the workload with our small team. While the printer we have produced is not yet a fully fledged manufacturing workhorse, it serves as a good prototype and proof of concept. It will also provide a foundation for future teams to build upon as they work towards realizing the full concept of the Mobile 3D Printer.

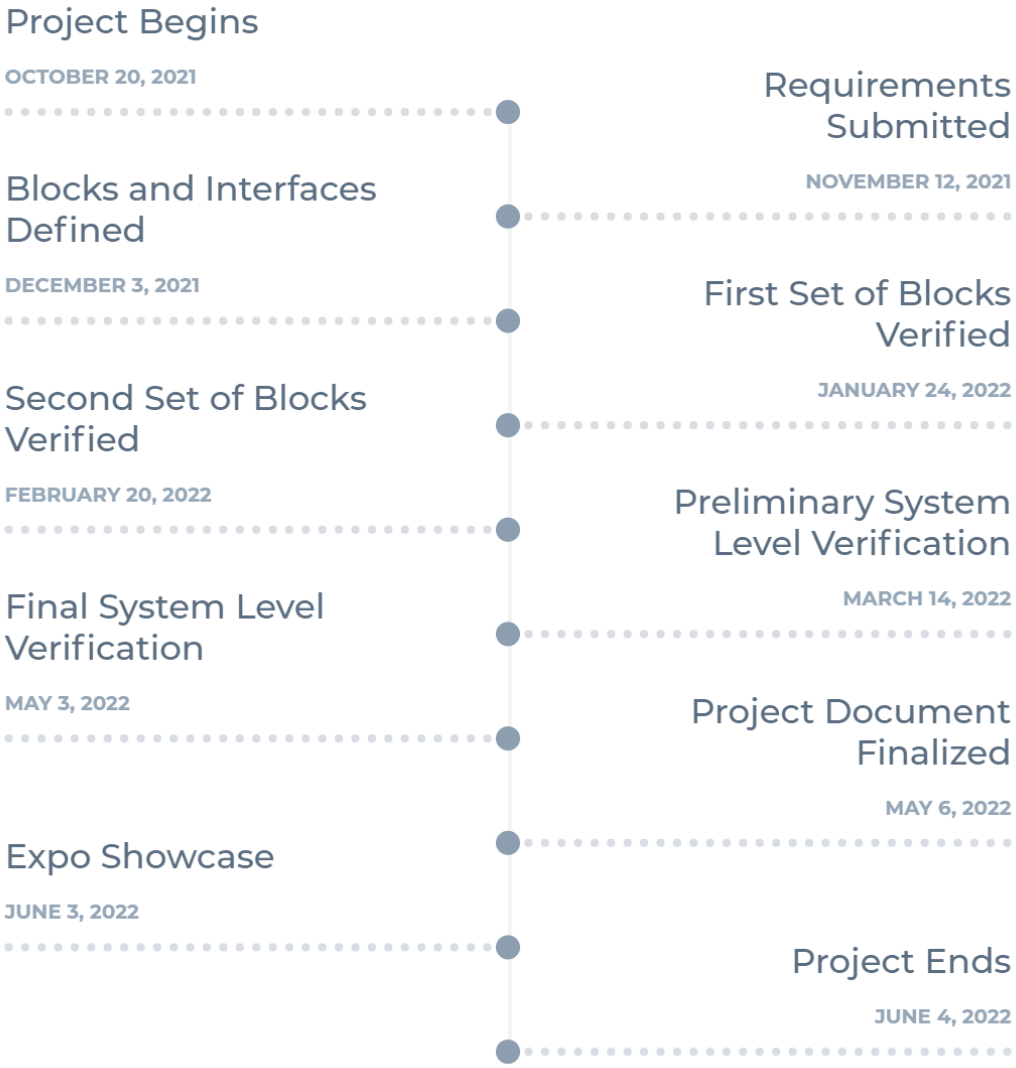

Figure 1: Timeline of the project, marking major milestones.