INDUSTRIAL SOLUTIONS LABORATORY

Company Information

Company Name	*Charlotte Super Fab Lab*	**Date Submitted**	*11/10/2024*
Project Title	*Developing Design Enhancements for Manufacturing Machines using Open Source Hardware (SUPERFABLAB_ENHANCE)*	**Planned Starting Semester**	*Spring 2025*

Senior Design Project Description

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills.

Discipline	Number	Discipline	Number
Mechanical	3	Electrical	1
Computer	1	Systems	

Company and Project Overview:

The Charlotte Super Fab Lab envisions becoming a world-class hub of innovation, where students, community members, and local industries collaborate to design, manufacture, and scale cutting-edge solutions. By providing access to advanced tools for metalworking, CNC machining, 3D printing, and digital design, we empower individuals to transform ambitious ideas into reality. As part of a prestigious global network, we aim to inspire creativity, foster sustainable development, and drive economic growth—positioning Charlotte as a leader in education, industry collaboration, and technological innovation.

The stakeholders of the project include Charlotte Super Fab, faculty members from Helmut Schmidt University, and Inmachines, the developers of the original open-source Fab Lab machines. Both Helmut Schmidt University and Inmachines are part of the larger Fab City Hamburg initiative, which is connected to the global Fab City movement. Through this collaboration, the project leverages the global Fab Lab network, including Charlotte Super Fab Lab and Fab City Hamburg, granting access to a wide range of resources, expertise, and shared knowledge from makers and engineers around the world. This network-driven approach fosters local production and global collaboration, enabling the project team to develop scalable, open-source hardware solutions

while regularly tracking progress and providing feedback to stakeholders throughout the process.

Project Requirements:

Design Problem:

The project revolves around designing and prototyping the next generation of Open Source Hardware (OSH) manufacturing machines specifically for the global Fab Lab community. The challenge is to democratize the manufacturing process by empowering individuals to construct their own machines. Currently, Fab Labs use a variety of open-source machines (laser cutters, 3D printers, desktop milling machines, etc.), and this project seeks to identify improvements and advance their designs to make these machines more accessible, efficient, and robust.

Project Objectives:

The key objective is to contribute to the open-source hardware library by improving upon one of the available OSH machines. Students will select an existing fabrication machine from a list (laser cutter, FDM 3D printer, desktop milling machine, vinyl cutter, or 3D scanner) and focus on researching, designing, and implementing improvements. The improvements could range from enhancing components, adjusting fabrication techniques, or redesigning the machine's mechanisms to boost performance, reliability, or ease of use.

Desired Output:

The desired outcome is a fully functional and improved version of the selected OSH machine. The team will document the research process, highlight the shortcomings of the current machine, and propose a design solution. They will then prototype, test, and refine the improvements. The final deliverables will include:

Research Documentation:

- A detailed report on the chosen OSH machine, including its functionality, current limitations, and potential areas for improvement.

Improvement Design:

- CAD designs and specifications for the selected improvements. This might include redesigned components, new fabrication techniques, or modified mechanisms.

Prototype:

- A working prototype of the machine with the implemented improvements.

Test Report:

- Documentation of the testing phase, evaluating how well the improvements have enhanced the machine's performance. This could include metrics for reliability, precision, speed, replicability, and ease of use.

Contribution to Open Source Community:

- The design files and documentation are to be shared in the Open Source Hardware community repository (version control software) from the beginning through the lifetime of the project. The intention is to ensure that other Fab Labs or individuals can replicate or further improve upon the new machine design.

Scope & Specifications:

Machine Selection:

- The project starts by selecting one of the following open-source fabrication machines: Laser Cutter, FDM 3D Printer, Desktop Milling Machine, Vinyl Cutter, or 3D Scanner.

Research and Ideation:

- Conduct an in-depth analysis of the selected machine, identifying areas where improvements can have a significant impact, either in performance, cost-efficiency, or ease of construction.

Design Constraints:

- The design must adhere to OSH principles—meaning it should be open for anyone to access, modify, and share.
- Components must be either easily sourced or produced in a Super Fab Lab to ensure accessibility for the global Fab Lab community.

Prototype Development:

- Use digital fabrication tools and materials accessible to Fab Labs to build the prototype.

Testing & Iteration:

- Test the prototype machine to evaluate the improvements, ensuring the new design performs better or more efficiently than the original.
- Incorporate feedback from the testing phase to iterate on the design.

By the end of the project, students will have enhanced a fabrication machine's design and functionality, contributing back to the global Fab Lab community and promoting the democratization of manufacturing through open-source tools.

Disposition of Deliverables at the End of the Project:

Students are graded based on their display and presentation of their team's work product. It is mandatory that they exhibit at the Expo, so if the work product was tested at the supporter's location, it must be returned to campus for the Expo. After the expo, the team and supporter should arrange the handover of the work product to the industry supporter. This handover must be concluded within 7 days of the Expo.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- Machine Design and Analysis
- Embedded Systems
- At least two students who have taken MEGR 2156 Machining Lab