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“DANCEDEMIC” in a Pandemic: A New Networked Reality

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Abstract

The Covid-19 pandemic of 2020 forced large parts of the globe and entire industries to shut down. Network connectivity became a necessary lifeline deploying a host of technologies that, while once considered experimental, were to be adopted as a vital part of just-in-time solutions-based practices. This report examines the implementation of one of these topologies in the form of an artist-built, artist-owned global network in the hopes that other small-sized organizations can benefit from these ad hoc, but successful solutions.

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Turn on a Dime

Figure 1: Dancer Hussein Smko wearing an EmotiBit on his forehead and dancer Razvan Stoian wearing an EmotiBit on his finger during the live networked "DANCEDEMIC" performance. Screenshot by author.

In 2020, Jonathan Hollander, the Director of Battery Dance in New York City, and I were awarded a U.S. Department of State Alumni TIES (Thematic International Exchange Seminars) grant to develop dance performances incorporating sensor technologies. The performances needed to relate to themes of migration and immigration, with the results slated to be part of the 40th Annual Battery Dance Festival, an international festival of dance taking place in Lower Manhattan in the "Battery"—an area named for the the Hugh L. Carey Tunnel, commonly referred to as the "Battery Tunnel"—between New York and New Jersey. Two immigrant dancers, Razvan Stoian from Romania, and Hussein Smko, a Kurdish-Iraqi native, were selected to perform by Battery Dance. The title of the project was "Dance for Transformation."

Little did we know just a few weeks later how "transformative" this dance project would become. The Covid-19 pandemic hit New York and it hit hard, plunging the city into a strict Covid-19 lockdown. Forced to turn on a dime, Art-A-Hack, part of ThoughtWorks Arts (TWAs), pivoted to a new model by producing "DANCEDEMIC." Born from the most severe restrictions of pandemic lockdown New York City had ever known, TWAs created a global, networked performance from inside a storage closet at the Battery Dance company's studios where we pushed the limits of what

a network performance was and could be. Along with global collaborators, we utilized biometric sensors and experimental streaming services to create a just-in-time, customized, artist-run, and artist-owned network. The issue of being able to create networked collaborations through live-streaming platforms that are not controlled by the major players in technology is a very important one. Overzealous or misinformed content moderation has become a gatekeeper strangling innovative approaches to remote collaborations and interactivity. Financial limitations created by streaming platforms are another way to inhibit access and different voices.

Global Cohorts

We used the working methodology I had developed for Art-A-Hack™ rapid-prototyping workshops based on the Actor Network Theory of Bruno Latour. In this methodology, all aspects of a network, including both human and non-human elements, are considered "actors." How the actors form and disassemble connective elements through actions and non-interactions becomes part of the overall development process of a network. We placed an open call for artists and technologists to work together remotely. Applications poured in from all over the world, and two teams were formed whose respective members were based in the United States (California, New York, and Florida), Canada, Brazil, England, Ukraine, Estonia, and India. We constructed a dedicated server in New York remotely controlled through the collaborative software TeamViewer and piped out our experiments to the e-lektron platform, a dedicated streaming network developed by artists for artists in Tallinn, Estonia. Our goal was to bypass the major players in the field of streaming services and create our own on the fly, just-in-time alternative.

Emotibit

Along with the participation of the two dancers, we brought in the biometric startup EmotiBit, run by neuroscientist and new-media artist Sean Montgomery.[2] We wanted each dancer's biometrics to be integrated into the networked performance. Sean had created a compact wearable device that measured sixteen signals from the body by utilizing a PPG (photoplethysmogram) picking up heart rate, breath, and blood oxygen; an IMU (Inertial Measurement Unit) with a right-and-left accelerometers; a gyroscope plotting the x, y, and z coordinates of an individual's movement in space; a magnetometer based on the magnetic north pole; an EDA (electrodermal activity) reader

tracking emotional arousal or the flight-or-fight response; a medical-grade temperature measurement instrument; and a sensor to measure the body's humidity.

EmotiBit employed a SAMD21, a type of microchip controller with a USB port, as the core of its Adafruit Feather 21 device. With specialized programming the EmotiBit can work with a live video-stream, as it senses signals from the body and makes them part of the overall expression of the dance performance. The data was both logged as a file as well as streamed, though packet losses did occur when deployed over a livestream. To send data out of the EmotiBit, only one click was necessary to enable OSC (Open Sound Control) to stream to an EmotiBit address. The receiver program of this EmotiBit data timestamped the data about every 100 milliseconds. This timestamp allowed the data to be further manipulated because it supplied exact coordinates and measurements.

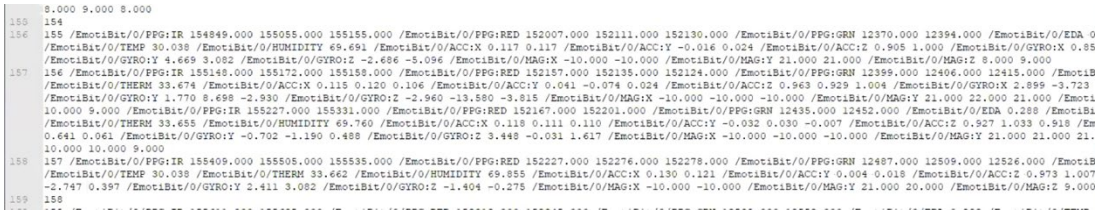

Figure 2: Screenshot of raw EmotiBit data, including frame numbers. Screenshot by author.

EmotiBit connected to the EmotiBit oscilloscope client over Wi-Fi and pumped the coordinate data out to both OSC and to a custom-built Max/MSP patch. This patch captured both EmotiBit and video data, syncing the two data-streams into one. For instance, whenever a video frame was captured from the performance, the EmotiBit data received during that same time period was captured as well. The patch was designed by Taavet Jansen at e-lektron especially for "DANCEDEMIC" using a Max/MSP frame-rate tool. The sync tool was both a recorder and a transmitter that could play back the OSC streams in sync with the video.

Figure 3: e-lektron Max/MSP patch with a viewer for the camera, a recording tool, a sync tool for video and data, a side panel for EmotiBit data, and a port input channel from the EmotiBit. Screenshot by author.

All the lines of the EmotiBit data file were numbered to correspond with the video frames, i.e., there was a 1: 1 correspondence. This allowed for the asynchronous saving of data so that it could be replayed and worked with by the dancers and their teams at any time, not just during live performances. Most frames had three biometric numbers, but some biometric processes required only one value, not three. Each packet contained an identifying number at the beginning of the data-stream; the OSC message needed to match with the number of the frame. EmotiBit data is asynchronous, meaning that the sensors sometime updated with each frame, however sometimes they did not. The data was not out of sync, but occasionally a frame was missing. This had to do with the speed of the network send or snapshot rates. The EmotiBit player streamed the OSC data out. That data could then be used by Max/MSP, Processing, openFrameworks, or any other program that uses OSC data.

According to Sean Montgomery, with machine learning, a skilled scientist can separate six to eight emotions out from the biometric data, though it varies depending on the context. For

example, the data is even more fluid in a dance performance, though it is beyond the scope of this paper to delve into those methods.

We mapped the data of our dancers and sent their information over the custom-built network at Battery Dance to be reconfigured by our teams of creative technologists who were building live real-time environments for both visuals and sounds. We streamed the data out to the server in Estonia. We also tried but failed to include an anonymized aggregate of the audience's emotional responses as they viewed the dances to be included as part of the performance; this would have allowed the audience to see their collective responses as real-time, aggregated measurements. We were unable to develop that aspect due to time constraints.

Birthed in a Closet

Amid the raging pandemic, we started our process by focusing on our basic needs: the network connection and carrier. Battery Dance had a standard internet connection that was not robust enough for our needs, so it had to be upgraded quickly. This was difficult enough during lockdown, but we encountered another obstacle: Battery Dance was located in a landmarked historic building, which meant we were limited in terms of how much drilling, wiring, and alterations could be done to the building. The basic network carriers for that part of New York City were overwhelmed with requests for new installations due to the shutdown of the city. We wanted a fiberoptic connection, but there was no trunk line we could tap that would reach the dance studio. Still, we managed to take the ultra-slow 11Mbps speed and upgrade it to a 35 Mbps upload.

Another restriction we encountered was that the studio followed strict Covid-19 protocols. It was used by other dance companies throughout the week, so the entire setup had to be compact and something that could be locked up. The next thing we did was take a standalone computer terminal and turn it into a robust OBS (Open Broadcast Server) performance server. We connected our OBS server to the upgraded network of Battery Dance through an ethernet cable and then placed our server and camera inside a small lockable storage closet in one of the dance studios.

The server contained all the different software we needed, as well as the support routers and connections to the HD camera that would stream the dancers' live performances. The camera had to meet specific requirements including being activated with just one touch and working with a Blackmagic HDMI setup. Prior to this occurrence, the dancers had never trained in performing solo in front of a camera; neither had they worked with remote collaborators nor had they been wired up with biometric equipment. Certainly, they had never performed while incorporating their own biometrics nor while creative technologists utilized such biometric data to augment a

performance. Razvan and Hussein had to learn to do all of this, as well as develop a choreography that worked with the remote environment, in a matter of weeks.

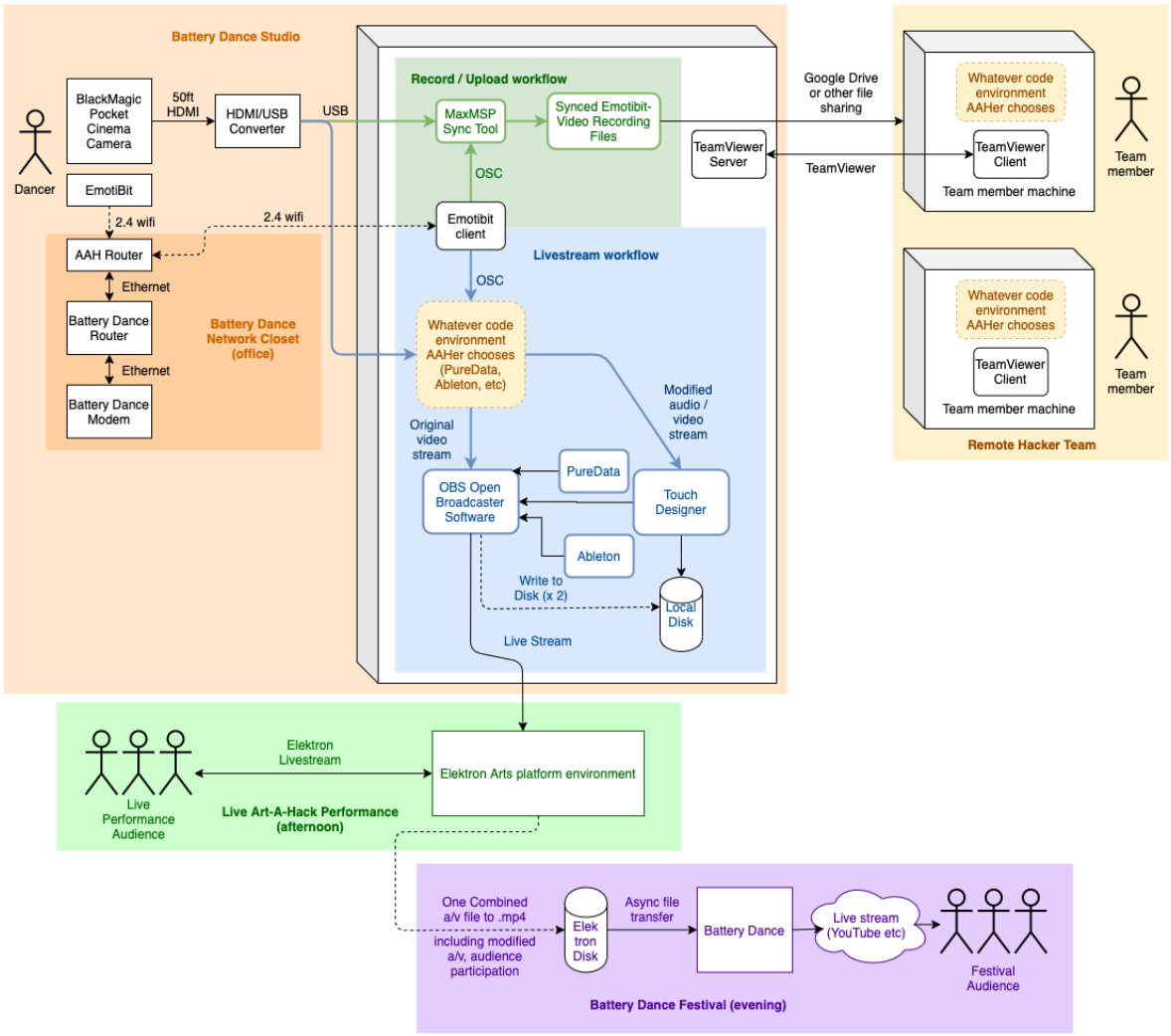

Figure 4: Live Network Setup. Diagram by Katie Larsen.

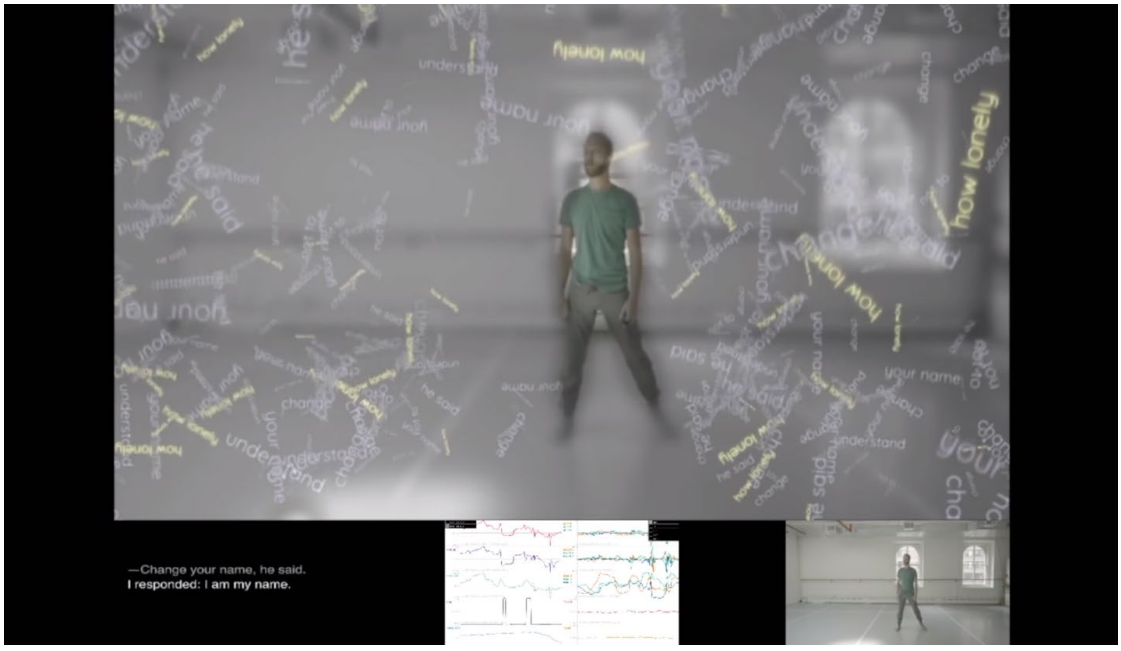

Figure 5: Razvan Stoian performing at the Battery Dance Festival on August 21, 2020, as shown in a composite video with audio and floating words wearing an EmotiBit on his finger. *Lower register, left to right,* poem, the live EmotiBit data, and the actual in-studio performance without effects. Screenshot taken by author.

The Nitty Gritty

Team Razvan
KeyMaster, OBS, and Ableton Live lead: Yuri Tymoshenko
TouchDesigner lead: Vinay Khare

Stoian and his team drew upon language describing the perceptual experience of otherness. Shifting between English and his native tongue in Romanian, the work *Hieroglyph* used both interactive visuals and audio to evoke the tension of moving through unfamiliar landscapes, both literally and perceptually. The choreography was a study in contrasts: turbulence and calm, dark and light, both highlighting reflections of inner and outer worlds. Data collected from the EmotiBit on Stoian's finger measured his blood-oxygen and muscle-tension levels. That data changed the color, size, speed, sound of the cascade of graphically generated words, and how his body interacted with those words on the screen.

Before the performance, Yuri Tymoshenko, the OBS and Ableton Live software lead based in Ukraine, and Vinay Khare, the TouchDesigner video artist based in India, launched TeamViewer.

The oscilloscope pane of the EmotiBit biometric device, locally based in New York, was also opened. The EmotiBit's IP address and OSC streaming ports were enabled, as their data affected the speed of the words floating on the screen. Tymoshenko opened Ableton Live and set up a port to receive data. He also enabled streaming ports for TouchDesigner as well as for Pure Data (PD), an additional form of music software run out of California by Derek Kwan. Tymoshenko opened PD to receive from his Ableton port, then set the outgoing port to send data to Touch Designer. A port was opened on TouchDesigner that was set to receive data from Ableton and PD. The Spout app plugin, which enables ultra-fast video routing with near zero latency, sent the video information to OBS. The OBS Studio environment was launched and set to receive the input from Spout. OBS was tested locally first in New York to make sure it worked. This was done in advance of streaming the performance to the e-lektron platform in Tallinn, Estonia.

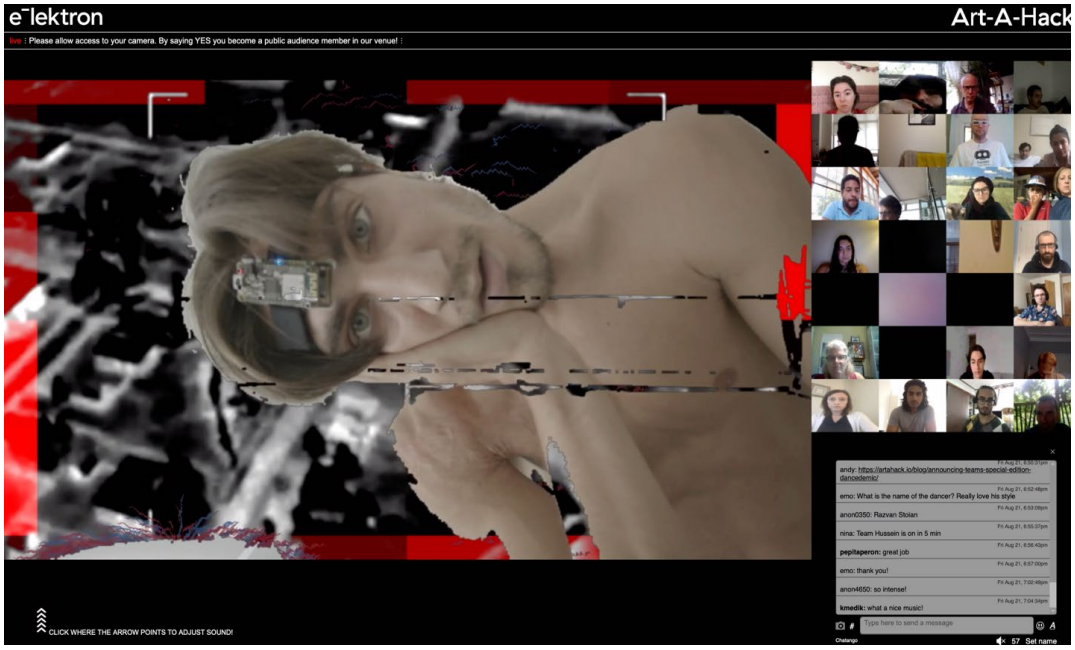

Figure 6: *Left*, Hussein Smko wears an EmotiBit on his forehead for his August 21 performance at the Battery Dance Festival. The red and blue squiggles and the red horizontal and vertical bars that "frame" Smko represent the dancer's biometric readings. *Upper right*, the global audience. *Lower right*, comments from the audience. Screenshot by author.

Team Hussein

KeyMaster and OBS lead: Kat Sullivan

OpenFrameworks and TouchDesigner lead: Sandro Miccoli

Smko's team presented *Walk with Me*, an individual's journey about finding mental strength and resilience in the face of adversity and chaos. Smko's memories of growing up in wartime Iraqi Kurdistan formed the backbone of the piece. He also embodied the practice of a ronin (a masterless samurai) who, no matter the situation, must find calmness from within and stay grounded. The biometrics read by the EmotiBit worn on his forehead were represented visually in the form of changing, multicolored strokes that surrounded his body throughout the duration of the performance.

Before the performance, Kat Sullivan, the OBS lead based in New York, and Sandro Miccoli, the openFrameworks and TouchDesigner video artist based in Brazil, opened TeamViewer. Sullivan launched the camera and the Spout app. She also opened the EmotiBit oscilloscope in order to check on Hussein's EmotiBit IP address to make sure the OSC data was streaming to the correct port. Hussein's EmotiBit readings would change color on the screen; these data tracings included colors such as white, tan, brown, black, and red. Sullivan then opened her specialized patch, Miccoli's code, and software developer Tyler Parker's specialized app Painterly that drew the EmotiBit designs correlating to Smko's biometrics. The sound designed by Minga Li was loaded, Kat began streaming and then recorded it, both in OBS Studio.

e-lektron

Both performances were sent via OBS to https://artahack.elektron.live in Tallinn, Estonia. e-lektron was launched in 2020 as a response to the pandemic, with its first performance occurring in April 2020. "DANCEDEMIC" was streamed live shortly afterwards on August 21, 2020. The e-lektron platform is like other streaming platforms as it uses RTMP (Real-Time Messaging Protocol) protocols for streaming and OBS to connect to the streaming server. The RTMP stream can also be sent to other servers. There are two ways to receive video from this configuration. The first uses the RTMP server to view what is being transmitted; the latency is usually less than one second. This configuration is only necessary for the server administrator to view the stream in real time. The audience does not see the RTMP stream, but instead sees an HLS (HTTP Live Streaming) open-specification data-streaming cluster; the latency is usually around 30 seconds.

For "DANCEDEMIC," e-1ektron's custom Max patch synched the RTMP video-stream with the dancer's biometric data. The platform was able to place a small wrapper around the OSC data from the e-lektron server to make the stream deploy globally through TCP (Transmission Control Protocol). OSC was more appropriate for the local network at Battery Dance, and so, UDP (User Datagram Protocol) was preferred over TCP to transmit data. The test site with RTMP video was maintained throughout the broadcast and OSC data was delivered with about a 100-millisecond

synchronization difference. As network bandwidth goes, the video-stream and the OSC were not very resource hungry, using between 2 to 4 Mbps per stream. However, once multiple video screens, audience interaction, mixed data, and live performance were added, issues arose with the computer hardware and software. It became a burden to both browser memory and computer-processing capacity. The two streams were combined to create a resultant stream that sat on the e-lektron platform, which we then viewed from a third window. The broadcasting endpoints are limited in that some sit directly on the server while simultaneously streaming to it. Each dance performance was also given its own root domain address to avoid confusion.

The Upshot

"DANCEDEMIC" was an interactive, globally networked dance, sound, and video performance that utilized collaborative methodologies and biometric technologies over custom-built networks. It was set up and deployed in about three months during the first phase of the Covid-19 pandemic in New York City. The event showed how performance with multiple collaborators around the globe could be deployed using artist-built and artist-owned networks in unexpected and innovative ways.

The seamless integration of choreography, sound, live video and enhanced computer-generated backgrounds, interwoven with the dancer's biometric data exceeded our expectations. We were so inspired by the results from "DANCEDEMIC" that we developed a residency at ThoughtWorks Arts devoted solely to artistic collaborations over networks for the 2021/2022 season.[3]

The pandemic, whether we like it or not, has forced the entire globe to come to terms with the relationship between in-person, remote, and hybrid life. As these new technologies are further integrated into emerging platforms, artists' ability to create and experiment are key to ensure that this thriving community can further develop even more new modes of artistic collaboration.

Acknowledgments

Additional support came from ThoughtWorks Arts: Andrew McWilliams (Technical Lead) and Katie Larsen (Project Management); Team Razvan: Aline Martinez, Manik Perera, Ni Ni Than, Nuntinee ("Nun") Tansrisakul, Yuguang Zhang, and Kat Mustatea; Team Hussein: Dan Oved, Neve Parker, Tyler Parker and Nina Mirhabibi; e-lektron: Taavet Jansen, Andrus Asaliad, and Kaie Olmre;

[3] The residents at ThoughtWorks Arts for Fall 2021 were h0t club and the Dilate Ensemble.

EmotiBit: Sean Montgomery; Battery Dance Company: Jonathan Hollander (Artistic Director), Emad Salem, and Barry Steele; and U.S. Alumni Ties, World Learning, U.S Department of State.

Appendix

Links to software, platforms, and performances mentioned in this essay:

TeamViewer

e-lektron

EmotiBit

Art-A-Hack "DANCEDEMIC" 2020 Live Performances [YouTube]