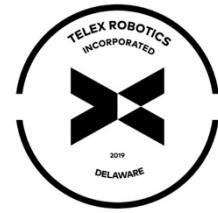


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Executive Summary

It has always been our dream to build technology that enables people push the limits of human exploration and collaboration. We envision a novel technology that allows people to interact with one another in the context of a fully immersive virtual environment. We imagine an architect taking her clients on a virtual tour of a proposed building; the architect walks them through the atrium, encourages them to look around and see the room, hear the sounds of the nearby traffic, and feel the building's material textures. We imagine engineers from around the world getting together in a virtual makerspace; they work with one another in real time, feeling the textures and the inertia of the tools as they use them. We imagine humans going where no human has gone before: mining fuel from an asteroid in outer space; walking along the bottom of the sea floor and documenting previously unseen creatures; venturing into the interior of a nuclear power plant during a meltdown to repair a damaged coolant system. In our vision of the future, technology that transports a human presence across the world not only exists, but is widely accessible and is used daily, from education—transporting a student to a remote classroom—to disaster relief.

We are proposing the development of a two-part system—a *robotic avatar* controlled by a *human operator* who is acting in a virtual space—that enables the above scenarios and more. One part of our system is a biologically-inspired humanoid robot, capable of moving with the speed, agility, and strength of a human. To facilitate social interactions, the robot will not only move like a human, but it will look like a human: it will comprise a head, two arms, and two legs; it will use underactuated, passively compliant hands for dexterous object manipulation; it will rely on a bipedal leg structure for fast, agile, and efficient locomotion. Our robot's joints will be milled from solid aluminum blocks, and its bones welded from hollow titanium tubing. Its actuators will be placed according to muscle placement in the human body, and then covered in a highly durable Kevlar skin to give the appearance of an organic form. In its movements, our robot will be deft, natural, and resilient to unexpected environmental perturbations. When interacting with people, our robot will faithfully replicate the operator's micro-expressions, subtle nods, and other social cues they use to navigate social interactions.

The other part of our system is an immersive virtual reality (VR) suit that senses the operator's movements and provides the operator with visual, aural, olfactory, tactile, and force-based sensations. The VR suit will comprise: a virtual reality headset to display visual data received from visible and infrared cameras on the robot; an array of speakers that spatially reproduce audio perceived by the robot; a custom haptic feedback bodysuit that renders tactile sensations as well as rigid and soft contact forces; an aroma device to replicate smells that the robot encounters; and a vestibular stimulation system, capable of influencing the operator's sense of

balance for the purpose of communicating the robot's spatial orientation. Even if the operator is located thousands of miles away from the robot, the robot's experience will be transmitted to the VR suit and rendered for the operator with imperceptible latency. We attempt to achieve this by implementing a continually-learning generative adversarial network to preemptively send data between the operator and the robot.

We are aware that this project is a moonshot, but cutting-edge, never-been-done-before territory is where our team thrives. Our team is composed of two passionate core members and a diverse advisory board, consisting of professional engineers, artists, and professors, each an expert in their field. The small size of our core team allows us to move fast, quickly innovating and iterating on our designs. The intellectual breadth and depth of our advisory board allows us to tackle the most challenging problems standing in the way of developing full telepresence technology. Along with the entire ANA Avatar XPRIZE community, TeleX Robotics is excited and ready to bring telepresence technology to the world.