XPRIZE
AVATAR

ANA

FINALISTS
2022

THE NEW STANDARD FOR TELEPRESENCE

ANYWHERE IS POSSIBLE

Telepresence technology is not new, but a new standard is being defined by Avatar Robots. Today, telepresence comes in forms ranging from typical video conference calls to wheeled systems with built-in display screens, and these have become key components in our daily global communications. But as the integration of a variety of technologies continues to drive innovation in the robotics space, it is now possible to transmit more human senses and capabilities through telepresence systems. Catalyzed in part by the recent global shift toward hybrid or fully remote work, as well as increasingly isolated social groups and the environmental impact of travel, Avatars are changing the manner in which we can communicate and will enhance our remote interactions. Avatars act as a human-operated extension of the body, and can be deployed anywhere; from populous cities to remote locations that are difficult, expensive, or perhaps impossible for humans to physically reach, but where human decision making and skills are still necessary. Avatars can enhance our daily social interactions, medical care, scientific research and exploration, industry and commerce, and more.

The ANA Avatar XPRIZE challenges and incentivizes universities, startups, companies, and individuals from around the world to develop these technologies on an accelerated timeline and bring a viable product to market.

INVESTMENT LANDSCAPE

There has been huge growth in the economic benefits of robotic services in areas as diverse as surgical assistance, warehouse and inventory tasks, research and development, and social interactions. The global telepresence robots market reached a value of US$ 248.2 Million in 2021 and it is poised to have an increasing global economic impact predicted to reach a value of more than US$ 580 Million by 2027. While avatar robotics is a relatively new field in the telepresence arena, over the course of this decade the technology will continue to be honed, playing a more integral role in a wide variety of use cases. In the wake of that development, the market is set to continue its upward trend.

AVATAR XPRIZE

The teams profiled within are Finalists in the ANA Avatar XPRIZE, a $10 million global prize competition to develop a physical robotic avatar system that enables a human operator to transmit their senses, actions, and presence to a remote location in real time, so that they can interact within that space as if they were physically there.

Over the past four years each team has been vetted by a panel of expert judges against performance metrics that assessed the Operator's experience controlling the Avatar, the Recipient's experience interacting with the Avatar, and overall system capabilities including object grasping and manipulation, mobility, touch and haptics, and others that enable an authentic and immersive remote experience. Now they are further developing and enhancing their Avatars as they prepare to demonstrate their capabilities on the Finals Test Course, where their systems will be challenged to demonstrate advanced mobility, haptics and manipulation, and interaction capabilities while completing tasks across three domains: Connectivity, Exploration, and Skills Transfer.

The Finalists are currently engaging investors to fund their developments and beyond. Investors and prospective partners interested in learning more are encouraged to contact the team leaders directly for specific inquiries, or to connect with XPRIZE for general information (avatar@xprize.org).

FINALISTS

- ALTEREGO
- AVADYNAMICS
- AVATAR-HUBO
- AVATRINA
- CYBERSELVES | TOUCHLAB
- DRAGON TREE LABS
- I-BOTICS
- ICUB
- INBIODROID
- JANUS
- LAST MILE
- NIMBRO
- POLLEN ROBOTICS
- TANGIBLE
- TEAM NORTHEASTERN
- TEAM SNU
- TEAM UNIST

Show All Finalists

AlterEgo

AlterEgo exploits soft robotics to create effective, versatile, and intuitive avatars for the real-world, so that even the most naive operator can use it to experience a remote environment.

CONTACT:
Team Leader: Manuel Giuseppe Catalano
Team Contact: CEO, Manuel Giuseppe Catalanoz, manuel.catalano@iit.it

iit.it/it/web/soft-robotics-for-human-cooperation-and-rehabilitation/service
@alterego_iit.cp
AlterEgo

FUNDING NEEDS:
Yes

FUNDING STAGE:
Starting

PARTNERSHIP NEEDS:
Product Developer

LOCATION:
Genova, Italy

TECH STAGE:
TRL 6, Prototype

OFFICIAL TEAM PARTNER(S) OR UNIVERSITY AFFILIATION:
Istituto Italiano di Tecnologia, Genoa, Italy iit.it, University of Pisa, Bioengineering and Robotics Research Center "E. Piaggio", Pisa, Italy centropiaggio.unipi.it

Our ambition is to create a platform that can remotely share the physical and social interaction skills of a human being. Leveraging the scientific and technological background of our group, we are creating a real-world effective avatar robot that can perform complex bi-manual manipulation tasks and share the social communication modalities of humans, such as posture, gestures, gaze direction, and facial expressions. Using feedback collected from naïve people operating the avatar, we developed an intuitive directly experienced by the pilot, and natural and unobtrusive input interfaces for controlling the robotic avatar.

THE AVATAR

AlterEgo is a collaborative, modular lightweight robot with a humanoid upper body and a wheel-based mobile platform, designed for safe and effective interaction. It has 6-DoF robotic arms and soft hands. These have anthropomorphic shape and kinematics and feature synergetic nature-inspired motions to yield intuitive and proficient operation. Thanks to its elasticity, AlterEgo adapts both to heavy duties and delicate tasks. The avatar stands on 2 wheels, as an inverted pendulum: this minimizes its footprint and yields agile navigation in narrow spaces.

AlterEgo is equipped with a stereoscopic vision system and a multidirectional microphone array and speaker system to enable bidirectional communication and situational awareness. An active robotic neck supports the avatar's head following the pilot's head. The hands integrate IMUs to measure the hand configuration and dynamic interaction to render it to the pilot through haptic interfaces and augmented reality.

MARKET APPLICATION

AlterEgo can closely replicate the movements and dynamics of the operator. This endows the robot with the human-like capability of regulating the interaction with the environment. It can effectively replace human presence in several situations, including operation in dangerous or hazardous environments (e.g. nuclear waste decommissioning), disaster response (e.g. nuclear disaster, earthquake, floods), healthcare and remote caregiving (e.g. nursing, elderly assistance, family care), and expert technical interventions (e.g. industrial maintenance).

TEAM COMPOSITION

The team is a joint venture among two research institutions: Istituto Italiano di Tecnologia and University of Pisa.

Istituto Italiano di Tecnologia contributes its longstanding experience in soft robotics, humanoid design and control, manipulation, teleoperation, and shared-autonomy control. University of Pisa brings long standing experience in wearable technologies and sensory feedback techniques.

The team is led by Manuel G. Catalano, PhD, researcher in the IIT SoftBots research Line, and counts 10 Engineers, 5 PhD Students and 5 Senior Researchers, from IIT SoftBots, IIT HRI, IIT HHCM and University of Pisa's Robotics Research Center "E. Piaggio".

BUSINESS MODEL

We aim to implement an affordable teleoperation platform by combining technologies that are maturing and are now available on the market (e.g., soft robotics, HMDs, robot hands).The product will sell for a price comparable to that of a motorbike. Therefore, direct commercialization of the robotic platform and renting will be feasible business models.

AlterEgo enables remote operation by robotics-naive, application-savvy operators, without additional infrastructure and training, lending to applications in healthcare, inspection, maintenance, hazardous material handling, and social interaction.

Show All Finalists

AvaDynamics

Our mission is to provide a platform for humans to contribute and flourish in the workplace of the near future while decoupling the location of the worker from the workplace.

CONTACT:
Team Leader: Billy Zelsnack
Contact: Billy Zelsnack, billy.zelsnack@gmail.com

avadynamics.com
@BillyZelsnack

SPONSOR(S):
TBA

LOCATION:
Pittsburgh, USA

CORPORATE STATUS:
LLC

TECH STAGE:
Advanced prototyping

Technological advancements have always created more job opportunities than they made redundant. Will this continue into the near future as robots become ubiquitous in the workplace? Yes. However, newer job opportunities typically require more specialized skills, which require more training. With Avatar technology we can seamlessly combine skills training and work. You can always be up to date with the skills that employers need because skills training is built into your work. You are also not limited to work near where you live. Now the opportunities of the entire planet are open to you.

THE AVATAR

The Team AvaDynamics Avatar system is built around the idea that humans must always feel safe around the system. This is accomplished by keeping the avatar robot aesthetically non-intimidating and by using lightweight and maximally compliant limbs. Conventional robot limbs use small motors with high ratio reducers which make them very stiff and non-compliant to external impacts, but they can be extremely accurate and repeatable. Our limbs use large motors with low ratio reducers which makes them more spring-like and compliant to external impacts, but accuracy and repeatability is reduced. This is more in line with the capabilities of humans and it is safer, so the trade-off is worth it.

MARKET APPLICATION

In a few years it will be possible for a worker to begin training for a skill in virtual reality and gain accreditation for the mastery of that skill. A skill acquired in virtual reality will be directly transferable to performing the same skill with a robot in real life. That robot can be a few feet away from the operator, halfway around the world, or even operated from the earth to a robot in orbit.

People with skills and people requiring skills will be able to negotiate a trade on a worldwide marketplace and in any currency. These trades could be attached to their real life identity or to a pseudo-anonymous virtual avatar into which an operator has invested their accredited training.

People requiring skills will be able to easily create and update virtual reality training programs that train for the exact skills that they require and their talent pool will be worldwide.

TEAM COMPOSITION

Team AvaDynamics contributors change with the various stages of the competition. Currently the team consists of two active members: Billy Zelsnack and his son Turing Zelsnack. We build a lot of prototypes and leverage CAD and 3D printing as much as possible. For finals we have been building a completely new robot using the lessons learned from the competition so far.

Show All Finalists

Avatar-Hubo

We pioneer novel solutions in robotic telepresence to build a better future.

CONTACT:
Team Leader: Dr. Paul Oh
Contact: Dr. Jean Chagas Vaz, chagasva@unlv.edu

avatarhubo.com
@avatarhubo_unlv

FUNDING NEEDS:
$500,000

FUNDING STAGE:
$35,000

PARTNERSHIP NEEDS:
Corporate funded sponsorships; Equipment-in-kind donations (based on team's list of preferred equipment)

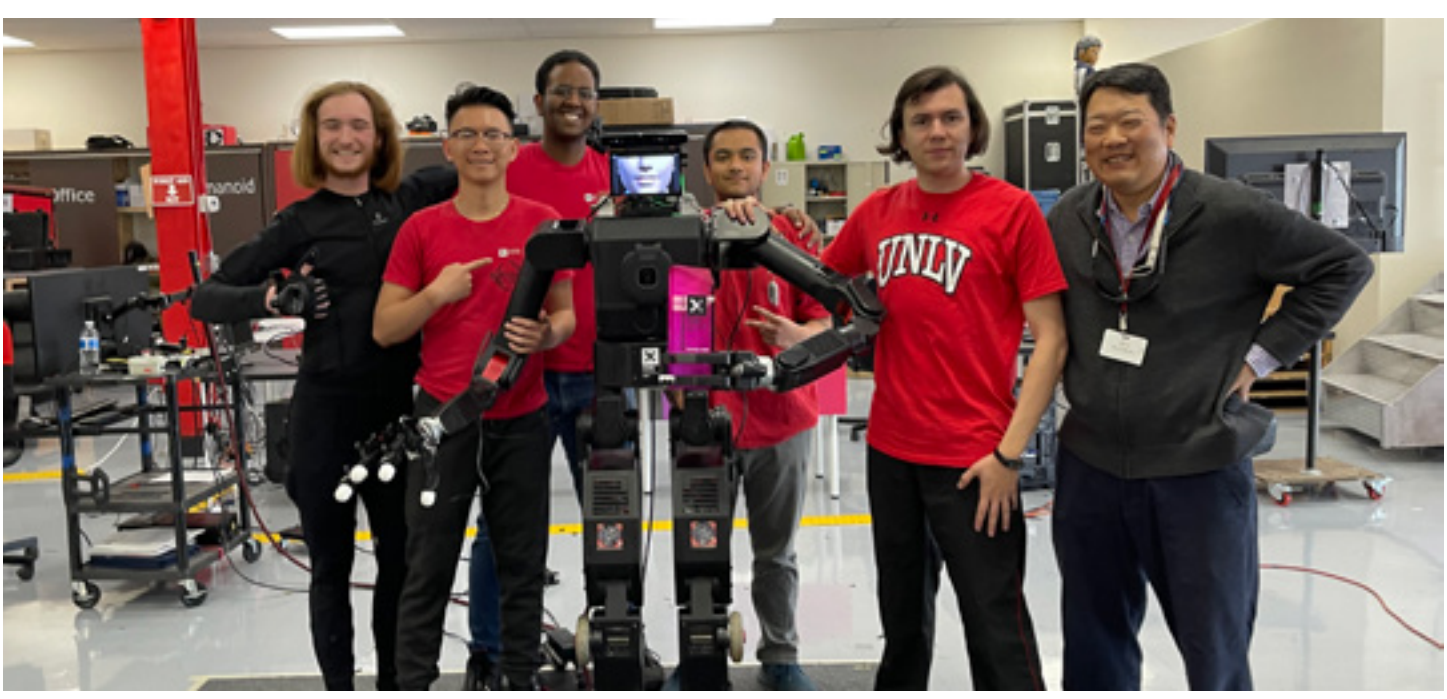
SPONSOR(S):
University of Nevada Las Vegas (UNLV) and UNLV's Drones, and Autonomous Systems Lab (DASL)

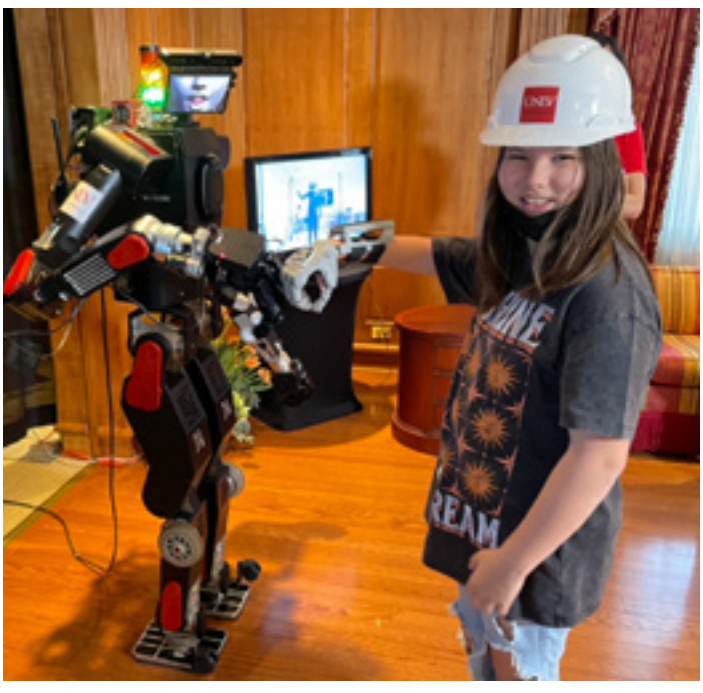
LOCATION:
Las Vegas, NV, USA

CORPORATE STATUS:
State Public University

TECH STAGE:
Technical Readiness Level (TRL) = 6 (Technology demonstrator)

OFFICIAL TEAM PARTNER(S) OR UNIVERSITY AFFILIATION:
University of Nevada, Las Vegas, Drones and Autonomous Systems Lab @ UNLV





Our team wishes to benefit humanity through the employment of Avatar robotics. We envision a future consisting of an "Avatar Revolution", characterized by people freely embodying humanoid Avatar systems to work, connect with others, and even explore distant locations. Through the harmonious integration of human intuition into robotics, we wish to supersede the physical limitations of mankind, be it in strength, stamina, or location. Imagine a firefighter saving lives while staying out of harm's way, a father bonding with his children overseas, or mankind exploring Mars without leaving Earth. By repurposing a disaster response humanoid to be an Avatar System, our team will be part of such an innovative revolution.

THE AVATAR

Our humanoid Avatar system, Avatar-Hubo, is a completely revamped version of the famous transforming dual-locomotion disaster response humanoid, DRC-HUBO, which won the DARPA Robotics Challenge in 2015. Since then, the engineers at our robotics research lab have expanded the robot's material handling capabilities, enabling it to carry large buckets of water, push shopping carts, and even manipulate objects like wheelbarrows, demonstrating a level of material handling that Avatar Systems seldom have. Avatar-Hubo was upgraded with a highly dexterous hand for intuitive, human-like, dexterous manipulation, two additional computing units, and a custom-designed telepresence-ready head. This Avatar System also features operator equipment like a Valve Index Headset, a pair of Bebop haptic motion-capture gloves, and full-body electro-stimulation haptics via a Teslasuit. The amalgamation of these technologies grants an operator the ability to embody a powerful functional humanoid in an intuitive, immersive manner.

MARKET APPLICATION

Avatar Systems like Avatar-Hubo mimic the actions of a human. The inherent benefit of allowing a body to mimic actions remotely cannot be understated; for example, Avatar technology allows dangerous and physically strenuous tasks to be done by a human through a robot, protecting the operator and reducing the risk of injury. The remote work capabilities of this technology also show great promise in skill-intensive fields like surgery. Through Avatar Robotics, surgeons can work remotely, removing costs associated with transportation while also providing higher-quality medical operations and procedures around the world. Avatar-Hubo's particular robustness may also prove beneficial in the aerospace industry. Transportation across the globe can take hours or even days; imagine embodying an avatar system and transporting your presence anywhere in the world in mere seconds.

TEAM COMPOSITION

The Drones and Autonomous Systems Laboratory (DASL) at UNLV is led by Dr. Paul Oh, who guides team captain Dr. Jean Chagas Vaz. His team comprises bright and innovative DASL researchers, including Ph.D., graduate, undergraduate, and international students with plentiful experience in robotics, virtual reality, manufacturing, and electronics. This variety in experience brought forth the Avatar-Hubo that we see today. The coordinated efforts between the three main subsystems—motion, vision, and haptics—produce the seamless and immersive Avatar experience provided by Avatar-Hubo.

BUSINESS MODEL

Following the ANA Avatar XPRIZE finals, we want to continue research in robotic telepresence and Avatar Systems, especially in functional robotics contexts. One major aspect of Avatar Systems we wish to improve is material handling during locomotion (loco-manipulation). For example, firefighters embodying an Avatar System will require a system capable of locomotion through debris-filled terrain while also handling non-rigid objects like fire hoses. Additionally, great work can be done in the area of social robotics; Avatars allow humans to possess and command a robotic body naturally, creating training data for machine learning-driven social robotics AI.

Show All Finalists

AVATRINA

Team AVATRINA builds on decades of prior research in telerobotics, VR, and autonomy to deliver a highly capable Avatar and ergonomic user experience.

CONTACT:
Team Leader: Kris Hauser
Contact: Professor Kris Hauser, UIUC, kkhauser@illinois.edu

avatarxprize.web.illinois.edu
@lllinoisecs
@lllinoisComputerScience

FUNDING NEEDS:
$2M

FUNDING STAGE:
Basic and Translational Research

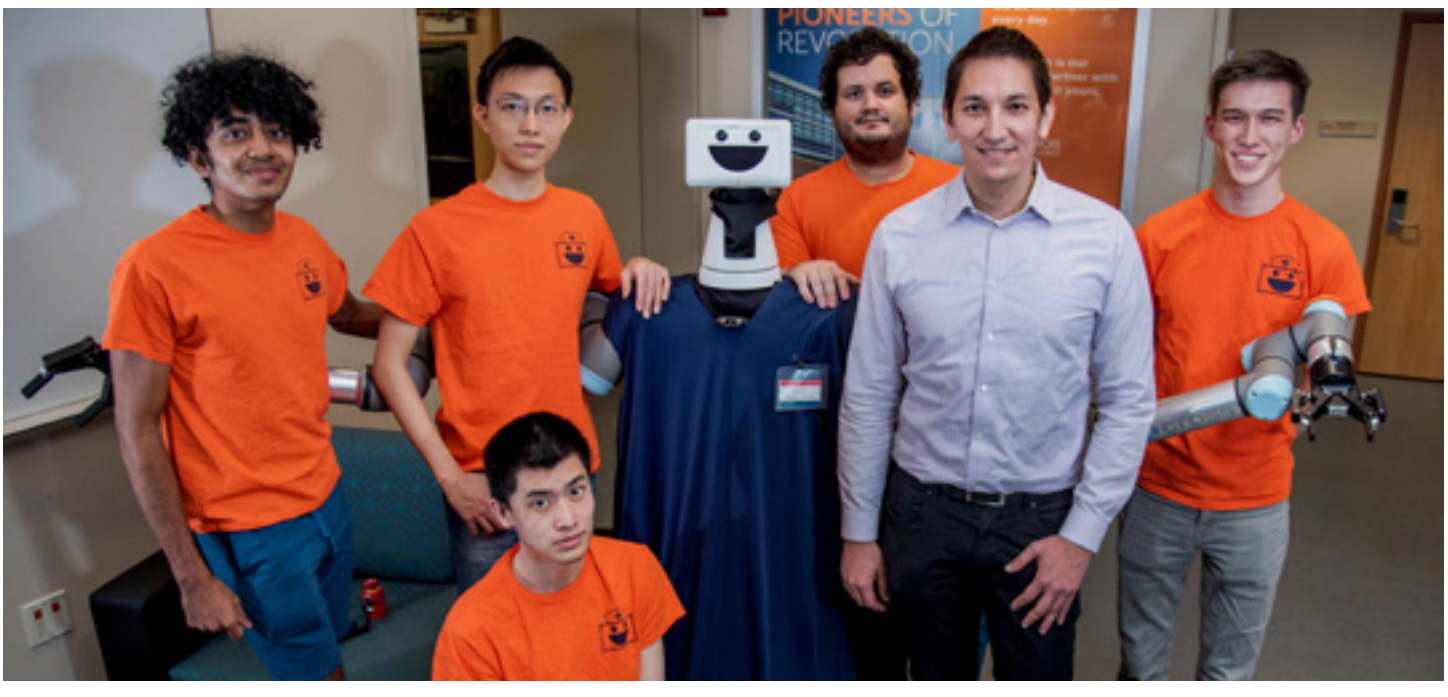
SPONSOR(S):
National Science Foundation

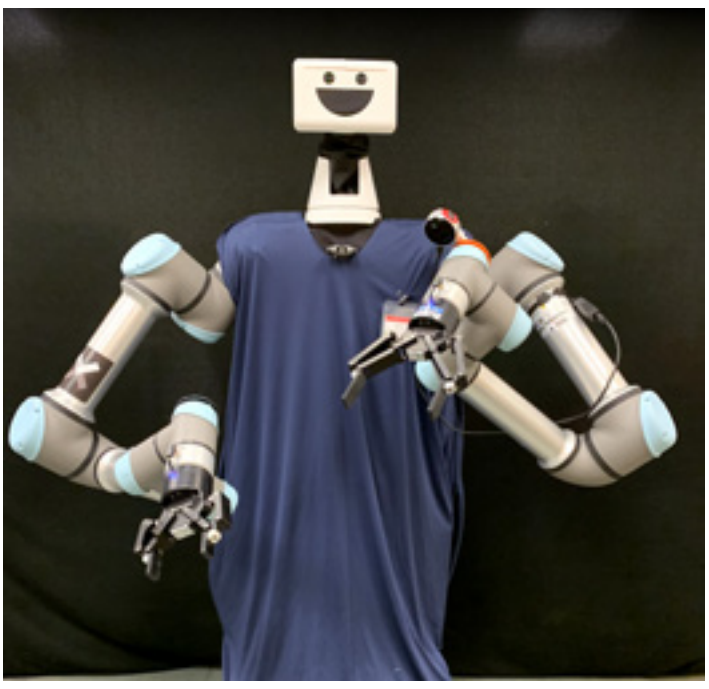
LOCATION:
Champaign, IL, USA

CORPORATE STATUS:
Not incorporated

TECH STAGE:
Lab pilot

OFFICIAL TEAM PARTNER(S) OR UNIVERSITY AFFILIATION:
University of Illinois, Urbana Champaign; VRotors LLC





Team AVATRINA is a collaboration between University of Illinois, Urbana-Champaign and VRotors, Inc., to build a robotic avatar for the ANA Avatar XPRIZE. Our telepresence platform is named TRINA (Tele-Robotic Intelligent Nursing Assistant) and provides communication, mobility, manipulation, and sensing for nursing, in-home care, tourism, and remote work applications.

This ANA Avatar XPRIZE effort builds off 7 years of NSF-funded research in tele-nursing and semi-autonomous teleoperation. The vision behind this work is that teleoperation in healthcare settings is an enabling technology for infection risk reduction during pandemics, caregiving for immunocompromised patients, and remote and rural healthcare. TRINA's capabilities have been developed and tested with human nurses and nursing student operators, and have demonstrated a wide variety of caregiving tasks.

THE AVATAR

TRINA (Tele-Robotic Intelligent Nursing Assistant) consists of a mobile base, two robot arms, grippers, a movable head, and many sensors. The robot can run off an onboard battery for two hours of continuous use, or through a tether. It has similar height and reach as an average adult female. TRINA's Operator Interface consists of a VR headset and haptic gloves to convey high quality vision and touch feedback to the operator.

TRINA's head mimics the operator's head movement to convincingly display nodding and other head gestures. It also contains a screen showing telepresence video of the operator. When the operator is wearing a VR headset, we perform a "deepfake" rendering to display an unobscured view of the his/her face, including mouth movements and facial expressions.

Safety features include speed limits, compliant motion, proximity sensors, and a system-wide emergency stop. TRINA can be also outfitted with a variety of grippers to provide different functionality for specialized contexts.

MARKET APPLICATION

A looming crisis for the upcoming decades is providing affordable healthcare to an aging population – in fact, there is a projected deficit of 1 million home health care jobs by 2035 in the U.S. alone. We envision remotely operated robots that allow relatives, caregivers, and emergency responders to directly render physical aid to older adults, which will save time and money and improve health outcomes by reducing the need for commuting. We are tantalizingly close to this reality; telepresence robots have already been used during the COVID pandemic to provide telehealth services and communication with loved ones to hospital patients in quarantine. More generally, telemanipulators like TRINA have applications in surgery, explosive ordnance disposal, space exploration, and logistics, and the core technology developed by our team applies directly to these broader areas.

TEAM COMPOSITION

Team AVATRINA is a partnership between the University of Illinois at Urbana-Champaign and VRotors, Inc., a startup company in California. Led by Professor Kris Hauser of the UIUC Department of Computer Science, the team is composed of university researchers and students at UIUC and professional engineers at VRotors.

BUSINESS MODEL

Our current research is studying semi-autonomous methods to deliver higher efficiency and improved ergonomics of teleoperation. During tedious or routine operations, treating the robot as a "taskable" autonomous tool will help operators make better use of their time and attention. Our research is studying AI algorithms for learning, planning, and recommending autonomous actions to users. Crucially, these algorithms are trainable to allow a user to tune a robot's operations to the task context and perform better over time, and adaptive so that the robot's capabilities and awareness can progressively be expanded in open-world deployment.

Show All Finalists

Cyberselves | Touchlab

We combine Touchlab's human-like touch with Cyberselves' hardware-agnostic, low-latency software to remove the barriers to entry and make robots work.

CONTACT:
Cyberselves
Team Leader: Daniel Camilleri
Contact: COO, Michael Szollosy, michael@cyberselves.com

cyberselves.com
@cyberselves
Cyberselves
@cyberselves
linkedin.com/company/cyberselves
@cyberselves

CONTACT:
Touchlab
Team Lader: Dr. Zakareya Hussein
Contact: CEO, Zaki Hussein, zaki@touchlab.io

touchlab.io/
@touchlab_limited
Touchlab
@TouchlabL
linkedin.com/company/touchlab-limited
@touchlabL

FUNDING NEEDS:
Cyberselves £2M
Touchlab N/A

FUNDING STAGE:
Cyberselves £2M
Touchlab £3.5M

LOCATION:
Cyberselves Sheffield, UK
Touchlab Edinburgh, UK

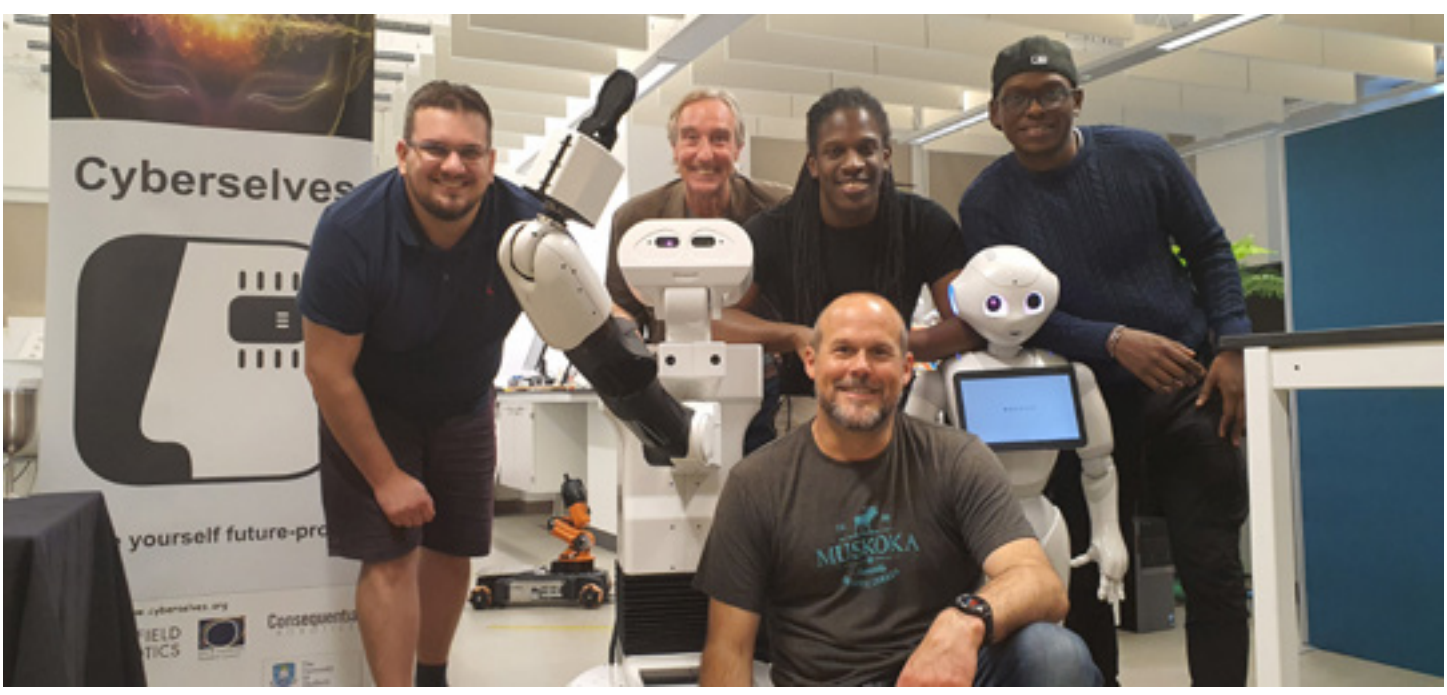
PARTNERSHIP NEEDS:
None

SPONSOR(S):
PAL Robotics (Barcelona, Spain); QTSS (Quantum Tunnelling Super Sensors); ECR (Edinburgh Centre for Robotics); Hitek; Higgs Centre for innovation; PEL (Printed Electronics Limited); SCHUNK GmbH & Co. KG.

CORPORATE STATUS:
Cyberselves Ltd.
Touchlab Ltd.

CUSTOMER(S):
Touchlab Shadow Robot
Sellafield Ltd.
Cyberselves UK DASA, Heriot-Watt University, Sheffield Robotics

TECH STAGE:
Cyberselves' core technology, Animus, is at an alpha release stage and commercially available to select customers.



Team Cyberselves | Touchlab fuses both of Great Britain's competitors in the ANA Avatar XPRIZE into one super-team that wants to bring a more human touch to robotics. Touchlab brings its world-leading e-skin haptics technology, while Cyberselves provides its renowned low-latency communication that can integrate any hardware configuration. Both teams are driven to use their technologies to make a real difference in the pressing social and environmental issues that the world faces today, particularly in healthcare, environmental security, and nuclear decommissioning. To maximize their impact, both teams are committed to wide collaboration, and to deploying solutions that are flexible, affordable and scalable, helping technology touch more and more diverse lives, while also making that touch more meaningful and intimately human.

THE AVATAR

The avatar system, THAT (Tactile Human Avatar Telepresence) System, incorporates the latest technologies in robotics and human-machine interfacing in the construction of an unparalleled, near-human-performance telepresence system. Our avatar includes radical innovations such as advanced optic systems to enable an operator to view their surroundings with natural depth, and highly dexterous hands with high-density haptic feedback that allow an operator to manipulate objects as if they were using their own hands. THAT System further augments the immersive experience with whole-body tracking, facial feature tracking and force feedback. All of this is packaged into a single, fully integrated, commercially-viable system that anyone can learn how to use within an hour by completing the pre-packaged VR training scenarios.

MARKET APPLICATION

Our initial application of the avatar technology will be in the medical sector. Here, we are using the avatar to reduce the transmission of healthcare-acquired infections in hospitals and have scheduled a medical Telerobot pilot for a Finnish hospital in early 2023. In addition to healthcare, our technology addresses many of the issues faced by social care today, such as a shortage of care providers and fears of cross-contamination between patients and care staff. Our avatar technology can also have a real impact in education, providing learners of all ages with tangible contact with high-end robotics technology that is so lacking today. Environmental and social sectors are key to our market strategy,with avatars helping to keep humans from harm in hazardous environments, such as in nuclear decommissioning and the emerging Space sector.

TEAM COMPOSITION

Team Cyberselves | Touchlab leaders, Daniel Camilleri (Cyberselves) and Dr Zaki Hussein (Touchlab), are the founders and CEOs of their respective companies and the developers of cutting-edge technologies in their respective fields. The team is supported by a talented group of developers, roboticists and designers that will deliver world-leading hardware and software for our avatar system, bringing together state-of-the-art technologies and a user interface that is intuitive and comfortable for operators across a range of tasks. The team has strong links to UK universities, with a mix of employees and academics working on the project.

BUSINESS MODEL

The combined teams look to lease the avatar components from suppliers, before integrating the e-skin and Animus software to make the avatar a commercial product and service. The team favors a Hardware as a Service (HaaS) approach to selling the avatar and accompanying software, due to the hard-to-access nature of our target markets in healthcare, education and hazardous environments such as nuclear decommissioning.

Show All Finalists

Dragon Tree Labs

Dragon Tree Labs is in stealth mode working on a commercial product in the area of telerobotics.

CONTACT:
Team Leader: Llya Sedoshkin
Contact: Project manager, Igor Kovrigin, igor@dtlabs.tech, Llya Sedoshkin, i@dtlabs.tech

dragontreelabs.tech
@dragontreelabs
Dragon Tree Labs
linkedin.com/company/dragontree-labs
@dragontreelabs

FUNDING NEEDS:
Private funding for technology development

FUNDING STAGE:
Funded, seed-stage

PARTNERSHIP NEEDS:
- Haptics tech developers
- Tech giants focused on telerobotics and consumer electronics
- Global leaders in space exploration

LOCATION:
Singapore

CORPORATE STATUS:
Registered Legal Entity

TECH STAGE:
Technical prototypes development

Our team has been working towards super intelligence systems for many years now. Human-machine symbiosis is needed to make meaningful progress in this field. Technology-wise, an avatar system allows us to utilize real life human behavior and decision making for the development of AGI.

For all of us, Avatar technology will change how we work and communicate in the real world. Distance and geographical presence will no longer impact how we convey our emotions, intentions and actions. Our Avatar system is designed to transmit a complete personality of an operator sitting remotely by transferring his actions and 3D audio-video look into the remote space.

Our team is extremely focused on creating mass-market tech solutions and implementing cost efficient tech into the system.

THE AVATAR

System Name: ANTHROPOPHONE © Beta, by DT Labs (short: Nrophone)

Nrophone avatar system is a wheeled platform with 2 arms built of 6DoF manipulators and 4 fingers. The avatar's head has flexibility to turn in 3D directions observing the surroundings and presenting the face of the operator. We aim to construct a Human-like head that displays the Operator's face & emotions (details not disclosed until patent published).

The avatar is controlled from the operator's station consisting of a 3D screen combined with a wide-angle curved display to observe Avatar's surroundings. The Operator has the ability to switch to a VR headset. The Operator is using a Haptic-controlled interface with fingers force feedback and ability to switch to copying manipulator mode (patent-pending).

Unlike existing solutions, our Avatar system is capable of transferring a 3D view of both the Operator's and Avatar's surroundings.

Core technologies that we use include ROS, RealSense & computer vision, Dynamixel motors with low level code, 3D Display & VR.

MARKET APPLICATION

Immersive, real-life remote communication for personal and business needs. The system will support social interaction, feeling of the remote space and the ability to communicate remotely as if you are there. Currently, we are testing simplified versions of the telepresence systems for B2C and B2B usage to enable people to accompany one another and experience similar environments and activities.

Due to high costs of each system and custom specs requirements by different industries, today such systems can be used by university research labs, space exploration industry, and potentially rescue teams. Additionally, state programs for elder care can already utilize telepresence solutions for better, more attentive support of elderly people.

Show All Finalists

i-Botics

i-Botics creates synergy in multimodal telepresence, transporting the operator's social and functional self to any fit-for-purpose avatar through a compelling combination of state-of-the-art social, visual, haptic, audio and olfactory technologies. i-Botics: Be anywhere!

CONTACT:
Team Leader: Jan Van Erp
Contact: Prize Coordinator, Tycho Brug, tycho.brug@tno.nl

i-botics.com
linkedin.com/company/i-botics-xprize

FUNDING NEEDS:
We are open to discuss sponsoring

PARTNERSHIP NEEDS:
Open to investigating collaboration (within the ANA Avatar XPRIZE or related projects)

LOCATION:
Soesterburg, The Netherlands (primary); also The Netherlands, Norway, Germany, France & Switzerland

CORPORATE STATUS:
Companies (Halodi, Haption, Sensiks), universities (ETH Zürich, University of Twente) and applied research organization (TNO)

CUSTOMER(S):
Governmental institutes to high-tech industries

TECH STAGE:
Part research and development, part commercial product

OFFICIAL TEAM PARTNER(S) OR UNIVERSITY AFFILIATION:
Halodi, Haption, ETH Zürich - RSL, Sensiks, TNO, University of Twente

Our vision is that distance should not be a barrier to experiencing social connectedness or to applying one's skills and knowledge to make this world a better and safer place. Our mission is to develop a system that enables the user to feel present at, and interact with, a remote environment and the people in it as if physically present. By joining the ANA Avatar XPRIZE, we are determined to create societal impact (e.g., in challenges facing aging, health care, safety and security) and business impact (i.e., contributing to strengthening the business proposition of our partners).

To achieve this mission, we strive for full avatar ownership, meaning that anyone can operate the avatar as if it were his/her own body.

THE AVATAR

We believe that impact can be made by using fit-for-purpose avatars. Therefore, we use two different robotic systems.

We use EVE, a social avatar capable of functional tasks and designed to optimize interaction with humans. EVE is a mobile human-like robot with 23 degrees of freedom. It has a payload of 8 kg per arm, and has force and impedance control in all joints.

Next to EVE is ANYmal, which is optimized for rough-terrain scenarios. ANYmal is a quadrupedal robot with dynamic motion capabilities. It features a robotic arm to manipulate its environment and is equipped with a variety of sensors for effective remote operation.

Our universal control pod transports the operator's actions and senses to any fit-for-purpose avatar. It enables the operator to control the movement of the avatar and its output devices (voice, posture, arm and hand movements, and facial expression). It blocks perceptual input from the local environment and provides full, multisensory cues from the robotic setup (including force feedback in arms and fingers and auditory and visual feedback) and from the remote environment (temperature, airflow and smell).

MARKET APPLICATION

We see four major fields of application of the technology of i-Botics:

Feeling together: Relieve the effects of social isolation and of social distancing by providing a level of interaction and intimacy beyond that of current video-conferencing systems.

Feeling cared for: Facilitate high-quality sustainable health care from health care professionals and family. The time saved by not traveling long distances can be spent on high quality interactions.

Expertise at a distance: Enable experts to apply their skill anywhere instantaneously. Removing the need to travel to remote sites results in a reduction of downtime and costs and an increased sustainability of work.

Safety without compromise: Support people with hazardous jobs. Operators can do their vital jobs without putting themselves in harm's way in order to be prepared for and responsive to threats and disasters.

TEAM COMPOSITION

i-Botics is a combination of universities, an applied research organization and cutting-edge high-tech industry. The University of Twente and ETH Zürich have a state-of-the-art knowledge base, TNO integrates fundamental knowledge and industry interests towards working demonstrations, and our industry partners Sensiks, Halodi and Haption achieve high technology readiness levels. This combination of fundamental and applied knowledge, market knowhow and integrative skills is what makes this team strong and able to realize our vision.

The team is led by TNO, under the guidance of team leader and lead scientist Jan van Erp. Around 40 team members contribute actively to i-Botics Avatar. The team members have different backgrounds and nationalities, but combined have the needed breadth of expertise for the competition.

Show All Finalists

iCub

We combine Artificial Intelligence with Mechanics to provide mankind the next generation of Humanoid Robots that will help us face many looming societal challenges.

CONTACT:
Team Leader: Daniele Pucci
Contact: Daniele Pucci, daniele.pucci@iit.it

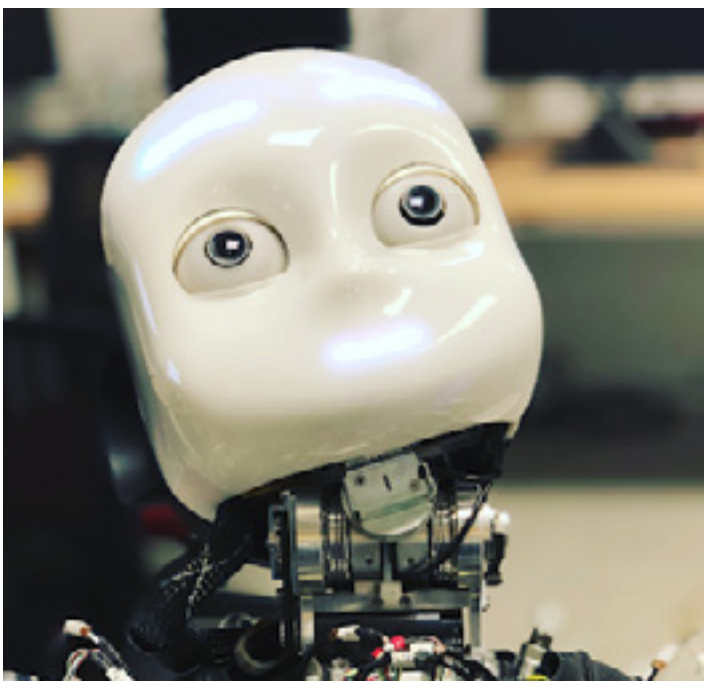
ami.iit.it
@artificialmechintelligence
@ami_iit

FUNDING NEEDS:
Open to discuss

LOCATION:
Genoa, Italy

CORPORATE STATUS:
Research Institute

OFFICIAL TEAM PARTNER(S)
OR UNIVERSITY AFFILIATION:
Istituto Italiano di Tecnologia (IIT)



Developing an Avatar system is one of the core objectives of the iCub Team research. The ANA Avatar XPRIZE is a unique occasion to test and benchmark the team's research outcomes.

The iCub team's first effort has been to migrate the algorithms and technologies from the avatar iCub 2.X to a newly developed robotic avatar iCub3. Since then, the team has pursued an increase in the performance of both the avatar and operator sides of the system. The team improved the dynamism of the robotic avatar, while increasing its overall robustness. On the operator side, the team is integrating a variety of technologies, aimed at achieving a lightweight, intuitive, wearable avatar system.

THE AVATAR

The iCub Team's avatar is a legged humanoid robot named iCub3. It is 125cm tall, and weighs 52kg. iCub3 has 54 degrees of freedom including those in the fully articulated hands and in the eyes, and they are all used in the operation of the system.

A particular feature of iCub3 is the vast array of sensors. iCub has six-axis force/torque (F/T) sensors, tactile sensors that act as an artificial skin on the upper arm and the hands, which provides information about both the location and the intensity of the contact forces. The head sports several sensors. It has two cameras, a microphone on both ears and a speaker behind the face. Finally, a set of LEDs define the robot's facial expressions.

iCub3 can be powered by an external supplier or by a custom-made battery. The connection to the robot can be established through an Ethernet cable or wirelessly.

MARKET APPLICATION

The iCub Team envisions future applications of the avatar system in disaster response, futuristic whole-body prosthesis, remote tourism and the metaverse.

The iCub Team believes that the avatar humanoid shape is an advantage in some contexts, where remote interaction with humans is crucial. In fact, the human-likeness factor increases the acceptability, the social closeness to the robot, and the clarity of its intentions.

Another potential application is ergonomic collaboration in workplaces. A remote operator can help a coworker through an avatar system, together carrying boxes or large items, reducing the risk of injuries on both parts.

In addition, some of the avatar components and the wearable technologies can be directly employed in the rehabilitation market.

TEAM COMPOSITION

The iCub Team is part of the Artificial and Mechanical Intelligence (AMI) lab, a research line of Istituto Italiano di Tecnologia (IIT), and it is also composed of elements belonging to the iCub Tech Facility.

The iCub Team leader is Daniele Pucci, who is also the Principal Investigator of the AMI lab. Team technical activities are led by Stefano Dafarra, a Post-Doc of AMI. Avatar development is strongly supported by Team Fix, led by Ugo Pattacini. Team Fix is part of the iCub Tech Facility, led by Marco Maggiali.

The iCub development team is composed of about 14 people belonging to AMI group, including engineers, PhD students, and Post-Docs.

BUSINESS MODEL

The AMI fundamental research is driven by the following main applications:

1. Telexistence: the objective of this research is in line with the competition, allowing a human being to exist into another place via the humanoid robot iCub3
2. Human-robot collaboration: to allow the humanoid robot iCub3 to help and collaborate with humans. In this context, we are developing wearable human technologies and algorithms to retrieve human kinematics and dynamics to be used for online robot control. Besides human perception, controllers for the humanoid robot iCub3 have been developed for intentional human collaboration and ergonomics.

Show All Finalists

Inbiodroid

Inbiodroid is a high-tech company dedicated to the research, development, and commercialization of robotic avatar telepresence systems to be applied in various industries and activities.

CONTACT:
Team Leader: Juan Carlos Díaz Garmendia
Contact: Juan Carlos Díaz Garmendia, CEOjcdiaz0809@hotmail.com

inbiodroid.com.mx
@inbiodroid
@inbiodroid
linkedin.com/company/inbiodroid
@inbiodroid

FUNDING NEEDS:
$1.5M

FUNDING STAGE:
Seed

PARTNERSHIP NEEDS
Yes

LOCATION:
Irapuato, México

CORPORATE STATUS:
Incorporated

CUSTOMER(S):
Automotive Industry, Medicine, Tourism, Hotels, Entertainment, Assistance To The Elderly, Museums, Theme Parks, Farming, Mining, Deep Sea, & Space Exploration

TECH STAGE:
Prototype

OFFICIAL TEAM PARTNER(S) OR UNIVERSITY AFFILIATION:
Universidad de Guanajuato, IECA, Agrobioteg, Idea Gto.

Humans have always strived to meet seemingly impossible challenges. For the Inbiodroid Team, achieving the seemingly unattainable is the main element of our motivation to build an avatar system. We believe it is important to share inspiration with the next generations, so they know that it is possible to achieve any goal, no matter how ambitious or complicated it may seem. We hope to demonstrate that inventiveness can be found in anyone, regardless of nationality or economic condition. The Inbiodroid Team is composed of people who are passionate about their work, committed to their community, and want to generate revolutionary solutions to humanity's problems.

THE AVATAR

The main features of the Prometheus System include:

- A full-body immersion system, through which the operator perceives force feedback in the arms and hands and performs remote manipulation tasks through the avatar.
- Real-time transferral of the operator's facial expressions to the robot's display.
- Mobile cameras enable visualization of the remote environment.
- Voice transmission and binaural audio reception are enabled.
- The operator can command his torso configuration to the robot and receive feedback on the balance status of the robot.
- A lower extremity motion capture system will enable the capabilities of an omnidirectional treadmill to propel operator travel in any direction.
- Transferring the ability of locomotion with force feedback to the operator is a key feature that differentiates our system from the rest.

Main integrated technologies: Bilateral full-body teleoperation incorporating force feedback. High Performance Computing. Integration of audiovisual immersion technologies.

MARKET APPLICATION

In medicine, telepresence systems are of vital importance for the assistance of patients in the consultation, to follow up on the evolution of treatment and as assistants in surgery and rehabilitation.

On assembly lines of various industries, mainly in the automotive industry, increasingly skilled and anthropomorphic collaborative robots could facilitate and enhance interaction with humans.

In the entertainment industry there is a demand for telepresence services in tourist destinations, museums and entertainment centers that provide the user with an immersive remote experience through displacement and virtual sensory appreciation.

The elderly population needs various assistance services for the treatment of chronic conditions. In addition, avatars can act as companions, assistants and as a means of remote interaction with family members.

TEAM COMPOSITION

Engineer Juan Carlos Díaz Garmendia is the leader and CEO of the Inbiodroid Team, and has extensive experience in business management and leadership. The team is made up of a group of specialists that includes technical staff, engineers, PhD engineers, administrative staff, and student volunteers/interns. In addition, it has the external support of a group of highly trained advisors. Public institutions also collaborate in the development of Inbiodroid technology, among which we find the IECA, the University of Guanajuato, Agrobioteg and Idea Gto. The strategic alliance with the Japanese company MTL, manufacturer of high-performance servomotors, and with Shift 3D, experts in additive manufacturing, is under negotiation.

Show All Finalists

Janus

Team JANUS develops a cybernetic avatar to transport human presence to remote locations.

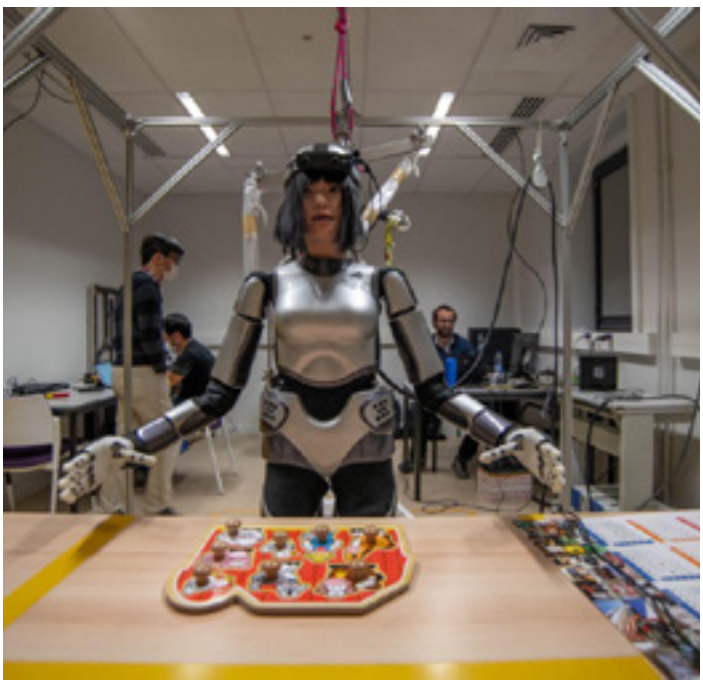
CONTACT:
Team Leader: Fumio Kanehiro & Abderrahmane Kheddar
Contact: Fumio Kanehiro, f-kanehiro@aist.go.jp, kheddar@lirmm.fr

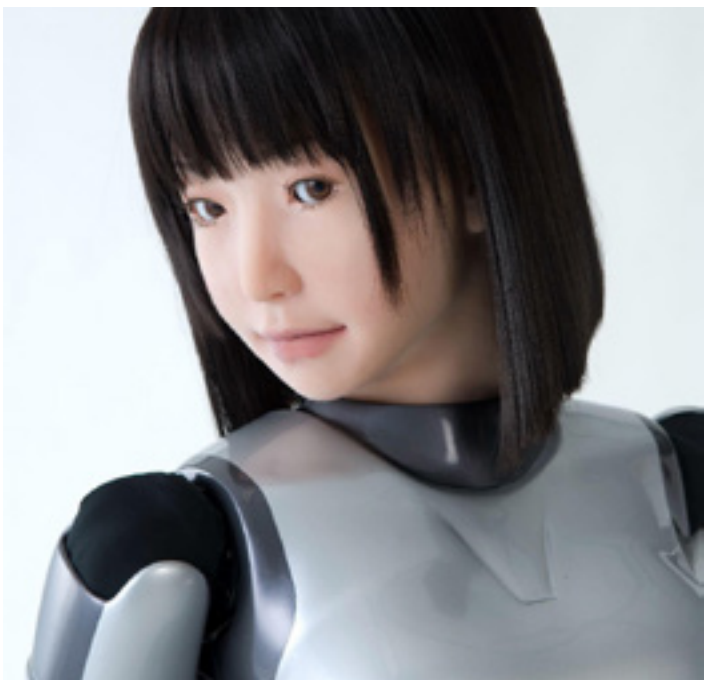
unit.aist.go.jp/jrl-22022/en/projects/janus/team-janus

LOCATION:
Tsukuba, Japan & Montpellier, France

TECH STAGE:
TRL 6, Prototype

OFFICIAL TEAM PARTNER(S) OR UNIVERSITY AFFILIATION:
CNRS-AIST and DOUBLE R&D





Our main mission is to create and advance knowledge for the well-being of humanity and society. Challenging competitions like ANA Avatar XPRIZE are the catalysts for new ideas and technologies. Furthermore, the Covid19 outbreak highlighted the need for avatar technology in healthcare services, frail persons' homes, as well as many other economical and societal sectors.

THE AVATAR

We are using a humanoid avatar. Among all the existing geminoids, HRP-4CR is the only one with a close-to-human appearance that can walk, manipulate objects, and realize facial expressions. Therefore, we didn't want to sacrifice the bipedal challenge nor its shape. Instead, we demonstrate a humanoid avatar that (i) is easily controllable, (ii) can provide rich sensory feedback, and (iii) can be an elegant solution in many applications.

HRP-4CR features force/torque sensors at the ankles and wrists that provide feedback to maintain balance, offer safe interaction, and detect the weight of objects. It also features dexterous under actuated hands capable of performing power and precision grasping, and a stereo camera that provides visual feedback to the operator using a Head Mounted Display (HMD). The HMD includes eye and mouth tracking that controls the eyes and mouth of the robot. Finally, HRP-4CR is controlled using mc rtc, an easy-to-use framework that is open source.

MARKET APPLICATION

HRP-4CR could be applied in a number of ways. Some examples include:

- Enabling communication that involves physical interaction between people that transcends space-time constraints. (e.g., communication between a person isolated due to an infectious disease and his or her family).
- Enabling work in harsh environments and hazardous tasks to be performed comfortably and safely. (e.g. decontamination work that must be performed under radiation).

TEAM COMPOSITION

JANUS gathers expertise from the Japanese National Institute of Advanced Industrial Science and Technology (AIST) and the French National Center for Scientific Research (CNRS), namely from CNRS-AIST Joint Robotics Laboratory (JRL) in Tsukuba and the Interactive Digital Human Laboratory (LIRMM) in Montpellier. The leaders are Fumio Kanehiro, the IRL Director at JRL, and Abderrahmane Kheddar, the CNRS Research Director at LIRMM. Additionally, we have a joint research project with the company Double R&D, which has developed the dexterous hands for the robot. The team is composed of researchers and PhD students from both laboratories, gathering members from several nationalities: Japan, France, Mexico, Algeria, China and India.

BUSINESS MODEL

Team Janus' research efforts focus on:

- An intuitive interface and method of controlling more complex whole-body behaviors.
- Artificial skin that can be touched and felt all over the body, which allows close contact with the humans.

LAST MILE

Our original technologies of AUGMENTED AVATAR and VISUAL BASED INTERFACE will realize a useful and reliable avatar system.

CONTACT:
Team Leader: Masaki Haruna
Contact: Team Leader, Masaki Haruna, mhalu11.goah@gmail.com

LOCATION:
Osaka, Japan

OFFICIAL TEAM PARTNER(S) OR UNIVERSITY AFFILIATION:
Mitsubishi Electric Corporation,
& Kansai University

Our goal is to solve for the "gap" caused by an uneven distribution of the world's workforce, which forces people to migrate domestically and internationally. We believe that Avatar Technology in the near future will lead to a world where we can stay anywhere where we want to, and live with anyone we want. Avatar Technology will lead to a symbiotic and empathic world where we can share our experiences, minds, happiness and love with each other and with nature, earth, and the universe.

THE AVATAR

The concept of our avatar system is simple and intuitive, which results in good usability, reliability and safety. Our avatar is named Augmented Avatar, which enables remote communication through both verbal and non-verbal means, owing to the implemented body scheme, and enables remote manipulation while ensuring the safety of people near or interacting with the avatar. This unique approach contributes to the flexible design of an avatar depending on the targeted application. The interface of our system is also a simple and intuitive design based on a good understanding of human capabilities. All the sensing information, including haptics from the avatar, is transmitted as visual information to the operator. This original approach of visual-based feedback has the potential to realize a simple and intuitive machine interface. Our original technologies of AUGMENTED AVATAR and VISUAL BASED INTERFACE will realize a useful and reliable avatar system.

TEAM COMPOSITION

Team Last Mile, led by Dr. Masaki Haruna and Dr. Masaki Ogino, started as a personal project in January 2019. Masaki Haruna is a specialist in the area of mechanics, electronics and control software for satellite telescopes in space and giant telescopes on the ground, and remote operation machine systems based on human recognition. Masaki Ogino is a specialist in the area of human recognition, human robot interface, robotics and machine learning. For the Finals, Dr. Shigeaki Tagashira and Dr. Susumu Morita join our team as specialists for tele-communication and locomotion technology, and Mitsubishi Electric Corporation and Kansai University will support LAST MILE.

Show All Finalists

NimbRo

Team NimbRo develops a fully-featured, robust Avatar system that produces an immersive telepresence experience in real-world scenarios through a clever combination of mechatronics and AI.

CONTACT:
Team Leader: Prof. Dr. Sven Behnke
Contact: Prof. Dr. Sven Behnke, behnke@cs.uni-bonn.de | Max Schwarz, schwarz@ais.uni-bonn.de

nimbro.net/AVATAR

FUNDING NEEDS:
Fully Self-Funded

FUNDING STAGE:
Fully Self-Funded

PARTNERSHIP NEEDS:
Open for Research & Application Partnerships after the Finals

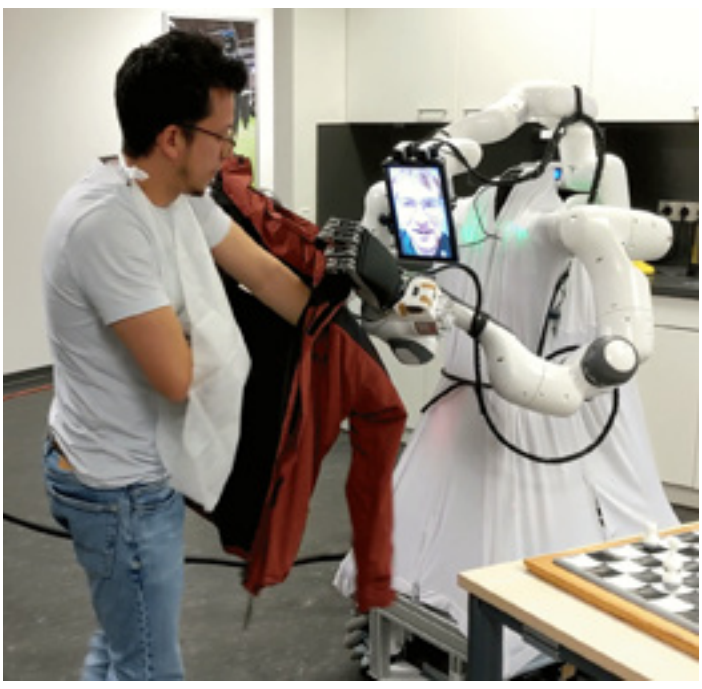
SPONSOR(S):
Fully Self-Funded

LOCATION:
Bonn, Germany

CORPORATE STATUS:
University

TECH STAGE:
Research Prototype

OFFICIAL TEAM PARTNER(S) OR UNIVERSITY AFFILIATION:
Rheinische Friedrich-Wilhelms-Universität Bonn, Bonn, Germany



Team NimbRo is convinced that Avatar technology plays a vital role in reducing carbon emissions & travel costs, increasing efficiency across many economic domains, as well as enabling rich remote interaction in situations difficult due to distance or danger to humans. Our team has a long history of success in robotics challenges, which gives us unique experience in what is necessary to develop complex, cutting-edge robotic systems that deliver performance in real-world situations. Thus, our approach is to work on the full Avatar experience rather than focus on individual sub-problems. We perform continuous testing of the entire system to make sure that users are comfortable while fully immersing in the remote situation. We believe that this approach is key to our success so far and look forward to the Finals!

THE AVATAR

Our system, NimbRo Avatar, consists of an avatar robot and the accompanying operator station. The Avatar robot has a human-like upper body with two arms equipped with dexterous five-finger hands. The robot's head is mounted on a robotic arm that gives it full freedom to move, mirroring the operator's head movements. The upper body is mounted on a holonomic base, ensuring full movement capability. The operator station is equipped with two robotic arms and hand exoskeletons, measuring the operator's arm and finger movements and providing force and haptic feedback. The operator wears a VR head-mounted display with headphones that allows full immersion in the remote situation. Their feet control the robot's movement in three axes. The operator face is captured by cameras and animated in the Avatar head to display facial expressions and gaze to the Recipient.

MARKET APPLICATION

Our system demonstrates key technological advancements, which allow commercial realization of more immersive Avatar systems. These systems will find applications in numerous economical sections, such as consultancy and international relations, where such systems improve efficiency and reduce travel costs, and also more private sectors such as caregiving and personal communication, where the technology can give meaningful interactions across long distances.

We highlight the design of our head & imaging system here, which allows unprecedented freedom of movement for the operator. This reduces simulator sickness by showing the correct point of view. This component can also be used in isolation for immersive tele-visualization applications.

Secondly, our integrated force-feedback manipulation system allows dexterous manipulation in delicate situations, giving feedback on the wrist and finger level. In expert consultancy applications, this gives the remote consultant the ability to not only advise on-location personnel, but to cooperatively work on challenging problems.

TEAM COMPOSITION

Team NimbRo is the competition team of the Autonomous Intelligent Systems group at University of Bonn, Germany, headed by Prof. Dr. Sven Behnke. The other team members are three research scientists, a mechatronics engineer, and a Master student. Our team has extensive background in developing complex robotic systems for challenging robotic problems, as demonstrated in highly successful participation in the international RoboCup competitions, the DARPA Robotics Challenge (DRC), Amazon Picking and Robotics Challenges, and the German Space Agency's SpaceBot challenges.

BUSINESS MODEL

As a university group, our aim is to acquire research projects from funding agencies and industry. Our research in Avatar systems will continue past the ANA Avatar XPRIZE. While the research problems inherent to an Avatar system, such as transparent teleoperation, tactile & haptic feedback, and operator assistance functions are of high interest to us, there are also exciting applications of Avatar systems in the context of AI, where such systems may be used to teach learning modules through exemplary demonstrations. We envision shared-autonomy systems, where human and artificial intelligence cooperatively learn from each other while solving more and more challenging tasks. Our objective is to make Avatar robots more autonomous, such that they can perform everyday assistance tasks by themselves. The operator would only be needed to resolve the most difficult situations, creating additional training data in this way. In such a scenario, one operator would supervise larger and larger numbers of Avatar robots, which allows for fleet learning.

Pollen Robotics

Pollen Robotics specializes in interactive robots and AI solutions and offers Reachy, the only 100% open source humanoid platform that allows rapid prototyping of advanced applications.

CONTACT:
Team Leader: Gaëlle Lannuzel
Contact: R&D Engineer, Gaëlle Lannuzel, gaelle.lannuzel@pollen-robotics.com

pollen-robotics.com
Pollenrobotics
@pollenrobotics
linkedin.com/company/pollen-robotics
@pollenrobotics

FUNDING NEEDS:
1,4 M€

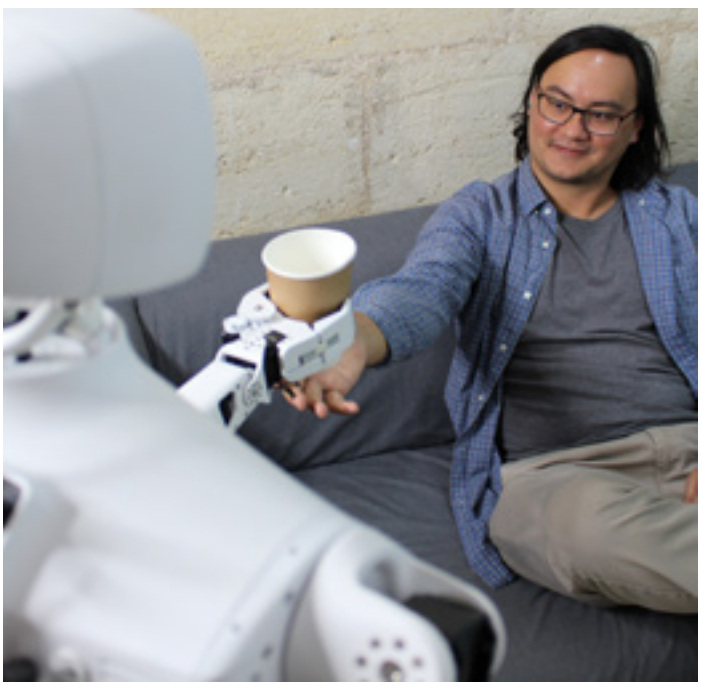
FUNDING STAGE:
Seed

LOCATION:
Bordeaux, France

CORPORATE STATUS:
Simplified stock company

TECH STAGE:
Commercialized solution

OFFICIAL TEAM PARTNER(S) OR UNIVERSITY AFFILIATION:
Cornell University, Accenture, Imperial College London, EPFL



At CES 2020 we introduced Reachy, our open source humanoid robot, to the world. Back then, Reachy was already able to run on autonomous applications thanks to a full Python SDK providing a unified API to simply control the robot locally.

At CES 2021(all digital), while the whole world was in covid-lockdown, we released the VR teleoperation that allows you to control Reachy from anywhere in the world, using a VR headset and controllers. Shortly after the release, we were lucky to be noticed by the XPRIZE foundation team who invited us to apply for the competition. We hadn't heard about it yet but we were immediately convinced that being part of it would be our next big adventure.

THE AVATAR

Reachy is our Avatar system based on our humanoid robot, entirely designed and developed at Pollen Robotics, with two bio-inspired arms, an expressive head with stereo-vision and an omnidirectional mobile base. The robot can interact with its surroundings, grasp objects and freely move around.

Reachy can be entirely tele-operated by a human operator through a VR system, where the user can see through the robot's eyes via the VR display and control the robot's head and arm by moving the headset and controllers. The mobile base is operated via a joystick on one of the controllers. Our core differentiation remains in the use of parallel actuators in the neck, shoulder, elbow and wrist of the robot allowing for more natural, expressive and dynamic motions. It reduces the operator's cognitive workload as well as reduces motion sickness as the avatar body is directly bio-inspired and can thus closely reproduce complex human motions. The overall solution is integrated into a carefully designed commercial robotics product.

MARKET APPLICATION

Our technology is dedicated to facilitating the design and development of interactive robots for real world services applications. It allows for the fast design of interactive manipulator systems in real world applications, where working closely with humans is required.

The ability to operate such systems remotely is key in such a context where having fully automated systems is still far from being possible, due to the limitations of current AI for manipulation and interaction in cluttered environments. Yet, those types of robots can already provide huge benefits to service applications.

Since Covid-19 and the explosion of remote work, having the possibility to physically perform movements remotely through a physical avatar is a central issue, especially in the medical context of home-care, where a single operator could quickly intervene among multiple patients through the avatar system without the need to be physically present.

TEAM COMPOSITION

Team leader: Gaëlle Lannuzel, R&D engineer

Team participants: Augustin Crampette, R&D engineer at Pollen Robotics | Fabien Danieau, PhD - R&D engineer | Rémi Fabre, R&D engineer at | Elsa Kervella, CMO | Matthieu Lapeyre, PhD - CEO | Jérémy Laville, R&D engineer | Simon Le Goff, R&D engineer | Steve N'Guyen, PhD - R&D engineer | Pierre Rouanet, PhD - CTO

BUSINESS MODEL

Pollen Robotics is already commercializing Reachy avatar solutions, both hardware and software, to R&D teams and academics. About 50 units have been sold around the world since 2020.

In addition, we are building an ecosystem of hardware and software assets that focus on human-robot interaction, manipulation of objects (grasping) and mobility in open environments. Each asset will be commercially available, with a focus on the tele-operation of the manipulator arm.

Tangible

We make remote manipulation dexterous with human-like robotic hands and haptics so you can feel and control robotic hands as if they were your own.

CONTACT:
Team Leader: Jeremy Fishel
Contact: Team Lead, Jeremy Fishel, jeremy@tangible-research.com

convergerobotics.com
in linkedin.com/company/converge-robotics

FUNDING NEEDS:
Open to discussion

FUNDING STAGE:
Joint Venture

PARTNERSHIP NEEDS:
Seeking strategic commercial relationships

SPONSOR(S):
Several companies have contributed critical technology or resources to the development of the Tactile Telerobot

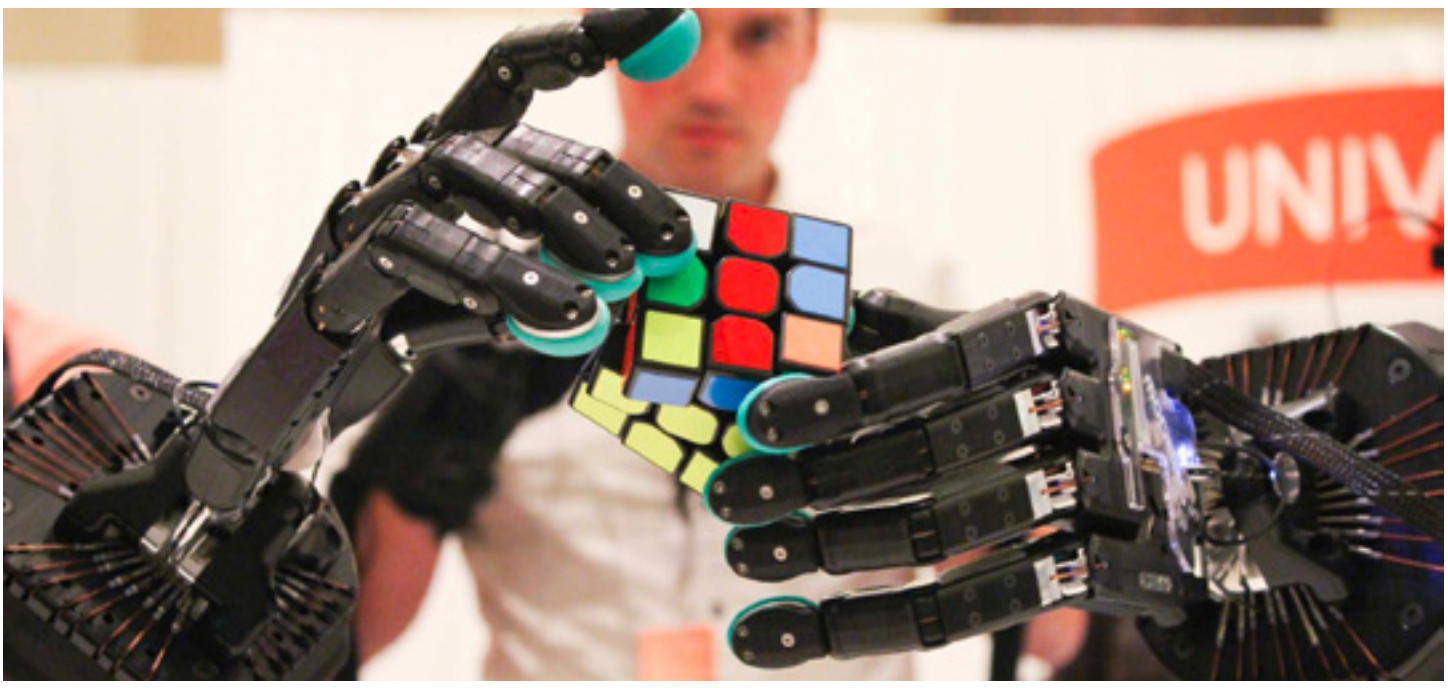
LOCATION:
Chico, CA, USA
San Luis Obispo, CA, USA
London, UK

CORPORATE STATUS:
Consortium

CUSTOMER(S):
IT, Nuclear, Pharmaceuticals, Industrial R&D

TECH STAGE:
Early Commercial

OFFICIAL TEAM PARTNER(S) OR UNIVERSITY AFFILIATION:
Tangible Research, HaptX, Shadow Robot Company



Our partnership originated with leaders in three separate companies with decades of combined experience creating the most advanced dexterous robotic hands, haptic gloves, and tactile sensors. Recognizing the potential to combine these best-in-class technologies into a telerobotic system with unrivaled dexterity and haptic capabilities, Converge Robotics Group was formed. Our approach to this competition and collaborative project has always been to deliver the most dexterous, realistic, and intuitive system possible with the ultimate goal of making these robotic hands as intuitive to use as your own hands.

THE AVATAR

The system we have developed is known as the Tactile Telerobot, which combines the human-like kinematics of the Shadow Dexterous Hands, SynTouch's biomimetic tactile sensors, HaptX's high-performance Haptic Gloves, Universal Robot's industry-dominating robotic arms, and Voysys' low-latency video communication software to create an intuitive and capable telerobotic system that is easy to use and learn. What makes the Tactile Telerobot special is the high-dexterity robotic hands with human-like kinematics combined with state of the art haptics allowing a previously unachievable level of fidelity.

MARKET APPLICATION

The Tactile Telerobot can add value to any application where human dexterity and intelligence is needed to physically interact with an environment, but directly placing a human in that environment is either unsafe, impractical, expensive, or otherwise undesirable. This includes Dull work (repetitive tasks in assembly lines), Dirty work (mining, cleaning), Dangerous work (nuclear decommissioning, bomb disposal), Delicate work (pharma labs, medical, fine assembly), Distant work (remote maintenance), or Difficult work (inaccessible areas).

TEAM COMPOSITION

Our team is composed of a group of companies that have been responsible for creating the world's most advanced dexterous robotic hands, tactile sensors, and haptic gloves – all of which come together to create the Tactile Telerobot, a system capable of allowing you to control and feel a pair of robotic hands at a distance with unparalleled realism. Across the three partnership companies (Tangible Research, Shadow Robot Company, and HaptX), more than 50 skilled individuals have contributed to technology development.

BUSINESS MODEL

Tangible Research, HaptX, and Shadow Robot Company have been working in partnership to develop and advance the Tactile Telerobot, and collectively learn more about the market potential and applications. Systems are currently being sold to a wide range of industries where remote manipulation is critical.

Show All Finalists

Team Northeastern

Team Northeastern strives to provide immersive, smooth and precise tele-interaction between the operator and the remote environment with our avatar system that is built around our novelly designed hydrostatic actuators.

CONTACT:
Team Leader: Peter John Witney
Contact: Taskin Padir, padir.t@northeastern.edu | Peter John Whitney, j.whitney@northeastern.edu | Rui Luo, luo.rui@northeastern.edu

robot.neu.edu/project/avatar
@northeastern_avatar

FUNDING NEEDS:
Our team is internally funded by the Institute for Experiential Robotics

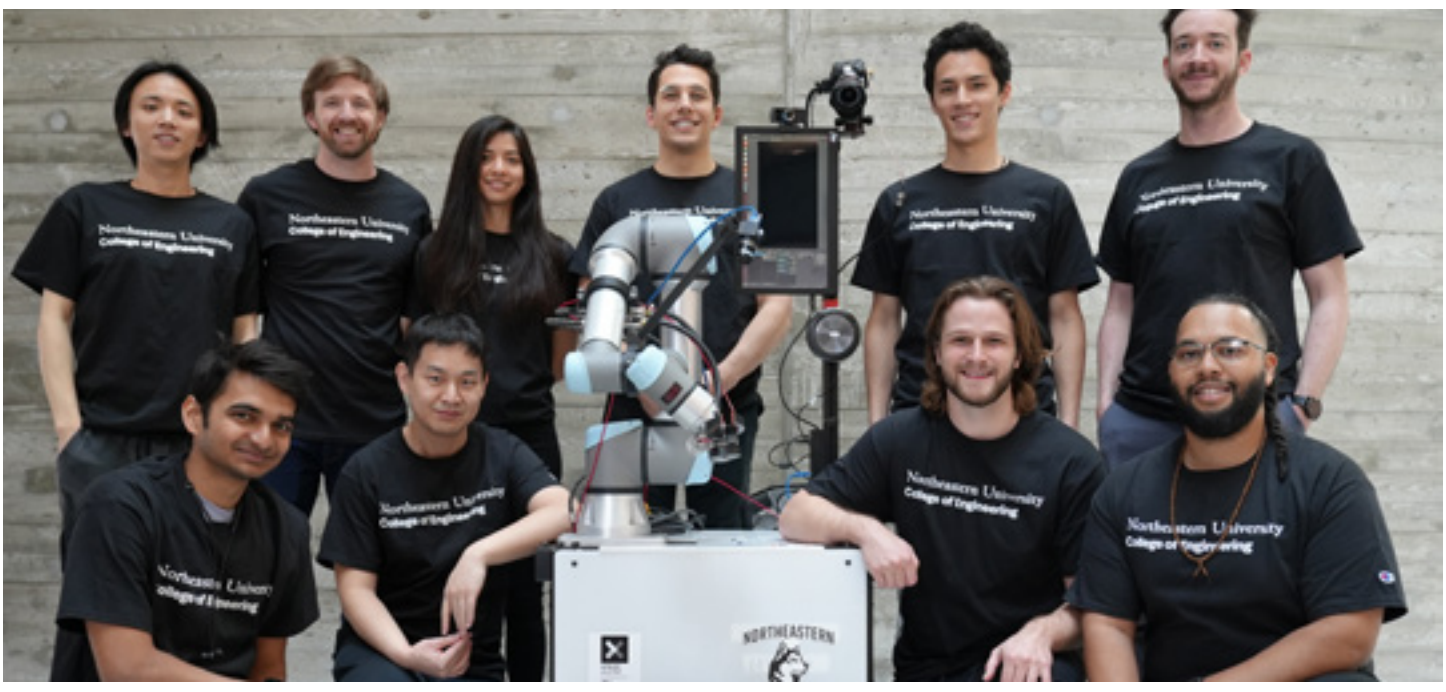
FUNDING STAGE:
We plan to run a partnership campaign over the summer months

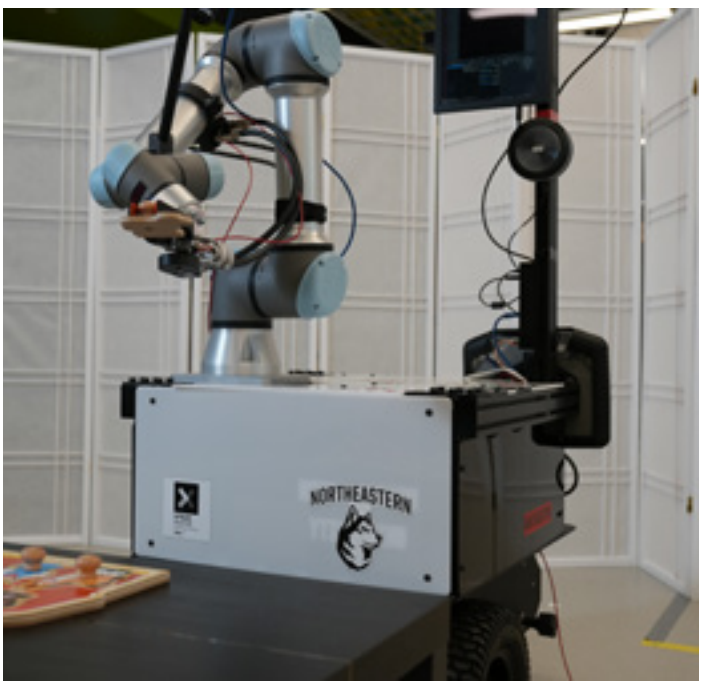
PARTNERSHIP NEEDS:
Hardware and Network

LOCATION:
Boston, MA, USA

TECH STAGE:
System Version 1 completed. Version 2 Prototyping Stage

OFFICIAL TEAM PARTNER(S) OR UNIVERSITY AFFILIATION:
Northeastern University





Team Northeastern's goal is to research robotic systems that benefit humanity. The ANA Avatar XPRIZE allows us to directly pursue this goal by building a system that can permanently revolutionize human-to-human interaction and communication. Our avatar system includes a holistic telerobotic system including both the operator and robot avatar that enables real-time telemanipulation, telelocomotion and bi-directional communication. To tackle the competition challenges, our avatar system uses a customized hardware design including an exo-skeleton input arm and a pair of hydrostatic actuated grippers that empowers the user to experience and interact with the remote environment at a new level of precision and immersiveness. Our approach is built strictly around providing the best experience for our user and those interacting with our avatar. We achieve this by prioritizing safety, predictability, precision, and reliability.

THE AVATAR

Meet Robalto, Team Northeastern's avatar system! Robalto uses a low-impedance hydrostatic manipulator to achieve haptic force feedback for delicate and precise interaction between the operator and the remote environment. The key components are extremely low friction actuators and hydraulics with pressure sensors which can read the very fine forces applied to the actuator, and communicate those forces between the operator system and robot avatar. Control commands are sent across a low-latency network from the skeleton arm to a Universal Robots UR5e, which is placed on a Husky mobile robot. The gripper, like the arm, was developed within our lab and allows for haptic feedback of the avatar's gripper to be felt by the user controlling the skeleton arm. The hardware we have developed opens up a lot of possibilities in the controller space which is not possible with traditional or commercially available hardware. This novel hardware system is what sets our avatar apart from the rest of the teams, no other team competing at ANA Avatar XPRIZE is using hydraulics within their system.

MARKET APPLICATION

The real-world application of our core technology is any task that requires a sense of touch or interaction with the environment to complete, for example scooping a piece of fish off a table which requires contact with the table and delicate force control. Our system is about reducing impedance, which results in a system that is inherently very safe around humans with low friction and a very low effective moving mass. We see our core technology as essential for in-home care robotics and for robotics in the workplace alongside humans.

TEAM COMPOSITION

Team Northeastern is led by Professor Peter John Witney and Professor Taskin Padir. Our team is entirely composed of PhD and Undergraduate students from Northeastern University College of Engineering and Khoury College of Computer Sciences. Currently there is no official partner for our team.

BUSINESS MODEL

Future research will cover both mechanical design and software development that includes but is not limited to real-time human-robot interaction with tactile feedback, human-in-the-loop shared control strategy over long distance teleoperation, fully hydrostatic actuated exo-skeleton arm.

Show All Finalists

Team SNU

We are a leading university research group in robotics.

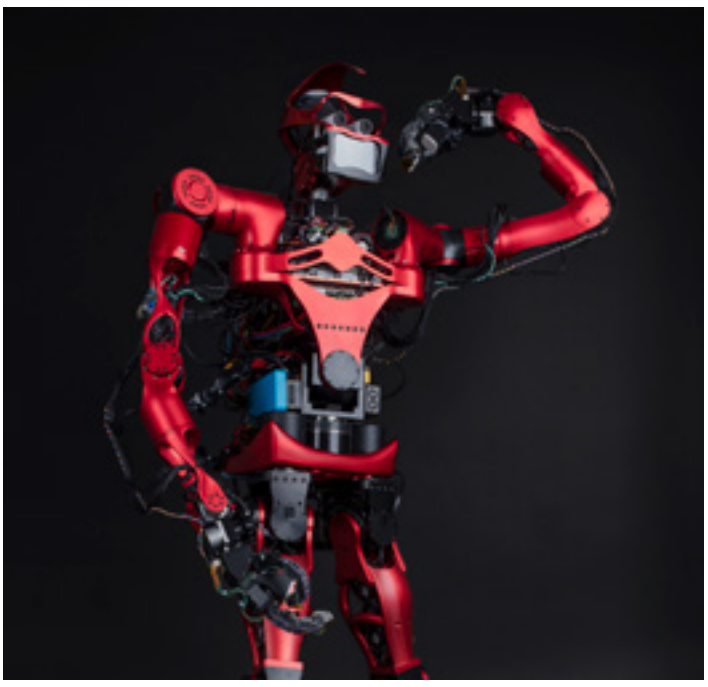
CONTACT:
Team Leader: Jaeheung Park
Contact: Jaeheung Park, Ppark73@snu.ac.kr

dyros.snu.ac.kr/avatar-xprize
DYROS

FUNDING NEEDS:
Open to Discussion about support for Team Development

LOCATION:
Seoul, South Korea

OFFICIAL TEAM PARTNER
Blue Robin



Our main approach in avatar development is to create an avatar robot with a human-like appearance that naturally mimics human motion. The avatar robot was designed to reflect the height of an adult male. Also, our humanoid robot has a wide range of manipulability, so it is possible to simulate most human motions. Furthermore, the robot hand reflects the human hand by implementing thumb adduction/abduction joints. Human motion commands are individually calibrated for each user so that actual human motion can be accurately transmitted to the avatar. In our approach, the most important part of manipulation is hand manipulation, and we are developing a haptic system by focusing on the feeling in the hand.

THE AVATAR

The name of our Avatar robot is TOCABI (TOrque Controlled compliAnt BIped). The robot's name, (Tocabi : goblin), is a tall, strong, and helpful creature in Korean fairy tales. The primary feature of our Avatar is a human-sized bipedal humanoid robot. It is characterized by having a high degree of freedom in each of the arms with 8 degrees of freedom. The large workspace resulting from this is a great advantage of our robot. The bipedal walking is what sets it apart from other teams' avatar systems. And the core technology integrated into our Avatar is whole-body control.

MARKET APPLICATION

Our avatar robot can be used in a next-generation telemedicine system that can perform both simple and complex procedures without the need for doctors to be next to patients. In addition, it can be applied to the education system to improve the quality of education by allowing students with disabilities to access various educational environments. Lastly, it can be effectively used to remove hazardous substances by being the first to enter an accident site, where it is difficult or potentially dangerous for humans to access.

TEAM COMPOSITION

Our team leader is Jaeheung Park, a professor at Seoul National University. He is an expert in humanoid control and design and he will manage the entire system integration. Prof. Dongjun Lee, an expert in robot control and haptics, will participate in the team for the master station. Prof. Young-Lae Park will provide soft skin sensor technologies and human pose estimation. In addition, other various Seoul National University laboratories related to robotics and sensors can participate in the team. Team SNU includes approximately twenty Seoul National University students.

Show All Finalists

Team UNIST

We develop innovative and practical wearable systems through comprehensive research with human-centered design and control of the wearable systems from the point of view of a ‘human’ not a ‘robot’.

CONTACT:
Team Leader: Prof. Joonbum Bae
Contact: Prof. Joonbum Bae, jbbae@unist.ac.kr, unistavatar@gmail.com

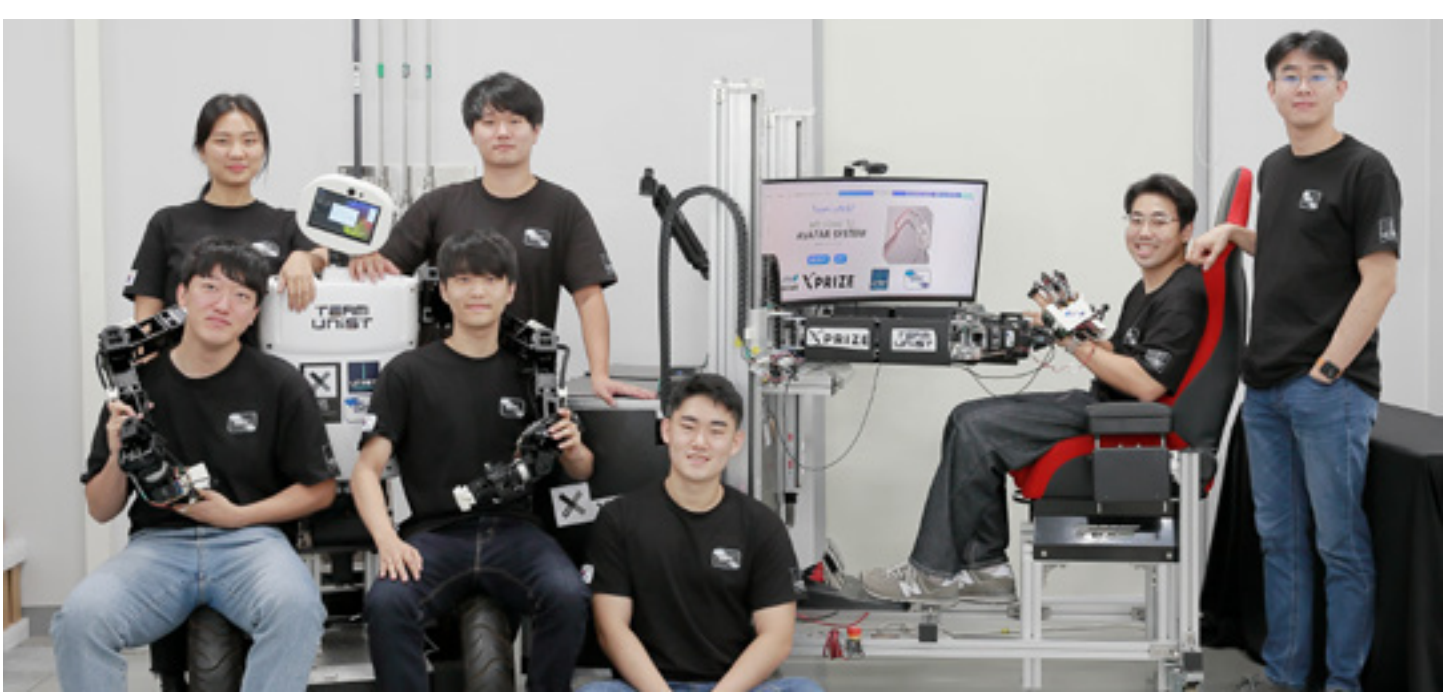
birc.unist.ac.kr
@unist_birc
linkedin.com/cin/unist-birc-475455207
@birc.unist

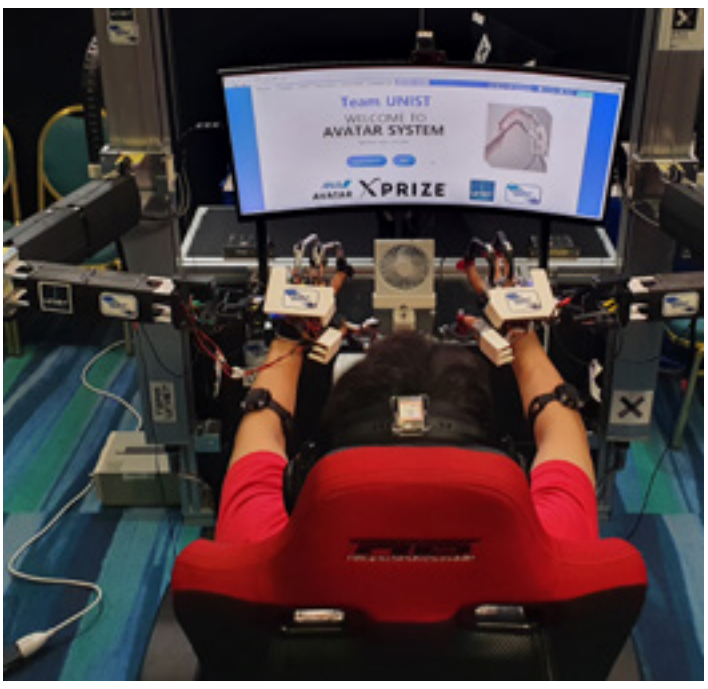
FUNDING STAGE:
Research stage

LOCATION:
Ulsan, South Korea

TECH STAGE:
Almost finished for the final, Research stage

OFFICIAL TEAM PARTNER(S) OR UNIVERSITY AFFILIATION:
Ulsan National Institute of Science and Technology (UNIST), South Korea.





Based on the vision of the ANA Avatar XPRIZE, our team tries to achieve the goal of real telepresence. To realize this goal, our team employs the following approaches. The first approach is sending human information to the robot by a sensor-fusion method. By accurately measuring the operator’s motion with various sensors, the robot is directly controlled in an intuitive manner. The other approach is receiving the information around the robot to the operator. The operator feels the information of the environment where the robot is deployed through rich information including 3D images and force information of the arm and the hand. By integrating these approaches, intuitive, interactive, and immersive control of the teleoperated robot can be achieved.

THE AVATAR

Our avatar system is called an AVATAR (an interActive and intuitiVe control interfAce for a Tele operAted Robot) system. Both the robot and control interface have been developed from scratch and integrated in our laboratory. We have focused on intuitive interaction between the operator and the robot; the teleoperated robot with 3 degrees of freedom (DOF) neck with dual cameras, dual 8 DOF arms, 5 DOF hands, a 2 DOF waist, and a 4-wheeled locomotion platform is controlled by the operator’s motion, and the information around the robot is transmitted to the operator as visual and haptic information. High quality of haptic feedback is provided to correspond with changes in various forces, including the stiffness of the object being manipulated by the robot. With the AVATAR system, the user can feel as if he/she is carrying out the same task in the same space as the robot.

MARKET APPLICATION

Telepresence systems can be utilized in various industrial fields. Teleoperation systems can respond to environments which are difficult for humans to access, such as dangerous industrial sites due to chemical or radioactive material leakage, disaster sites, or submarine and aerospace environments. As technologies for virtual and augmented reality emerge, such as ‘Metaverse’, the intuitive and immersive control interface that measures user movements and provides haptic feedback can become a crucial technology. An aging society continues due to low birth rates worldwide, which is expected to be used in the rehabilitation and medical robot industry, which is a fast growing market.

TEAM COMPOSITION

Our team is university-affiliated and consists of 8 members of Bio-Robotics and Control (BiRC) Lab at the Department of Mechanical Engineering, UNIST. Prof. Joonbum Bae leads the team by developing the avatar system. Dr. Sungman Park (post-doctoral researcher) works on the design and control of the avatar robot and the control interface. Junsoo Kim, Hojae Lee, and Minwoong Jo (Ph.D. students) work in detail on the design and control of the avatar robot. Sangyeop Lee and Dawon Ju (M.S. students) work in immersive visual feedback. Hyungju Choi (Ph.D. student) works in haptic feedback of the control interface.

BUSINESS MODEL

As our team is university affiliated, we will focus on future research areas related to avatar technologies. Manipulation using human motion can intuitively and quickly perform simple tasks such as grasping and moving objects, but very delicate or repetitive tasks may cause fatigue to the operator. Therefore, we are going to develop partial artificial intelligence (PAI) for the avatar robot that can recognize an operator’s intention and perform simple tasks on its own. Also, we plan to develop advanced control interfaces for teleoperated robots that use biometric signals such as electromyography (EMG) and electroencephalogram (EEG), and can directly stimulate the human brain to transmit various senses.