
BLENDED
REALITY
Yale University

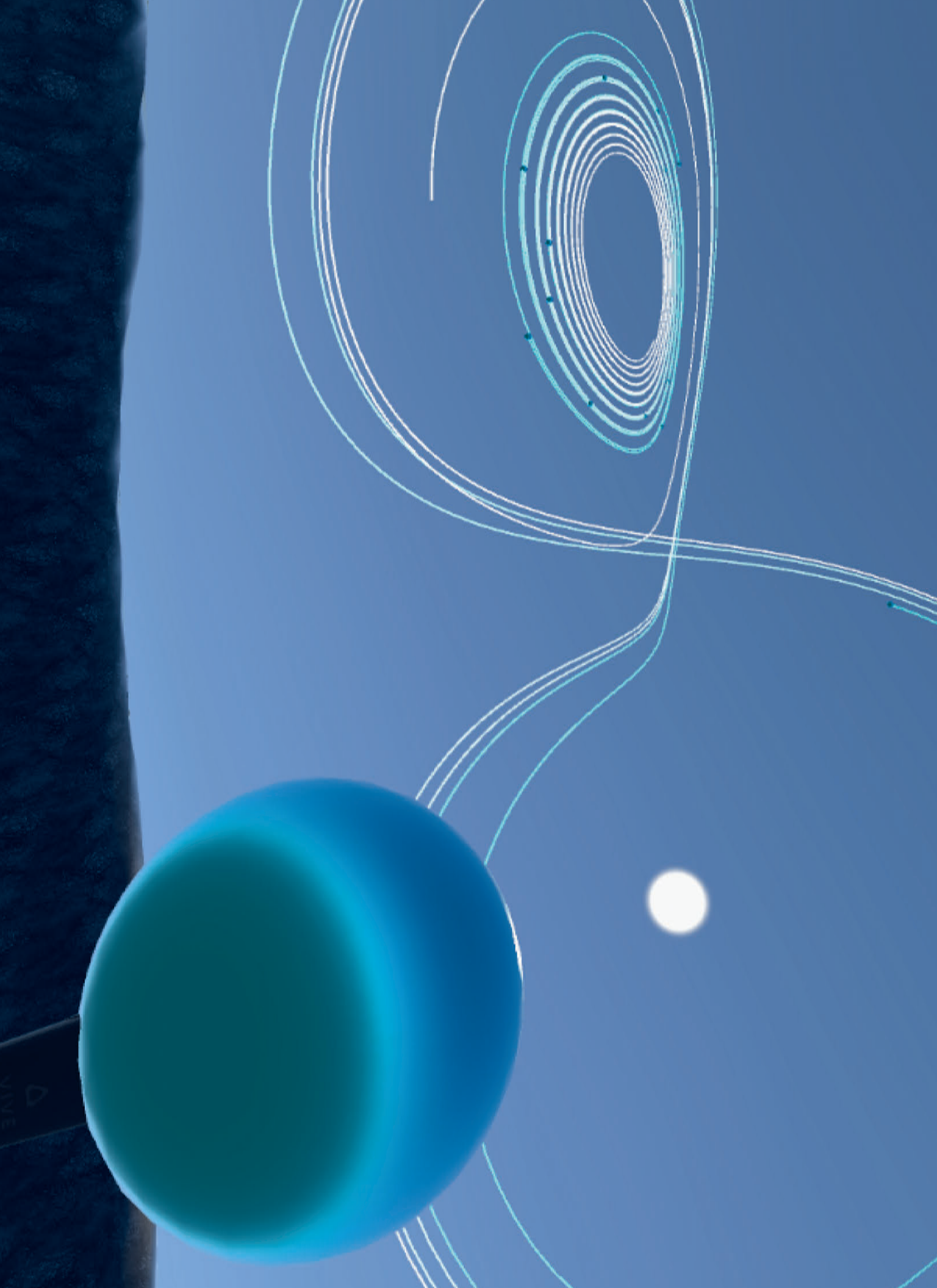
2019–20 ACADEMIC YEAR

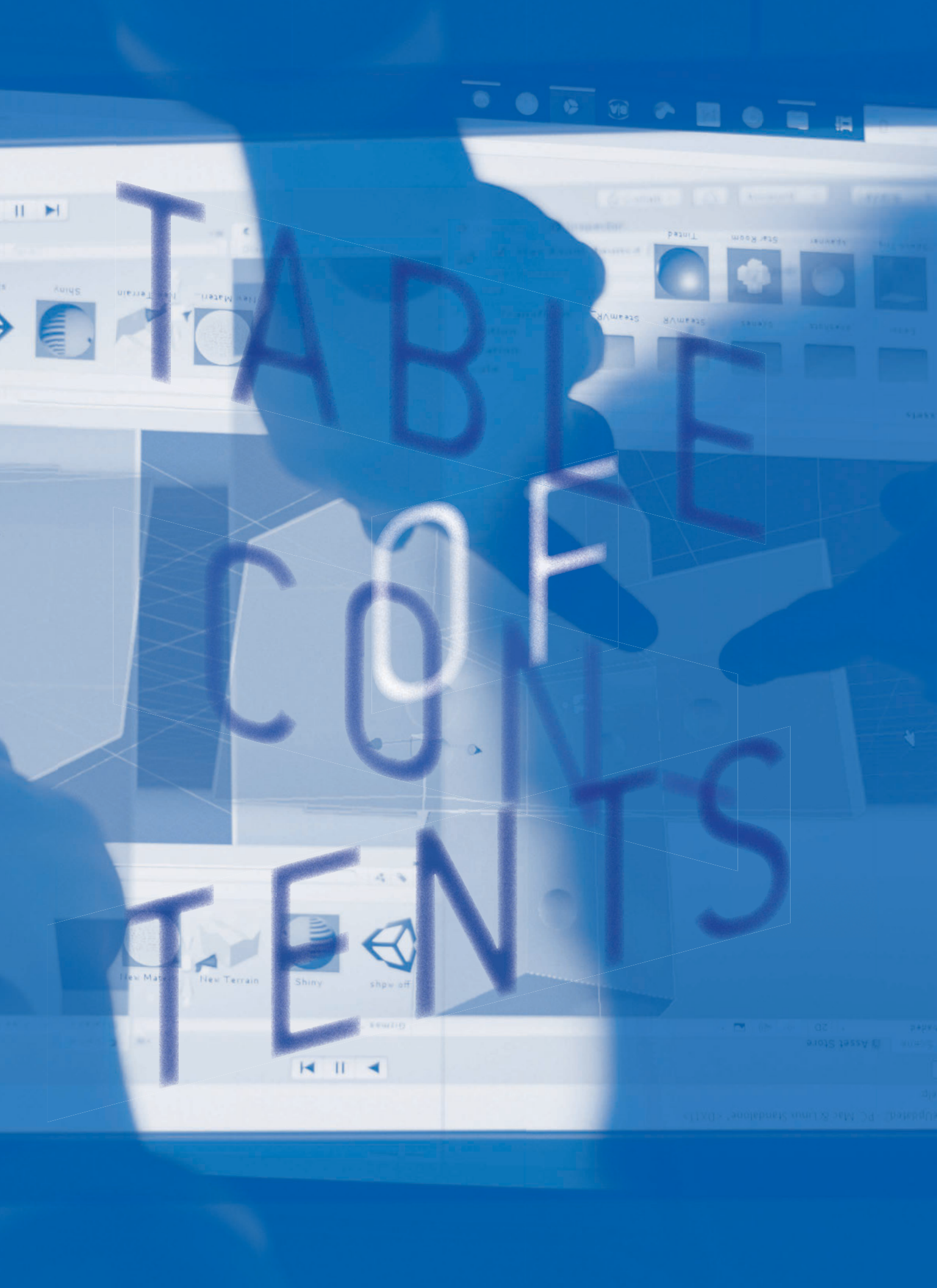
PRINCIPAL INVESTIGATOR
Justin Berry, Critic, Yale School of Art; Core Faculty,
Center for Collaborative Arts and Media

PROJECT DIRECTOR
Randall Rode, Director of Campus IT Partner Development,
Yale University Information Technology Services

PROJECT MANAGER
Miriam Schroers, Senior Project Manager

A YALE UNIVERSITY APPLIED RESEARCH PROJECT SPONSORED BY

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WHEN WE CHANGE
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THAT WE SEE

WHEN WE CHANGE THE WAY THAT WE SEE THE WORLD, THE WORLD THAT WE SEE CHANGES.

PRINCIPAL INVESTIGATOR
JUSTIN BERRY

Research into emerging media is not simply about exploring new technologies to see what they can do, or discovering the ways that they can improve on pre-existing media, it is about understanding the way that these new forms of experience shape our perception and understanding of the world. The Blended Reality project at Yale is interested in exploring new media using an arts based approach to research. Rather than begin with a hypothesis that we aim to validate, we look for projects interested in upending our expectations and current paradigms by exploring the space in between success and failure. Our goal is not to optimize emerging technology but to synthesize it in such a way that its unique features become accessible to a broader audience.

Participants in the program are not providing answers, they are asking questions and operating in a context that does not use success or failure as a metric. Projects are not measured by how well they perform their stated goals but by the extent to which their exploration reshapes our understanding of the technology and its potential. A low-stakes environment is one where risk is encouraged and where failure is seen as a learning opportunity. The advantage of a low-stakes environment is that while there is not much to lose, there are no limits to the potential for gain. The metric of our success is not the number of projects that have achieved their initial goal but the number of participants whose creative trajectory is forever altered by their participation in the program.

My thanks to several colleagues for their engagement and support; Randall Rode, my partner in this project, whose leadership and outreach have been instrumental to our success; and Jennifer Glass, Miriam Schroers, and Bobby Berry for their invaluable contributions to creating an active, engaged, and informed community. They are the ones who kept things moving and cleared away obstacles for participants when they arose. Of course none of this work is possible without the contributions of the faculty and students who participate in the project.

Our research work is made possible through the generous support of HP Inc. The members of their Immersive Experiences Lab welcomed faculty and students into their facilities and help inspire and catalyze student and faculty visions. With special gratitude my thanks to Gus Schmedlen, vice president of Worldwide Education at HP. He is sincerely driven to explore how innovation and exploration can be supported in the University context and has been a tireless supporter of our faculty and students. Without his support we would not be able to take these risks and create the vigorous community that has grown around this project in the last few years.

BLENDED REALITY BRINGS DIVERSE PERSPECTIVES TO EMERGING TECH

YALE NEWS STORY

This article originally appeared in Yale News, on May 1, 2019. For a complete listing of publications, presentations and publicity related to work under the Blended Reality project please visit **blendedreality.yale.edu/publications**

Four turntables are arranged on a table at a zoo by the bear enclosure. Play a record and the bears stand up and boogie. Turn around and Pegasus hovers over another enclosure. Toss an apple into the pen, and you will be astride the winged steed, poised for a memorable ride.

Yale sophomore Noah Shapiro created this fanciful virtual zoo. It is an immersive experience he developed in consultation with Yale Cancer Center's Pediatric Hematology and Oncology Program to provide a measure of joy to children during a frightening and difficult time.

"I thought that a zoo experience would be fun for the kids to explore and, in some way, restore some normalcy to their lives," said Shapiro, who plans to major in computer science. "I hope the fact that they can control the animals in different ways provides them with a sense of agency."

Shapiro presented his zoo experience at "Liminal Views," an exhibition of "blended reality" projects by Yale students and faculty held on April 26, 2019 at the Center for Collaborative Arts and Media (CCAM). The work presented was part of the Blended Reality Research Program—a partnership between Yale and HP supporting innovative, cross-disciplinary projects that blur lines between the physical and digital worlds.

The program seeks to make emerging technologies, such as virtual and augmented reality, 3D fabrication, and digital imaging, accessible to a broader range of people, opening new creative avenues for artists and scholars, explained Justin Berry, the research program's principal investigator and a critic at the Yale School of Art.

"We're trying to introduce this technology to people who don't have expertise with it—people who are not approaching it with preconceived ideas about what it is supposed to become," Berry said. "In doing so, we're bringing diverse and unique perspectives to an emerging technology. Very often it's people who aren't familiar with technology who have the most meaningful insights about it."

This diversity of perspectives was apparent in the broad range of projects presented at the event, which transported users inside the cell structure of a leaf, took them on a tour of an active Yale archaeological excavation in Egypt's Elkab desert, or invited them to create a 3D selfie, among other experiences.

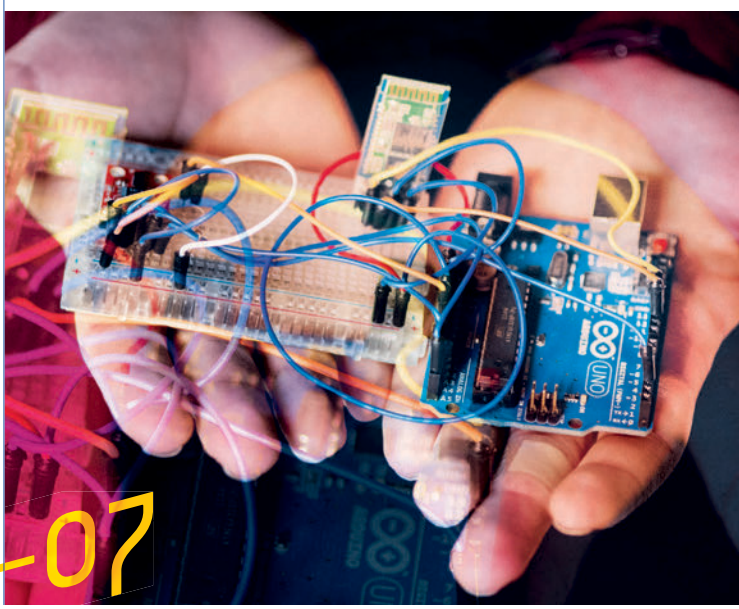
Dance artist Mariel Pettee, a Ph.D. candidate in physics, is collaborating with experts in particle physics and machine learning on "Beyond Imitation," a project to generate choreography through neural network architecture, a form of artificial intelligence.

Pettee has recorded various dance sequences in CCAM's motion-capture studio. The motion-capture data is fed into the neural networks, which produce variations on Pettee's movements or invent completely new dance sequences—insights that can inform her choreography and spark creativity.

"I really like the idea of having my choreographic potential recorded in a physical form that I can sample from infinitely," Pettee said, who is working on the project with Chase Shimmin, a postdoctoral researcher in the Department of Physics, and Douglas Duhaime, a programmer at Yale's Digital Humanities Lab.

Travis McCann, who is studying for a master's in science of nursing at the Yale School of Nursing, is collaborating with Yale undergraduate Bobby Berry to create dynamic medical-training simulations through augmented-reality technology, which unlike virtual reality uses real-world objects as part of the experience.

Typically, medical training simulations are performed on mannequins bearing wounds rendered with makeup. McCann and Bobby Berry, a senior majoring in computing in the arts, have created an app that uses augmented reality to simulate wounds and injuries on the mannequins more realistically.



"Before it was just makeup that looks like a cut," said McCann, a teaching assistant in the School of Nursing's simulation department. "With the augmented-reality headset, you can render an arterial bleed that will only stop once the student applies the correct treatment."

More realistic simulations will better prepare nursing students to respond effectively in genuine emergencies, McCann said.

"The less shocking that first medical emergency seems, the more likely you are to respond correctly," he said.

Undergraduates Lance Chantiles-Wertz and Isaac Shelanski are working with Sara Abbaspour, a photography student at the Yale School of Art, to develop a customizable interface that will help people create immersive experiences difficult to achieve with a traditional trigger-based controller.

"Most controllers resemble guns," said Shelanski, a junior majoring in physics. "The truth is that virtual reality and augmented reality have many uses outside of gaming, and even in gaming, outside of shooting things. Trigger-based controllers can be very limiting to the creativity that virtual reality makes possible."

Their device, called the "Clamshell Controller," can be customized with any number of different sensors to manipulate a virtual world, explained Chantiles-Wertz, a senior mechanical-engineering major.

"The idea is that you can take whatever sensors you choose and plug them into a device that is compact and very easy to use," he said. "And using it won't require a background in engineering."

For the exhibition, the project team customized the device to manipulate an ocean simulation. They outfitted the controller—which resembles an overturned flowerpot—with three sensors. Covering one made the sky go dark. Tapping another disturbed the water. Rotating the third changed the weather from sunny to stormy.

The project's early stages, which began in the fall, involved creating the platform to stream data from the sensors into Unity, which is the game engine that supports most virtual reality experiences, Shelanski said. The next phase will focus on making the controller's physical form more compact and capable of supporting more sensors.

CCAM—an interdisciplinary research center at 149 York St. where traditional arts blend with computer science and technology—serves as the hub for the Blended Reality Project. People from varied fields and backgrounds can collaborate there on projects and tease out ideas using a broad range of media resources, including a range of cutting-edge digital tools.

Shapiro recounted spending long nights at CCAM over the semester while creating his virtual zoo, which features flying whales and hungry rabbits in addition to dancing bears and Pegasus.

He is a member of the Yale Students Immersive Media Group, or YSIM, a team of undergraduates that creates virtual reality experiences for artistic expression, recreational enjoyment, and problem solving. The team created multiple experiences for the young patients at the Yale Cancer Center.

CCAM's resources were crucial to the project, Shapiro said.

"Virtual reality requires a lot of different disciplines," he said. "You need 3D modeling experience, coding experience, and game-engine software experience. Luckily, we have the opportunity to learn a lot of those things at CCAM. I've learned so much doing this project."

LIMINAL VIEWS 2019

SHOWCASE OF WORK FROM THE BLENDED REALITY PROJECT

BEYOND IMITATION: GENERATIVE AND VARIATIONAL CHOREOGRAPHY VIA MACHINE LEARNING

A project which explores use of machine learning to generate novel sequences of choreography and variations on a given dance phrase using neural network-based architectures.
Mariel Pettee, Physics PhD Candidate, Yale Graduate School of Arts and Sciences
Douglas Duhaime, Yale Digital Humanities Lab
Chase Shimmin, Physics Postdoctoral Researcher, Yale

VERB COLLECTIVE

A simplified development tool for teaching and making immersive experiences driven by meaningful interactions.
Justin Berry, Yale School of Art, Critic
Bobby Berry, Yale Center for Collaborative Arts and Media, Immersive Technology Technician

CLAMSHELL CONTROLLER

A custom designed electronic interface device to feed remote sensor data into an immersive experience simulation.
Lance Chantiles-Wertz, Yale College 2019, Mechanical Engineering
Isaac Shelanski, Yale College 2020, Physics
Sara Abbaspour, Yale School of Art 2019, Photography

LOSTLANDSCAPES

A single viewer virtual reality sound and audio experience
Sara Abbaspour, Yale School of Art 2019, Photography

ENERGY ACADEMY

An educational experience that teach users about how energy is transferred from the sun to the earth and to plants—and then how that energy eventually makes its way to the electrical grid and our homes.
Martin E. Wainstein, Yale TSAI Center for Innovative Thinking at Yale, Innovator in Residence
Bobby Berry, Yale Center for Collaborative Arts and Media, Immersive Technology Technician
Winter Willoughby, Yale College 2020, Psychology

MEDICAL TRAINING SIMULATION

Utilizing the Microsoft Hololens augmented reality headset to overlay medical training scenarios onto a real-world medical setting.
Travis McCann, Yale School of Nursing 2020
Bobby Berry, Yale College 2018, Computing in the Arts

ANCIENT EGYPTIAN ROCK ART VR

A virtual reality experience of an active Yale excavation site in the Elkab desert (Egypt) focusing on the post-prehistoric archaeological evidence, including Predynastic through Coptic Period graffiti inscriptions.
VR Developer & Technical Artist: **Winter Willoughby**, Yale College 2020, Psychology
VR Technical Consultant: **Bobby Berry**, Yale College 2018, Computing in the Arts
John Coleman Darnell, Director of the Elkab Desert Survey Project, Professor of Egyptology, Yale University
Alberto Urcia, Associate Research Scientist, Yale University

DEEP DIVE

An immersive exploration of novel interactions in a digital environment
Jack Wesson, Yale College 2019, Computing in the Arts

THE YSIM EXHIBITION: EXPLORING NEW WORLDS

A selection of VR projects from the Yale Students for Immersive Media.
Monique Baltzer, Yale College 2020, Graphic Design
Charlie Orr, Yale College 2021
Xavier Ruiz, Yale College 2021
Noah Shapiro, Yale College 2021, Computer Science
Jack Wesson, Yale College 2019, Computing in the Arts
Winter Willoughby, Yale College 2020, Psychology

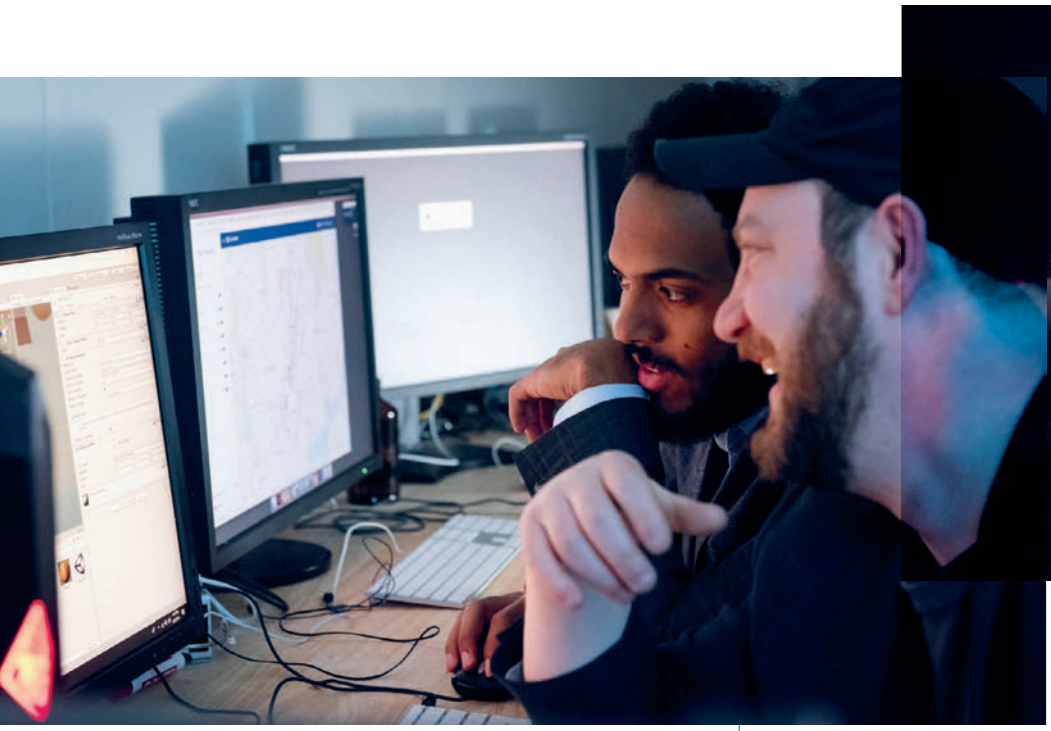
SOUND STORYTELLING

Explorations in capturing and sharing ethnographic field work with 360 video.
Dinny Aletheiani, Yale Macmillan Center, Council on Southeast Asian Studies
Sara Abbaspour, Yale School of Art 2019, Photography
Seth Wenger, Yale School of Divinity 2020


BIG
DATA

BRINGING VR TO THE MASSES

VERB COLLECTIVE



One of the main goals of the Yale Blended Reality project—perhaps even the major driver—is to make virtual reality (VR) more approachable to people outside of the computer sciences.

It's clear that principal investigator and faculty artist Justin Berry has made this his mission statement.

Verb Collective—which he created with recent graduate Bobby Berry (no relation)—aims to give people with little or no coding experience the ability to easily create VR experiences. They did this by creating a modular set of simple scripts based on meaningful interactions or verbs such as push, open, grow, shrink or walk. Users simply paste the scripts directly into Unity—a VR gaming engine—tweak some preset variables and publish instantly to see the results.

The idea is that someone can literally create a new experience on day one.

In a way, Justin and Bobby have created an open source low-code development platform directly in Unity. Each script is comprised of no more than 30 lines of code and can be easily tweaked through a series of variations. For example, a user can edit a single line of code to make a two-foot by two-foot cube expand to four feet by four feet in three seconds when a user types 'k' on the keyboard. Or it can expand to eight feet by eight feet in seven seconds when the user presses the trigger. And the coding process takes just a few seconds.

Scripts based on specific verbs are being created on an ongoing basis. A public release of the Verb Collective

will be available soon in the Unity Asset Store with an open-source project on GIThub in the works.

LEARN TO CODE BY CREATING CODE

More than just a coding shortcut, Justin sees Verb Collective as a teaching tool. The simple way that the scripts are written and the way that users can tweak each line and see immediate results makes it easy to learn what each line of code does. Justin hopes that these non-coders build upon this beginner framework and eventually become seasoned Unity developers.

"I learned to code by Googling, and I think that's true for most people," explains Justin. "I'd just search for something I needed, cut and pasted it into Unity and tweaked it until it did what I wanted. Often, I didn't even know what I changed to make it work. It was really just a shot in the dark."

Now, Justin hopes that the simple snippets of code that he created can help people really learn what each line does and how to change it to make it do the desired action.

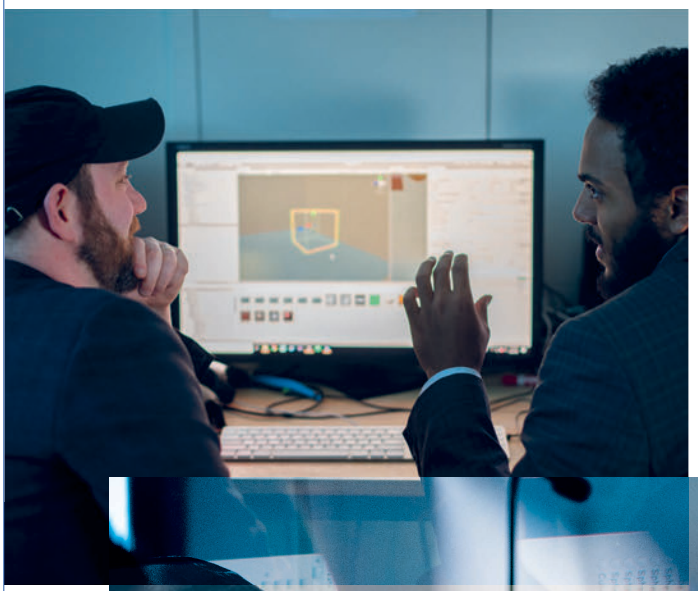
CONTINUED DEVELOPMENT

Recently, Justin and Bobby achieved a significant breakthrough by figuring out how to more easily build actions on top of actions—or triggered actions as Justin calls it. For example, the two-foot by two-foot cube referenced below can now be made to grow and move across the virtual room. Or, more practically, a user can make a door open when a button is pressed. This is important because of the complex process required to code triggered actions from scratch in Unity.

An experience that Justin created using Verb Collective shows just how simple making a VR experience can be. Putting on the headset transforms you to a virtual music studio where you can pick up and drop orbs in the path of a series of fast-moving panels. As the panels pass through the orbs, a chime resonates through the room. Put together a string of notes, and you're able to compose a beat or run. The whole thing took him less than an hour to code.

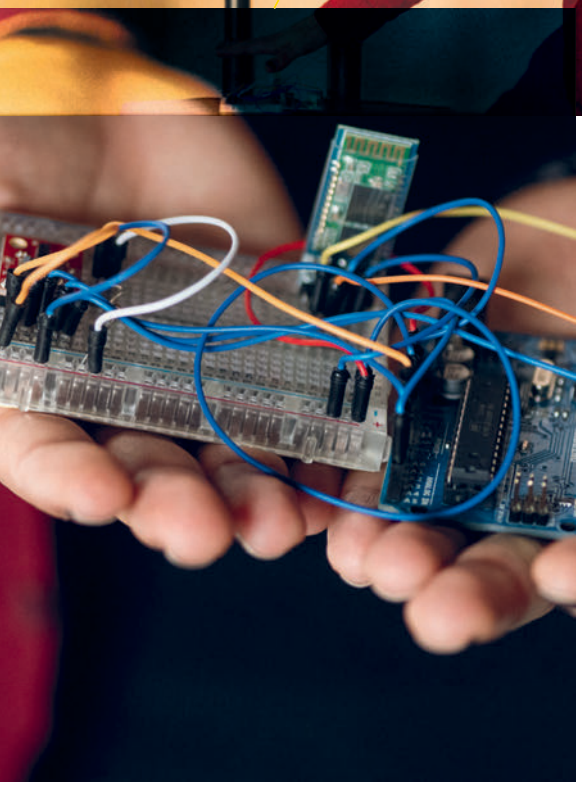
Justin introduced Verb Collective in a class called 3D Modeling for Creative Practice where students were required to make virtual rooms with triggered objects like the button opens a door example above. Justin estimates that only a third of the class had any practical coding experience—yet, everyone was able to create a wholly new experience in Unity.

"Ultimately, this isn't about the language of code. It's about just trying to make stuff, new experiences, VR worlds," Justin explained. "You learn to paint by painting. You should be able to learn how to make VR experiences by making VR experiences."



REIMAGINING THE VR CONTROLLER

CLAMSHELL



Mention virtual reality (VR) to the average person and inevitably the conversation starts with first-person shooters. They imagine themselves trespassing across a scarred battlefield or in a dungeon or post-apocalyptic landscape, holding some sort of gun in front of them as they try to kill as many zombies/demons/aliens as they can.

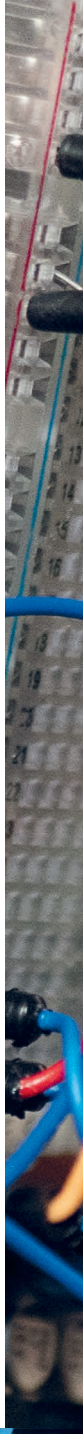
And, sadly, that's kind of accurate. Despite the potential for many innovative, society-changing applications for VR, the most popular experience in the medium is shooting someone or something.

A group of Yale students, Lance Chantiles-Wertz ('20, mechanical engineering), Isaac Shelanski ('20, physics) and Sara Abbaspour (MFA) decided that the medium could do better, and they set about to make it easier to create more versatile, perhaps more creative and inclusive experiences in VR.

Their starting place? Reimagine the VR controller.

"Existing controllers have one main action. You point and you click—just like a gun. As an artist, I don't really have that type of interaction," Abbaspour said. "We want to be able to build virtually any controller that can support any experience that anyone can imagine."

There was one catch: there was no way that a single controller—no matter how innovative and different—would be able to enable any experience that anyone could imagine. If you think about it, Shelanski explained, using your hands to pet a mythical creature and conducting microscopic laser surgery should require a different tool.



BUILDING A PLATFORM INSTEAD OF A CONTROLLER

As the team investigated different designs and experiences, one thing became clear. The controller would have to be modular and built as an open source platform that could have different sensors plugged in and swapped out at will without requiring extensive coding. That way, anyone could easily customize the controller with different sensors depending on the experience they wanted to create.

For example, a developer building an experience that allows immobilized users to drive a racecar could add a motion sensor that tracks eyeball movement. Pressure sensors on a glove could mimic the sensation of molding clay or holding something in your hand. Or magnets could be used to simulate friction or textures. The possibilities are endless.

"I've always thought that VR could be a powerful empathy engine that allowed people to interact with other people in new, interesting ways. This team is proving that," said Justin Berry, principal investigator for the Blended Reality program.

THE GENESIS OF AN IDEA

The idea of a new controller was born at a conference that Berry and Chantiles-Wertz attended in Ireland. By the end of the trip, the two had sketched out a variety of new controller designs ranging from a rose to a clamshell that fit over the hand like a glove. When he got back to campus, Chantiles-Wertz teamed up with Shelanski to build out the electronics out of an Arduino controller and Spark circuit board while Abbaspour put the finishing touches on several designs, including what the trio dubbed the clamshell.

The next step is to figure out how to connect various sensors to the controller in a way that isn't intimidating for the non-developer—and then get that data to seamlessly flow into the Unity game engine. According to Shelanski, a series of USB ports or Bluetooth could be potential options. Or machine learning could enable the controller to configure itself when a new sensor is plugged in—whether it has seen that type of sensor or not.

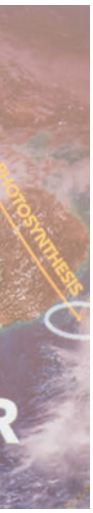
The semester is winding down, and the team is in the prototype stage. They still need to manufacture a working prototype based on Abbaspour's clamshell design, but it's easy to see how their controller could be a conduit for adding various sensors that enable different experiences.

The hope is that a more inclusive controller can spark new, innovative ideas for different VR applications and convince non-gamers to want to interact with those environments.

With their help, that reality is just over the horizon.

IMMERSING PEOPLE IN THE ENERGY ECOSYSTEM

ENERGY ACADEMY



Martin Wainstein is fascinated with climate change and people's interactions with the planet.

Starting his career at various universities around the world, Martin studied geo and astrobiology and developed new ways to think about the earth as a five-billion-year-old organism. His experience as a student, researcher and entrepreneur in Europe, New Zealand and his home country of Argentina eventually got him interested in climate change and how latency is the biggest obstacle to coming up with a viable solution that the whole world could get behind.

"If you think about it, the problem isn't political or financial," he said while taking a break in the Yale Center for Collaborative Arts and Media. "It's social. People don't have a good understanding of how the entire system works, and we need to give people instant feedback on our interactions with the planet."

Martin is now an Innovator-in-Residence at the Tsai Center for Innovative Thinking at Yale, and it's easy to see how his passion for social responsibility and climate change can rub off on others. He quickly caught the attention of faculty advising the Blended Reality project who recruited him to develop an immersive experience that would help close the latency gap between action and effect.

Over the summer, Martin teamed up with virtual reality developer and recent Yale graduate Bobby Berry, and the two quickly sketched out how to build a climate and energy focused immersive experience in virtual reality (VR).

The result: Energy Academy, an educational experience that teach users about how energy is transferred from the sun to the earth and to plants—and then how that energy eventually makes its way to the electrical grid and our homes.

A WELL-ROUNDED TEAM

Martin, Bobby and a third team member Winter Willoughby-Spera ('20) play on each other's strengths to develop the experiences in Energy Academy. Martin draws upon his lifelong experience studying climate change to come up with concepts, and the three of them work together to bring those ideas to life on a whiteboard. Once fleshed out, the team conducts various design sprints and builds out the project one component at a time.

It's Bobby, however, that takes the lead in creating the immersive experiences in Unity, a popular game engine. As passionate Martin is about the environment, Bobby is just as passionate about building virtual experiences.

"VR gives you a closeness that no other medium can provide," he said. "You're able to get a sense of scale that allows you to deal with issues people care about. Immersion takes you closer and deeper. It's pretty powerful stuff."

IMMERSED IN CLIMATE CHANGE

Putting on the VR goggles instantly transports you to a virtual campus made up of a series of geodesic domes—each one home to a separate experience.

The first dome teleports you to the center of our solar system where you can view photons traveling the 93 million miles to the Earth, learning the percentage that is reflected back into space versus absorbed into our atmosphere.

The second dome shrinks you down to various sizes in a terrarium where you can inspect how sunlight is converted into energy through photosynthesis. You start insect-sized and can scale down to the cellular level.

The third dome allows you to put yourself in the shoes of a local utility company and build a viable power grid across a region. Sponsored by local utility Everclear, the environment allows users to add solar panels, wind turbines and other energy sources and connect them to the existing grid. You can also run scenarios—such as a hurricane knocking out a relay station in Woodbridge, Conn., and take action to remediate power outages. The point, according to Martin, is to get people to understand how the energy grid works and how changes impact the system as a whole.

WEIGHING NEXT STEPS

According to Martin and Bobby, Energy Academy was designed to be a living, breathing environment that can be constantly changed and built on to. Of course, as the project comes to an end at Yale, additional funding and partners will need to be found. Already, Martin is fielding interest from people and organizations across the spectrum of academia and the private sector.

Within the Yale community, the team could decide to join forces with a group studying the connection between ecology and religion. Outside of Yale, a partnership with the producers of Grand Theft Auto to develop socially-conscience games has also been discussed.

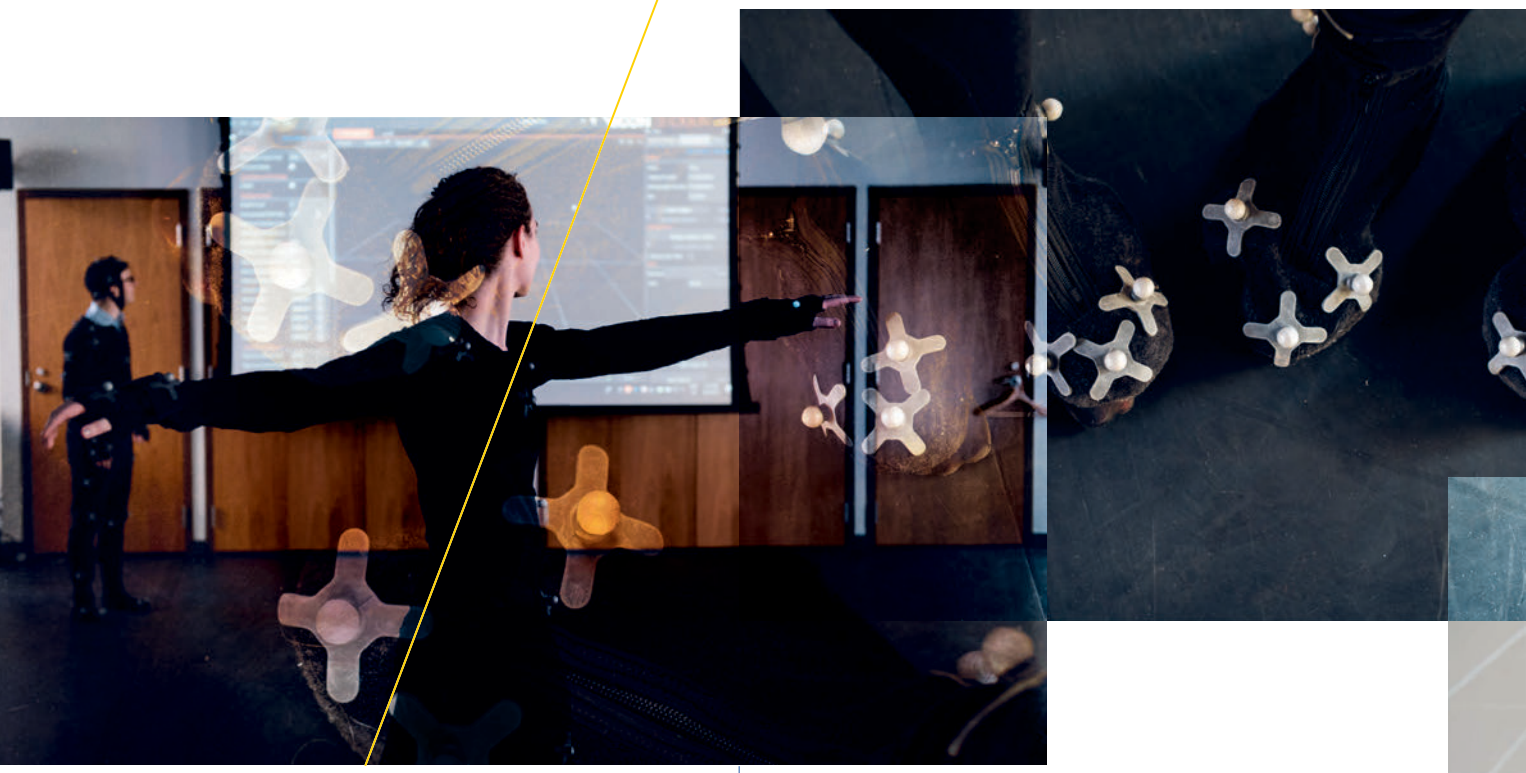
Most importantly, the creators of Energy Academy know that they need to focus the content in their project in easily-consumable four- to five- minute blocks. Currently, the experience is more open-ended and up to the user to navigate. The team could even crowd-source this task, allowing the open source developer community to create immersive education content on their own.

Whatever the team decides, Energy Academy is likely to be a lifelong project for Martin who is dedicated to tackling the climate change problem until it is fixed. In the meantime, it's all about using immersive experiences to give people a more personal understanding of how energy is transferred from the sun to our electrical outlets while seeing in real time how our behavior can impact climate change.

Powerful stuff, indeed.

BLENDING ART WITH SCIENCE, MACHINE LEARNING TEAM TEACHES A COMPUTER TO DANCE

MACHINE LEARNING



There are left-brain people, and there are right-brain people. It's not often you meet someone who is equally creative and science-based—much less a whole team of creative, intelligent artists and scientists.

But you haven't met the Machine Learning team from the Yale Blended Reality.

Meet Chase Schimmin, a particle physicist who is an avid outdoorsman and photographer from California. There's also Douglas Duhaime, a developer in the digital humanities lab whose job it is to bring digital transformation to the humanities. And Raymond Pinto is an actor and dancer on Broadway who's always been interested in the intersection of data and dance and whose approach to dance is based on reason. Then there's Mariel Pettee, a PhD candidate in particle physics who performs modern dance in her spare time. All four are deeply creative, passionate people who love the arts and the sciences equally and seek ways to merge the two in new, interesting ways that no one has thought of before.

Put them together in a digital media lab and give them virtually unlimited access to the latest virtual reality (VR) and artificial intelligence (AI) technology, and there's no telling what they'd come up with.

So that's what we did, and the results are outstanding. The team has taught a computer how to dance. Seriously. Not only can it mimic moves, it can improvise and create new dance moves and routines that are both beautiful and intimidating at the same time.

The idea is that dancers and choreographers can use this artificial intelligence to spark new ways to move the body, incorporate new movements in dance routines and teach other dancers the new moves.

SO, HOW DO YOU TEACH A COMPUTER TO DANCE?

The first step is to capture real movements that dancers use in typical routines. Pettee and Pinto donned motion capture suits equipped with high-contrast sensors on the head, body and limbs and danced in a studio outfitted with 20 motion-capture cameras.

Duhaime then took the raw data and fed it into a data processing model where it can be viewed and analyzed in different ways.

Pettee and Schimmin, the two physicists, then created a machine learning algorithm that allowed the model to vary the movements slightly to create new moves. The model can also stitch together different moves to create entire routines.

MACHINE LEARNING DANCING APPLICATIONS

Eventually, the team will explore ways to then teach the computer's routines to actual dancers—closing a 360-degree feedback loop that the team hopes will help people get out of creative ruts, inform more creative choreography and lead to better improvisations.

The algorithm could also be used as a teaching tool for choreographers who aren't physically able to demonstrate moves with proper technique due to age or physical ability. It can also be used in game design to create a troupe of dancers that aren't in lockstep with each other—like in a night club or ballroom.

However it is used, the simple fact that this team taught a computer to dance is incredible. It really shows what is possible in the fields of machine learning and AI—giving hope to those right/left brained people who don't know if they want to be an artist or scientist. They can be both.

PRESERVING SOUNDSCAPES BEFORE THEY ARE LOST FOREVER

SOUND STORYTELLING

The sound is unmistakable among the low rumble of passing traffic and rattling construction equipment in the distance. It's a consistent high-pitched hum coming from somewhere on your right about 20 feet away, presumably on the other side of the street. Presumably, because you're just listening to a 360-degree audio file and there's no visual element to tell you exactly what is between you and the hum. You can't see it, but you can almost feel footsteps going by, some idle chatter and a vehicle or two passing between you and the hum. It's unlike anything you've heard before.

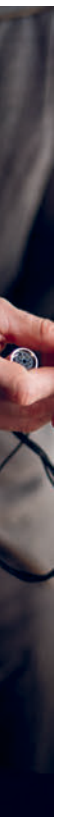
What is that? You ask Dinny Aletheiani, an Indonesian language studies professor who made the recording earlier this year on a trip to her hometown during Winter break.

Professor Aletheiani smiles. "It's the sound of a bamboo stove that is being used to make putu ayu, a local coconut snack made out of rice flour," she says. "It's a sound that you won't hear anywhere in the world."

You close your eyes and let the sound envelop you—and it does thanks to the 360-degree ambisonic microphone that the professor brought with her to record the soundscapes of Demak, an emerging city in central Java. Though when Professor Aletheiani lived there as a little girl, Demak was just a small village 500 kilometers from Jakarta on the Java Sea.

The recording is part of the Sound Storytelling Blended Reality project that Aletheiani created to help record the sounds that have been lost as one-time Indonesian villages explode into modern, growing cities. A linguistics and curriculum studies researcher, Professor Aletheiani believes that listening is a crucial component of learning a new language. Along with writing, speaking and reading, listening allows students to immerse themselves in a language and understand the context of how dialects developed over time.

She describes the local slang for "let's go" and how it mimics the putt-putting sound of the thousands of 50cc motorbikes that swamp the city. Reading the phrase in a book or even hearing a local enunciate the words wouldn't provide the same experience as hearing the actual sound of motorbikes swarming around you through the city.



The soundscape with the humming bamboo stove is just one of several two- to three- minute, 360-degree recordings and video that Professor Aletheiani created on her trip. There's the market soundscape with crowds of shoppers pushing past. There's a bird store filled with chattering parakeets in bamboo cages. And a woman on the outskirts of town harvesting enceng gondok, a local crop harvested in the wetlands along the banks of Lake Rawa Pening.

Upon her return to Yale, she gave the recordings to two graduate students who partnered with her on the Yale Blended Reality project: Seth Wenger from the Divinity School and Sara Abbaspour, a visual artist in the MFA program. Wenger has a background in video and sound editing, so he took the raw files and edited them into two- to three- minute soundbites. He then imported them into Unity where Abbaspour combined the audio and video to create the cohesive immersive experiences. Abbaspour was able to use gaze control to match directional sound to where the viewer is aiming his eyes, allowing you to vary perspective across the 3D sound experience.

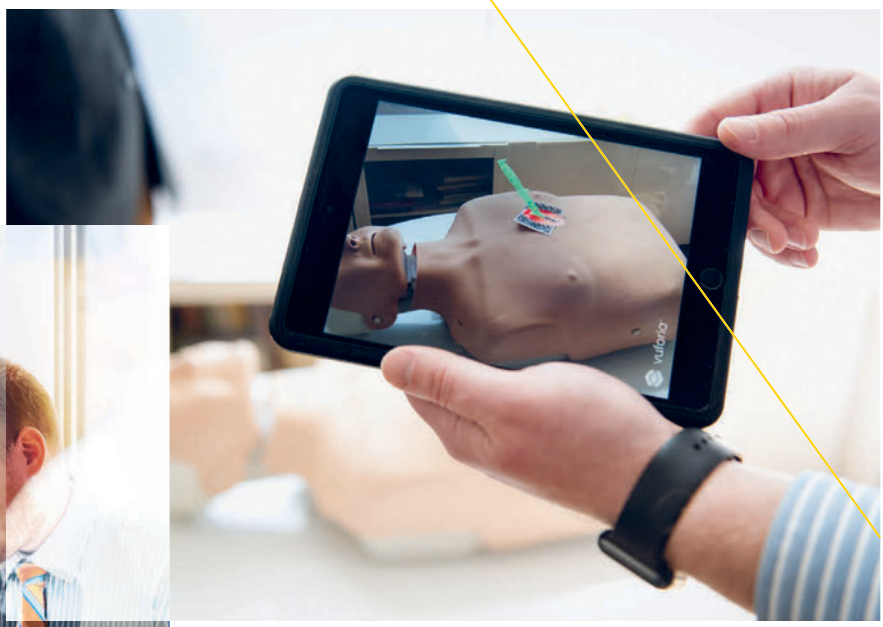
Professor Aletheiani has used the experiences in her classroom, allowing her students to put on a headset and immediately be transported to Indonesia with the context they need to truly understand the local dialect. She says that the soundscapes make learning the language in conjunction with the culture possible and lead to a richer educational experience.

Professor Aletheiani hopes to capture additional ambisonic sound and 360-degree video on future trips to Indonesia in hopes of capturing more nuance into Indonesian culture and language during this transformative period in the county's history. Soon, small villages will be swallowed up by modern cities, losing much of the flavor unique to that corner of the world.

Perhaps future generations will access Professor Aletheiani's soundscapes and wonder at a world when people still rode motorbikes and used bamboo stoves to make sweets.

NURSING TEACHING ASSISTANT USES AR TO STREAMLINE SIMULATION DEPARTMENT

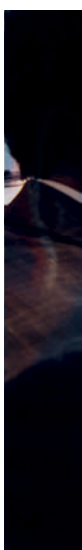
NURSING SIM

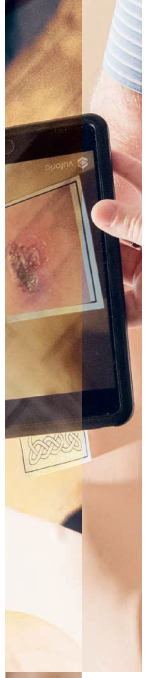


"Nurses need to be ready to deal with emergency situations on day one," says Travis McCann. "The natural instinct is to fight or flight which can lead to hesitation when there can't be any delay. The patient's life depends on it."

The Master of Science in Nursing (MSN) student at the Yale School of Nursing is finishing up his first year in the program while working full-time as a floor nurse at Yale Health. He's also a teaching assistant in MSN's simulation department.

His teaching assistant job in the simulation department requires him to create various 3D models out of clay, paint, makeup and other artificial ingredients for students who need to hone their instincts and decision-making skills when they encounter certain injuries for the first time.





The problem is that it takes a long time to build models of injuries that are realistic at scale. McCann could spend hours creating a model of a weeping wound on a forearm. A student comes in, runs through the simulation, and, in the process, creates a mess and ruins the model. McCann would then have to clean up the room and equipment and fix or create a new model—taking anywhere from a few minutes to a few hours. Running simulations for even a handful of students became a logistical nightmare.

Enter McCann's interest in creating an augmented reality (AR) experience with the Blended Reality project to replace the messy, tedious process. His hope is that his application allows him to run the same simulation (or multiple variations) to students right after the other without the limitations of physical models.

AUGMENTED REALITY SIMULATIONS

The first prototype that McCann created uses QR codes that can be scanned by a phone or tablet. A photo of an injury is rendered on the device, and the student has to run through a series of questions to prioritize, diagnose and treat the patient.

A second prototype requires the student to put on a HoloLens augmented reality (AR) headset that projects a virtual 3D model on top of a mannequin. A simulation created by McCann and his development partner Bobby Berry in the gaming engine Unity reveals a major gash on the forearm that is literally gushing blood.

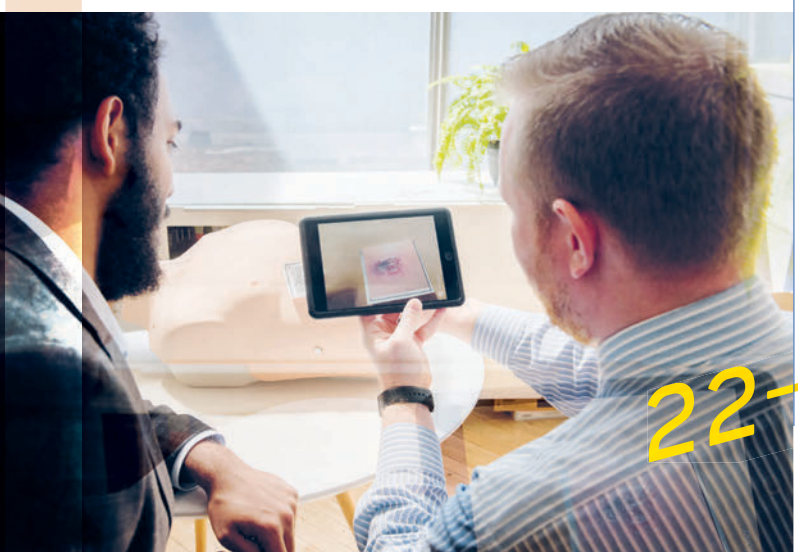
The student has to choose between three treatment options: put a band-aid on the wound, apply direct pressure or apply a tourniquet. If you choose the correct option—a tourniquet in this case—the bleeding stops. If you choose incorrectly, an explanation of the correct treatment is given, providing a teachable moment.

STREAMLINE TEACHING ASSISTANT JOB

The idea is that students will be able to experience as close to the real thing before being thrust into the field. This previously required inflexible physical models and messy fake blood, but now, everything can be cleaned up and reset at the push of a button. Eventually, McCann hopes to create a library of simulations that can be swapped out at will and added to full-blown scenarios that feature multiple injuries and victims. Having a stacked library will allow him to easily tweak scenarios in the middle of a simulation if something isn't working or if it gets repetitive—giving him flexibility to adapt curriculum on the fly. Most importantly, simulations that used to take a full day for hundreds of students can now be streamlined to take a few hours. The AR project will also save the department thousands of dollars on mannequins which can cost up to $50,000 for a single full-body figure.

It's these time- and cost- saving benefits that make McCann believe there could be a market for his AR application. According to a report by Grandview Research, the medical simulation market will grow to $5.26 billion by 2026 despite an absence of a viable VR or AR product today. McCann is already working with startup and business resources available through Yale to push something like this to market. He presented at the Yale Innovation Summit earlier this year and got positive feedback that he'll use to make his business case next year when he has a more developed product.

Until then, the Nursing Sim project will be used to streamline the simulation department in the nursing school. It's a great example of an innovative Yalie using technology and available resources to save the school time and money while improving education outcomes.

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CREDITS

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PRINCIPAL INVESTIGATOR
Justin Berry, Critic, Yale School of Art; Core Faculty, Center for Collaborative Arts and Media

PROJECT DIRECTOR
Randall Rode, Director of Campus IT Partner Development, Yale University Information Technology Services

PROJECT MANAGER
Miriam Schroers, Senior Project Manager

BUSINESS OFFICE
Gina Criscuolo, Faculty Research Management Services
Jennifer Glass, Associate Director of Stewardship Finance, Yale College

STAFF
Bobby Berry, Research Coordinator
Dan Miller, Programmer
Christina Strohmann, Research Assistant

CENTER FOR COLLABORATIVE ARTS AND MEDIA
Dana Karwas, Director
Caitlin Harder, Programs Manager

Tico Ballagas, Senior Manager, AI and Emerging Compute Lab at HP Labs
Todd Gustafson, Vice President and General Manager, U.S. Public Sector
Paul Martin, Distinguished Technologist/VR Evangelist, HP
Gus Schmedlen, Vice President, Worldwide Education
Shane Wall, HP Chief Technology Officer, Global Head of HP Lab

WRITING
Andrew Williams unless otherwise noted
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DESIGN
HvADesign, NY
Henk van Assen, **Meghan Lynch**, **Jodie Wijermars**

PHOTOGRAPHY
Stephanie Anestis

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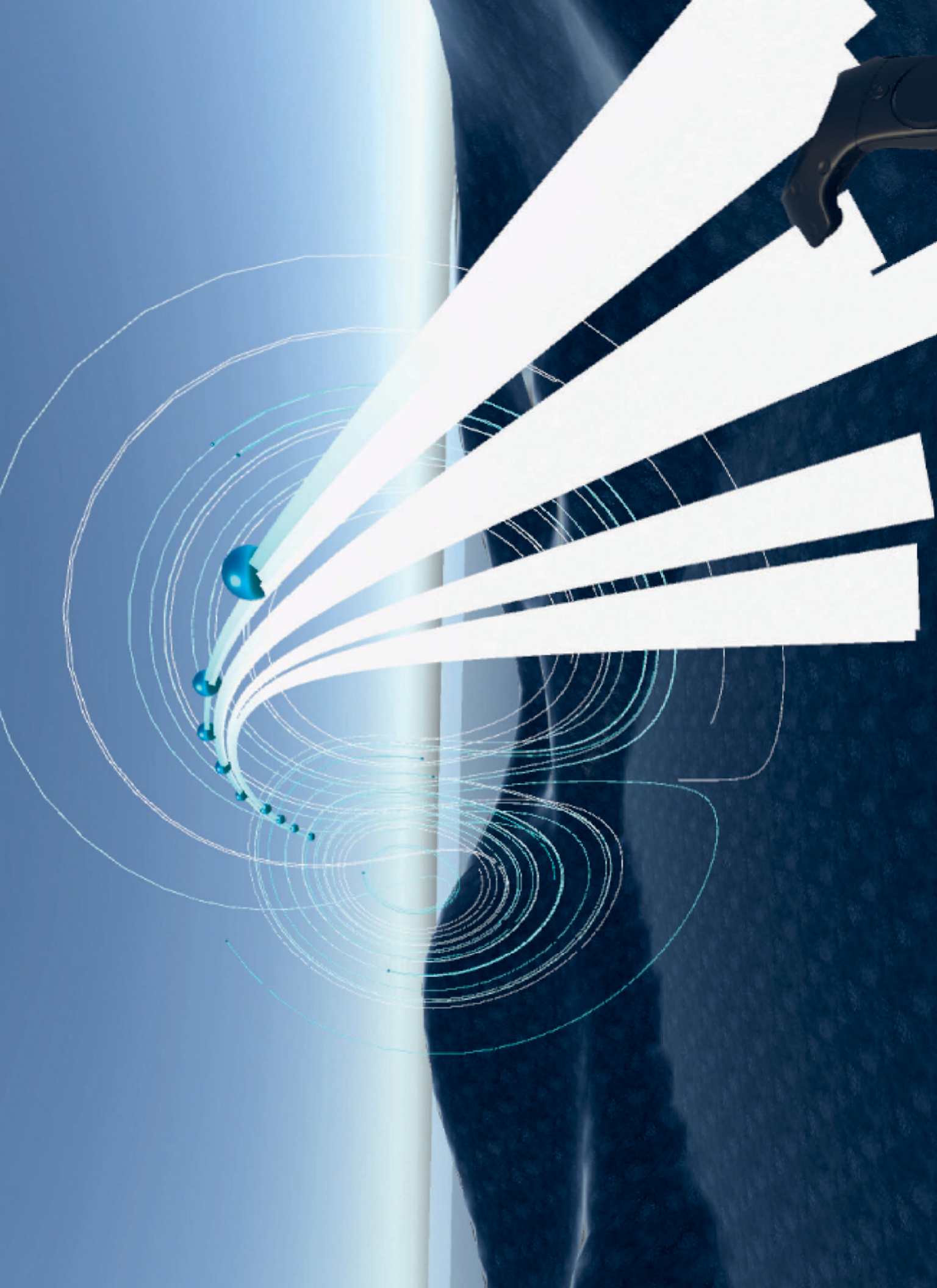
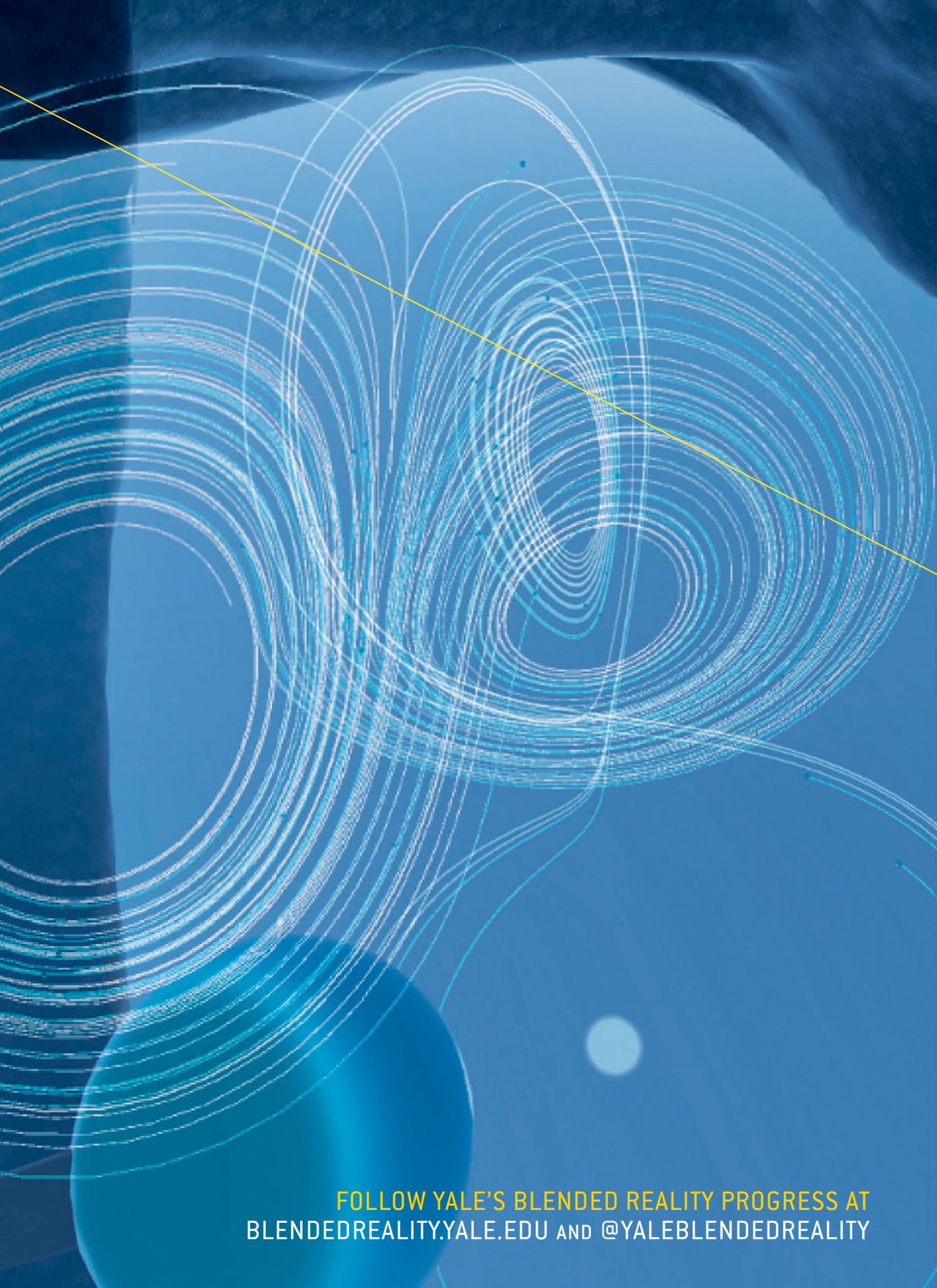
Visit **http://ccam.yale.edu** to learn more about CCAM's many events and facilities.





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