

# STARX Build Team Proposal

The Strength Augmenting Robotic Exoskeleton (STARX) build team is focused on making strength-augmenting assistive powered exoskeletons to increase the strength of the user, while not getting in the way of the user. This team will be spending the first two semesters of its existence designing, building, and testing one or more powered exoskeletons for the arm that would increase the strength of their bicep and triceps. This will mean regular meetings for collaborating on the design of the exoskeleton, machine work to build and assemble it, and doing both testing within the team and working with on-campus researchers for more accurate and in-depth testing.

The team is moving to be circularized for the purpose of getting more students involved, allowing more time for students to work on the project, and to legitimize the project in order to more easily obtain collaboration with research groups and funding/sponsorship. In other words, it would allow the team to get far much more done than on its own and allows the team to make real contributions to the field of powered exoskeleton technology. It would also enable a more structured team that would give students real hands-on experience in engineering that they normally would not get until getting a job.

Currently the team is structured as one whole group working on the overall design. Since a large portion of the team will be working on the project over the summer, during this time the team will split into two sub-teams based on student's interests: Structure and Control System.

## **First team division:**

Structure: This sub-team is concerned with the design of the skeletal frame of the physical aspects of the exoskeleton. This will include the skeletal frame of it, actuation, gearing, and integration.

Control System: This sub-team will work on the electrical side of the exoskeleton. This will include the algorithms and sensors used to control the exoskeleton and the power source.

In the second semester of the project, we should be far enough along in the design process to split the team down further, with appropriate team leaders in each. The team will be broken down into four sub-teams that will need to work closely together: Skeletal, Actuation, Control System, and Electrical.

## **Second Team Division:**

Skeletal: This sub-team must develop the skeletal structure of the exoskeleton and its integration with the human body. This means making the structure strong enough to handle the loads, making it comfortable for the wearer so it doesn't bruise the skin, and working closely with Actuation to properly leverage the actuation used.

Actuation: This sub-team will be determining what is used to actuate the limb of the exoskeleton, and what methods they will use to leverage the force of the actuation. Possible projects within this group may include braking system, clutch, and/or variable transmissions for the actuator depending on which form of actuation is decided upon.

Control System: This sub-team will focus on the algorithm that will control the whole system. This will mean making use of the sensors of the exoskeleton and making use of any braking, clutch, or variable transmission that Actuation develops.

Electrical: This sub-team will work toward making sure the whole system has reliable power. This will mean unifying the power source of the actuator, microcontroller, and sensors, as well as adding a system to display the battery power left and any safety measures needed to protect the batteries.

It is quite clear that there will be overlaps between sub-teams and their work. For this reason, they will need to work closely together in order to make sure each sub-team's work is compatible with the others. If the overlap becomes too large, the four sub-teams may reform back into two sub-teams.

The overall team objective is to develop practical strength-augmenting powered exoskeletons that can be used on a daily basis. Its main function will be to increase the overall strength of the user without inhibiting normal movements or actions. This means it must meet the following criteria:

- Be lightweight and not bulky
- Run for at least an hour on one battery charge
- Increase user's targeted muscle strength by at least 5-10 lbs.
- Be comfortable enough to wear for several hours a day (all day ideally)
- Be entirely limb controlled (no controller separate from exoskeleton)
- Have an entirely portable power source

The team will be tasked with designing, building, and thoroughly testing an exoskeleton from the ground up.

My role in the team will be both administrative and hands-on. I will be organizing such things as team meetings, sponsorship, and contact with research groups that can help or collaborate with our team. At the same time I will be involved with the actual construction of the exoskeleton. Since we are just starting out, I will be leading all sub-team meetings until I have a strong enough understanding of the members of the team is serious about the project and their sub-team to assign sub-team leaders.

When these team leaders are assigned, I will still be involved in each sub-teams work as much as possible, with a focus on the Control Systems sub-team. I will also be making sure there is consistent contact between sub-teams on important information. Since the sub-team's work will overlap so much, this will be necessary to maintain.

To accomplish all of this, small consistent steps will need to be taken. The team will be starting with a simple arm exoskeleton in order to keep complexity down and give us a starting point that can be accomplished by the end of the Winter semester. The team is currently meeting on a weekly basis until the end of the Winter semester to start basic design ideas. A significant number of members are available to work on the project over the summer, during which a significant portion of the design phase can be accomplished.

The team will move to two sub-teams as soon as the Winter semester ends. At this point we will be able to determine who is interested in what aspects of the project, as well as learn who is serious about the project. This will help determine who will be the sub-team leaders at the beginning of Fall semester. Once Fall semester starts, the team will split into the four sub-teams. We will have designs from the summer either partially or completely finished, and so we will be able to use the Fall semester for exoskeleton construction/concept testing, as well as finishing or remaking designs. Winter will be spent mostly testing the finished exoskeleton and fixing any design errors that show up during testing. The finished product will need to be complete by the Winter Design Expo, where we will show off our completed design.

Ultimately this team is looking to advance the field of powered exoskeleton technology to a practical and useful level. Most powered exoskeletons are confined to a lab area and are not usable by a person in a real world setting. Our purpose is to change that by designing and building an exoskeleton that can help the user with everyday tasks and make a difference in the real world. These practical solutions will help show the technology can be useful outside of just labs and military applications, and are a major step toward making this a mainstream technology that is within the reach of anyone who needs it.

We will be presenting our finished exoskeleton to our faculty adviser and any companies that give us sponsorship. The team would be evaluated by the team lead and the faculty adviser to who would check that the finished exoskeleton meets the initially set design criteria.