How Direct Digital Manufacturing Gives Life to Customizable Safety Devices

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With the ever-increasing use of additive manufacturing in the classroom, as well as in the highest levels of academia, it seems like everybody is 3D printing these days. Children as young as Kindergarteners are being exposed to this new type of manufacturing because of its ease of use. This opens up a new field for DDM (Direct Digital Manufacturing), as access to and operation of a 3D printer become more commonplace. The industry is already seeing this in the success of the customizable Cyborg Beast 3D printed hand. With open source files and customizable parts, these prosthetic hands have revolutionized the industry by directly connecting the consumer to the manufacturing process. The device we at Texas A&M designed for this competition, "The Exoskeleton" seeks to capitalize on this newly developed market of consumer customizable medical devices.

With the increasing amount of neck injuries and concussions due to sports and other risky activities such as horseback riding or snow skiing, protection of the neck and cranium are of vital importance. The Exoskeleton was developed in response to this, as the mobility of some is prohibited by fear of injury, or injury itself. The Exoskeleton is a neck brace designed to distribute stress around the neck through a hollow Voronoi mesh. The hollow Voronoi structure will be filled with a non-Newtonian fluid, used to distribute localized stress around the neck instead of exerting a high localized force on the neck, causing injury. Idealized simulations were done on a symmetrical mesh filled with water where hydrostatic pressure was analyzed. These results prove that the pressure around the neck is better dispersed when a hollow mesh is filled with water rather than a solid structure.

This mesh will be fully customizable by the consumer through DDM. Large databases will contain different models and sizes of the neck mesh that consumers can download, edit, and create through the process of additive manufacturing. This process directly connects the

consumer to their own personalized Exoskeleton. Additionally, they may personally model The Exoskeleton directly after his/her self with a picture, using Autodesk Fusion 360. Therefore, it would be our goal to fit every player in contact sports with their very own Exoskeleton.