

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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META PLATFORMS, INC.,  
Petitioner,

v.

CURIOXR, INC.,  
Patent Owner.

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Case No. IPR2026-00460  
U.S. Patent No. 11,656,742

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**DECLARATION OF GREGORY WELCH, PH.D.  
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF  
U.S. PATENT NO. 11,656,742**

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## I. INTRODUCTION

1. I have been retained by Meta Platforms, Inc. (“Meta”) to analyze the scope and content of U.S. Patent No. 11,656,742 (“the ’742 patent”) relative to the state of the art at the time of the earliest application to which the ’742 patent claims priority. My analysis relates to claims 1-20. I have also been retained to provide analysis regarding what a person of ordinary skill in the art (“POSITA”) would have understood at the time of the earliest application underlying the ’742 patent.

2. This declaration summarizes the opinions I have formed to date. I reserve the right to modify or amend my opinions, if necessary, based on further review and analysis of information that I receive subsequent to the filing of this declaration, including in response to positions taken by CurioXR, Inc. (“CurioXR”) or its experts that I have not yet seen, including any secondary considerations evidence that CurioXR or its expert may consider and present.

3. It is my opinion that claim 1 of the ’742 patent is invalid as obvious based on the following grounds.

|          |                                                        |
|----------|--------------------------------------------------------|
| Ground 1 | Tang with Ravasz Renders Obvious Claims 1-11           |
| Ground 2 | Ravasz with Tang Renders Obvious Claims 1-11           |
| Ground 3 | Ravasz with Tang and Mine Renders Obvious Claims 12-20 |

## **II. EXPERIENCE, QUALIFICATIONS, AND STATUS AS AN INDEPENDENT EXPERT**

4. My curriculum vitae (“CV”) is Exhibit 1004. I am a Pegasus Professor and the AdventHealth Endowed Chair in Simulation at the University of Central Florida (“UCF”) with appointments in the College of Nursing, the Department of Computer Science, and the Institute for Simulation & Training. I am also the Co-Director of the IST Synthetic Reality Lab. Prior to my appointment at UCF, I was a Research Professor at the University of North Carolina at Chapel Hill (“UNC”); prior to that I worked on airborne electronic countermeasures at Northrop-Grumman’s Defense Systems Division; and prior to that I worked on the Voyager Spacecraft Project at NASA’s Jet Propulsion Laboratory (Caltech).

5. In 1986, I was awarded a Bachelor of Science degree in Electrical Engineering Technology with Highest Distinction from Purdue University.

6. I was awarded a master’s degree, and then, a Ph.D. in Computer Science from UNC in 1995 and 1997, respectively.

7. My research career has focused on human-computer interaction, human motion tracking, and virtual and augmented reality, with applications such as healthcare and defense. Notably, my research includes my very highly cited 1995 introductory article on the Kalman Filter, which is an algorithm that provides an efficient way to estimate the state of a dynamic system from noisy observations (that is, data or measurements that are influenced by errors and inaccuracies).

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8. I have published over 200 articles in peer-reviewed journals, conferences, workshops, and symposia. A sampling of these papers include “Revisiting Trends in Augmented Reality Research: A Review of the 2nd Decade of ISMAR (2008 2017),” “The Office of The Future: A Unified Approach to Image-Based Modeling and Spatially Immersive Displays,” “High-Performance Wide-Area Optical Tracking: The HiBall Tracking System,” and “Motion Tracking: No Silver Bullet, But a Respectable Arsenal.” Notably, my introductory paper on the Kalman Filter authored alongside Gary Bishop has been cited over 13,000 times. My works in Augmented Reality and tracking were cited in my promotion to IEEE Fellow, and a pair of seminal papers of mine on Spatial Augmented Reality in 1998 earned me and my co-authors the Long-Lasting Impact Award at the IEEE Virtual Reality Conference in 2016.

9. I have served as a peer reviewer and/or associate editor for more than 15 journals and other peer-reviewed publications, and I have served as a federal grant reviewer for multiple funding agencies/organizations. I have also written a dozen book chapters and sections, including those on, for instance, virtual, mixed, and augmented reality in computer science.

10. I am named as an inventor on 29 issued patents and have several others in various stages of prosecution. Two relevant examples are US Patent. No. 11,410,270, “Intelligent object magnification for augmented reality displays” and

US Patent. No. 11,798,127, “Spatial positioning of targeted object magnification,” which pertain using AR to magnify distant things in the real world, i.e., to take things that are far away and bring them close.

11. My teaching experience includes undergraduate and graduate level classes. Example topics include Virtual Reality and Augmented Reality and computer modeling and animation.

12. I am a Fellow of the National Academy of Inventors (NAI) and a Fellow of the Institute and Electrical and Electronics Engineers (IEEE). I was inducted into the IEEE Virtual Reality Academy in 2022.

13. I have received a number of awards, including the Virtual Simulation Innovation Award in 2025 (UCF CON STIM Center), IEEE VGTC Virtual Reality Technical Achievement Award in 2018, the IEEE International Symposium on Mixed and Augmented Reality Long Lasting Impact Paper Award in 2016, and the IEEE VGTC Virtual Reality Service Award in 2026. I have also been designated a Pioneer of the Association for Computing Machinery’s Special Interest Group on Graphics and Interactive Techniques (“ACM SIGGRAPH”), which is a recognition of long-time contributions in the computer graphics space. I currently serve as a technical expert for the IEEE for its virtual, augmented, and mixed reality Public Visibility Initiative.

14. I have been a keynote speaker at more than 20 scientific conferences, workshops, and colloquiums throughout the world. I have similarly been invited to give talks at, participate in, or serve on dozens of scientific committees for conferences, workshops, and panels worldwide.

15. A detailed list of my professional activities, memberships, and speaking engagements is included in my CV (Ex. 1004).

16. I am being compensated at the rate of \$600 per hour for my work on this declaration. My fee is not contingent on the outcome of any matter or on any of the technical positions I explain in this declaration.

17. I have no financial interest in Meta. I have been informed that CurioXR, Inc. (“CurioXR”) claims ownership of the ’742 patent. I have no financial interest in CurioXR.

### **III. LEVEL OF ORDINARY SKILL IN THE ART**

18. In my opinion, a person of ordinary skill in the art in 2022 would have had at least a bachelor’s degree in computer science, computer engineering, or a similar technical field, relevant experience working with VR and AR systems. Additional experience could substitute for less education, and additional education could likewise substitute for less experience.

19. My opinions do not turn on this precise definition, and the challenged claims would be unpatentable from the perspective of any reasonable person of ordinary skill in the art.

20. I believe that I would have qualified as a person of at least ordinary skill in the art as of the earliest alleged June 1, 2022 priority date of the '742 patent. I believe that I have a sufficient level of knowledge, experience, and education to provide an expert opinion in the field of the '742 patent.

#### **IV. RELEVANT LEGAL STANDARDS**

21. I understand that statutory and judicially created standards must be considered to determine the validity of a patent claim. I am not an attorney and, consequently, will offer no opinion on the law itself. My understanding of the pertinent law is described in this section and is the result of explanations provided by counsel. I have applied this understanding in my analysis.

22. I understand that a patent claim is unpatentable if it is anticipated by, or obvious in view of, the prior art. I further understand that the time frame of reference for determining whether a claim is unpatentable is from the perspective of a person of ordinary skill in the art at the time of invention.

##### **A. Anticipation**

23. I have been informed that for a patent claim to be anticipated by the prior art, each and every limitation of the claim must be found, expressly or

inherently, in a single prior art reference as recited in the claim. I have been informed that a claim limitation not expressly found in a prior art reference is inherent if the prior art necessarily functions in accordance with, or includes, the claim limitation. Mere probability that a limitation is included is not sufficient to establish inherency.

**B. Obviousness**

24. In analyzing obviousness in light of the prior art I have been informed that it is important to understand the scope of the claims, the level of skill in the relevant art, the scope and content of the prior art, the differences between the prior art and the claims, and any objective indicia of non-obviousness (also called secondary considerations).

25. I have been informed that a patent claim is unpatentable for obviousness if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person of ordinary skill in the art to which said subject matter pertains. I have been informed that obviousness may be based on one reference or a combination of references. I have been informed that the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.

26. I have been informed that when a patented invention is a combination of known elements, the Patent Trial and Appeal Board (“Board”) must determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue by considering the teachings of prior art references, the effects of demands known to people working in a field or present in the marketplace, and the background knowledge possessed by a person of ordinary skill in the art.

27. I have been informed that the Supreme Court has recognized several rationales for combining references or modifying a reference to show obviousness of the claimed subject matter. I understand that several of these rationales are: (1) combining prior art elements according to known methods to yield predictable results; (2) simple substitution of one known element for another to obtain predictable results; (3) use of a known technique to improve a similar device (method or product) in the same way; (4) applying a known technique to a known device (method or product) ready for improvement to yield predictable results; (5) choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; (6) and some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

28. I have been informed that in order to prove that a claimed invention is not patentable for obviousness, a petitioner must (1) identify the differences between the claim and particular disclosures in the prior art references, singly or in combination, (2) specifically explain how the prior art references could have been combined in order to arrive at the subject matter of the claimed invention, and (3) specifically explain why a person of ordinary skill in the art would have had reasons to so combine the prior art references.

### **C. Priority and Written Description**

29. I have been informed that to claim priority to a prior application, each application in the chain that leads to an earlier application must comply with the written description requirement. I have been informed that in order to satisfy the written description requirement, the specification of the provisional application must contain a written description of the invention and the manner and process of making and using it, in such full, clear, concise, and exact terms, that it would enable a person of ordinary skill in the art to practice the invention claimed in the non-provisional application. I have been informed that the provisional application must describe the invention claimed in the non-provisional application such that a person of ordinary skill in the art can clearly conclude that the inventor had invented the claimed invention by the provisional application filing date.

## **V. MATERIALS REVIEWED AND CONSIDERED**

30. My opinions in this declaration are based on working in the field of computer science and engineering, including my teaching, research, and consulting. I have an established understanding of the relevant field at the relevant time frame and I have an understanding of the skill set, capabilities, and knowledge of a person of ordinary skill in the art as of 2022.

31. My opinions are also based on investigation and study of the patent at issue, its file history, and the prior art. In the course of forming my opinions, I have reviewed the exhibits submitted with the Petition and any other materials cited in this declaration, which are specifically identified in Appendix A.

## **VI. TECHNOLOGY OVERVIEW**

32. Below, I provide overviews of prior art and technologies pertinent to the '742 patent.

### **A. Technology Underlying Virtual Reality**

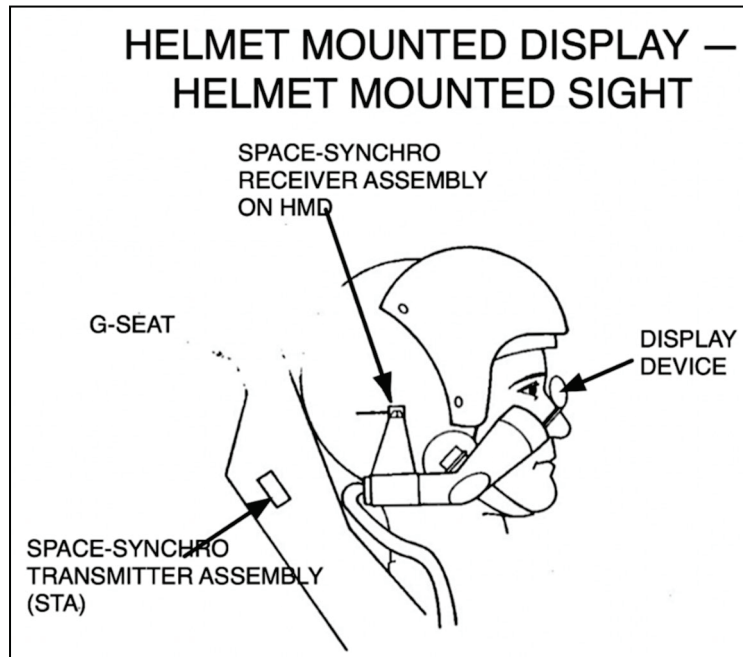
33. “Virtual reality is an attempt to provide an interactive, immersive interface to a synthetic, computer-generated world,” and it “provides direct manipulation and control of synthetic objects as well as providing the user with the illusion of immersion.” Ex. 1026 (“NSA, Virtual Reality”), 46.

34. Virtual environments generated by a computer have been around for many decades, long before 2022. What began as targeted, virtual simulations have

grown into more comprehensive virtual “experiences,” with the common goal of complete immersion driving these developments through the 2000s.

35. Some of the earliest examples of regularly used systems for 3D human-computer interaction for visual simulation were flight simulators. The earliest example of a flight simulator is an electromechanical pilot trainer developed by Edwin Link in 1929. Ex. 1010 (“The Link Flight Trainer”), 2-3. Real-time simulators with digital displays became available in the 1950s to 1960s, when realistic imagery of scenery could be coupled with the motion systems of those simulators. Ex. 1011 (“Flight Simulation and Synthetic Trainers”), 1-2; Ex. 1012 (“Characteristics of Flight Simulator Visual Systems”), 64-65 (describing flight simulators that upgraded their CRT displays to digital displays).

36. Looking more narrowly at systems with interactive graphics, in around 1966 the Air Force Aerospace Medical Research Laboratory (AFAMRL) was working on the Visually Coupled Airborne System Simulator (VCASS), shown below in Figure 2. Ex. 1013 (“A Visually-Coupled Airborne System Simulator”). The VCASS was one of at least two visually coupled systems being pursued by AFAMRL:



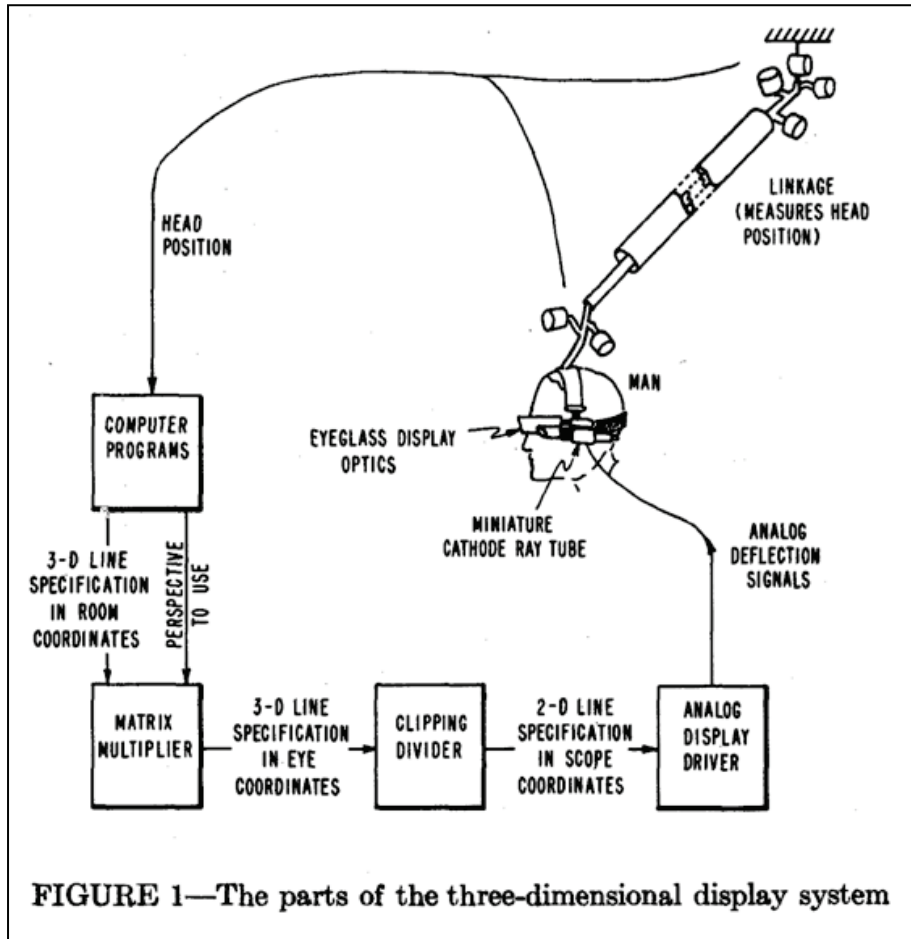
*Id.*, FIG. 2.

37. This work gave rise to the development of the Space Synchro (SPASYN) magnetic head-tracking technique by Polhemus Navigation Services, and the Isotrak tracking system, introduced by Polhemus in 1979, which would become the primary means for head tracking in VR for years. Ex. 1014 (“An Electromagnetic Position Sensor”), 9-11, 17-20, FIG. 3.

38. Systems for what today would be called Mixed Reality (MR), Augmented Reality (AR), and Virtual Reality (VR) also existed for decades before 2022.

39. A seminal example of such work is that of Ivan Sutherland and his students at the University of Utah in the 1960s, including Sutherland’s “head-

mounted three-dimensional display” paper, which is among the most well-known in the field:



Ex. 1015 (“A Head-Mounted Three Dimensional Display”), FIG. 1 (Sutherland’s three-dimensional display system); *see also id.*, FIGs. 2-4 (photographs of Sutherland’s prototype system, showing for example a custom graphics computer, a head tracking system, and a head-mounted display):

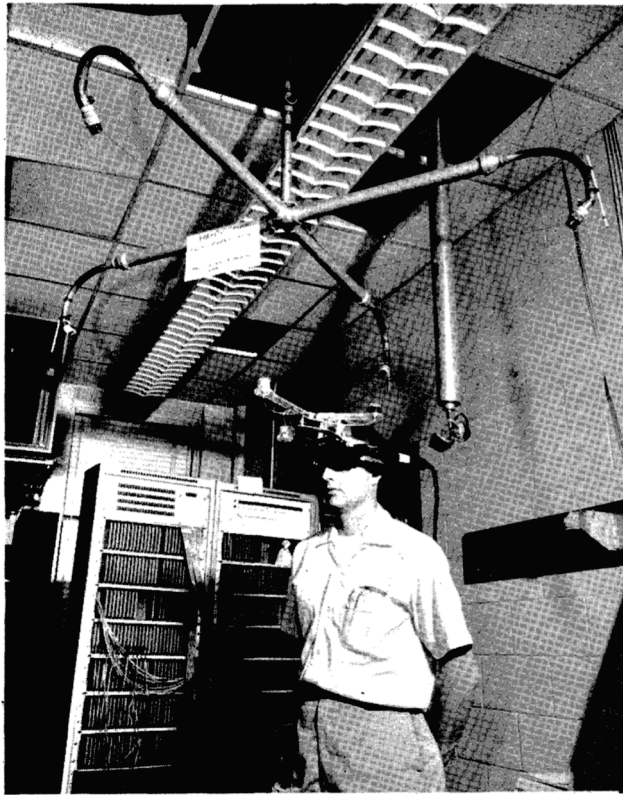


FIGURE 3—The mechanical head position sensor in use



FIGURE 4—The ultrasonic head position sensor in use

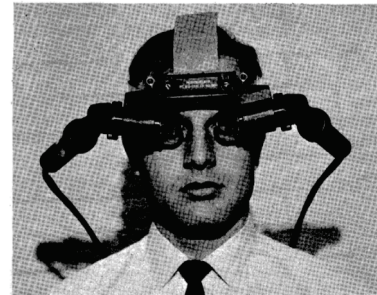


FIGURE 2—The head-mounted display optics  
with miniature CRT's

40. Sutherland's work offers one of the earliest examples of AR and VR wearable electronic devices for displaying AR and VR environments to users, for tracking users' positions and orientations (the "pose") in a coordinate system corresponding to real, physical space, mathematically transforming pose estimates into a coordinate system corresponding to virtual space, rendering the virtual environment, and displaying it in a head-worn device—i.e., a head-mounted display (or "HMD").

41. Over the years, the systems and methods associated with each of those component areas steadily evolved into more sophisticated, higher performance, and

more robust versions. In parallel, researchers around the world have been developing sophisticated user interfaces (UI) for navigating virtual environments and interacting with virtual objects and entities.

42. For example, “tracking systems” have evolved from versions requiring relatively significant infrastructure on and around the user, to systems that can estimate a user’s pose using only devices worn on the user, and trackable devices with at least six degrees of freedom—three for position and three for orientation. As one example, by the early 1980s, the “Self-Tracker,” prototyped at the University of North Carolina, Chapel Hill, provided “[t]racking with an outward view,” which “offers the possibility of operating in many different environments, ordinary rooms with ordinary room lights, with little or no overhead of setup.” *See* Ex. 1016 (“The Self-Tracker: A Smart Optical Sensor on Silicon”), 67.

43. Similarly, computer graphics systems have evolved from room-sized racks of computers and specialized graphics computers to personal computers with specialized graphics processors, to battery-operated systems that reside entirely on the user. Some of the earliest interactive computer graphics systems used custom built hardware and software. For example, as part of development of a spaceflight simulator, General Electric (GE) employees working for NASA during April–July of 1966 developed specialized hardware to be used with a Raytheon 520 computer to carry out rendering related operations such as three-dimensional object

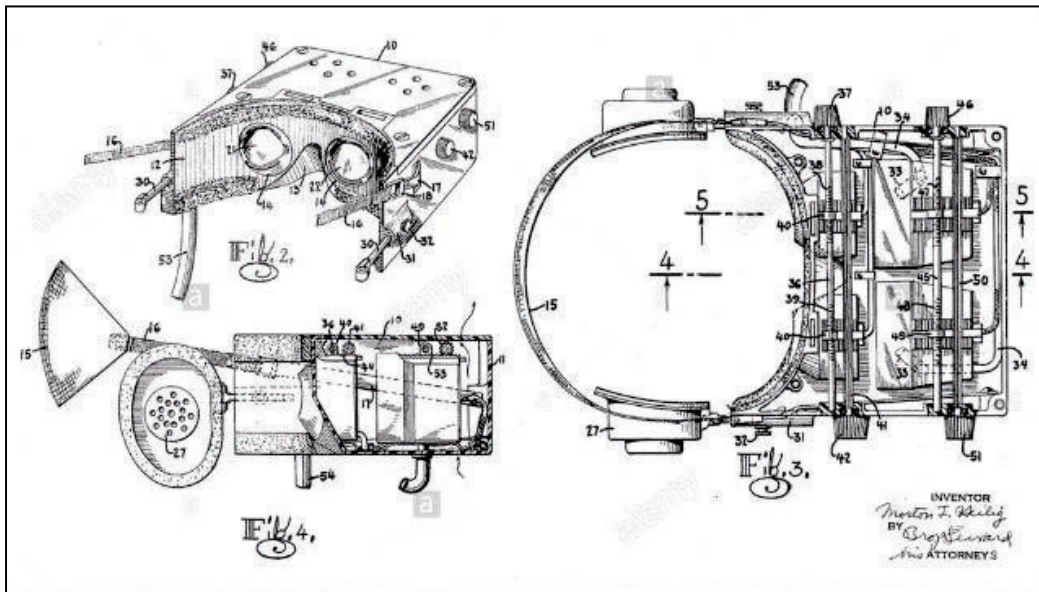
generation, the ability to drive three independent displays, and the ability to interface with other input-output equipment. Ex. 1017 (“Modifications to Interim Visual Spaceflight Simulator”).

44. Modern development environments and rendering engines such as Unity and Unreal have been freely available and were well known, well before 2022. *See* Ex. 1018 (“Learning Virtual Reality”), 1 (recognizing “Unity3D and Unreal game engines” as “tools of choice for native VR development”). The core components of the Unity and Unreal game engines included a modeling system to create and position virtual objects (including visual components and sound sources) throughout a three-dimensional virtual scene, a rendering engine for generating 3D graphics, a physics engine that simulated real-world physics, and a UI system that allowed users to navigate and interact with virtual environments. And with these pre-built tools, developers could design immersive virtual environments and intuitive ways to interact with them. *Id.*

45. “Head-mounted displays (HMDs) are the most common visual interface to virtual environments.” Ex. 1026 (“NSA, Virtual Reality”), 25. HMDs are also sometimes referred to with other names, such as a head-worn display or a heads-up display, and sometimes provide specificity as to the type of HMD, such as “glasses” or “goggles.”

46. Such head-mounted display (HMD) devices have existed since at least the 1960s, as shown by, for example, the VCASS flight simulator system shown in Figure 2 of Ex. 1013 (“A Visually-Coupled Airborne System Simulator”), or the HMD of the Sutherland system shown in Figure 2 of Ex. 1015 (“A Head-Mounted Three Dimensional Display”), both reproduced above.

47. Another example of an early HMD comes from a 1960 patent, which taught the use of stereo displays to create 3D peripheral images, and stereo and binaural sound played through adjustable earphones:



Ex. 1019 (“Heilig”), 3:18-21 (“By the independent feeding of right and left eyes with images taken by separate film or TV cameras equipped with wide angle lenses, a truly three dimensional peripheral image is created.”), 1:37-40 (“Another object is to provide ear phones which are so designed that the outer ear is completely free and untouched, thus allowing the ear phones to operate fully as sound focusing

organs.”), 3:14-17 (“the spectator is given a complete sensation of reality, i.e., moving three dimensional images, which may be in color, with 100% peripheral vision, binaural sound, scents and air breezes”), 3:22-25 (“By providing independent ear phones, which are fed separately from sounds recorded by independent microphone systems, excellent stereophonic or binaural sound is given.”), FIGs. 2-4.

48. Driven primarily by the advent of the smartphone—in particular the Apple iPhone in 2007—AR and VR systems became self-contained within single head-worn units that included computers, wireless networking, motion tracking, graphics rendering, and high-resolution displays.

49. For example, in 2015, Microsoft unveiled its HoloLens HMD and invited developers to create AR applications for it. Ex. 1020 (“HoloLens Hands-On: How We Built An App for Microsoft’s Augmented Reality Headset”), 1 (“Microsoft gave developers ... a chance to spend some quality time with HoloLens by building our own ‘holographic application’ using the Unity engine and Visual Studio.”). HoloLens was a “self-contained, untethered headset” that rendered “virtual objects into the users view of the real world”:



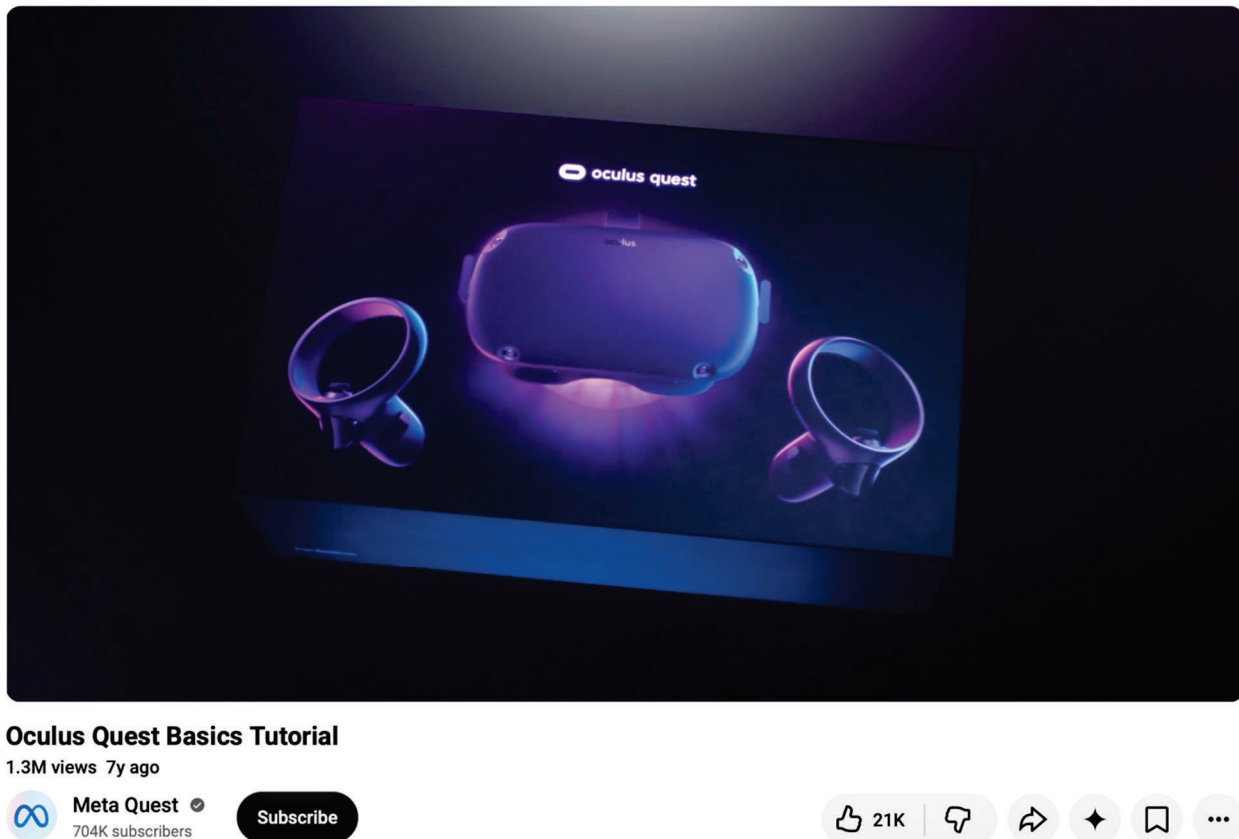
Ex. 1021 (“Watch Halo Played on Microsoft HoloLens in Augmented Reality”), 1-2.

50. Other popular systems available before 2022 included Samsung’s Gear VR (below on left) and Google Cardboard (below on right), both of which ran on a smartphone:



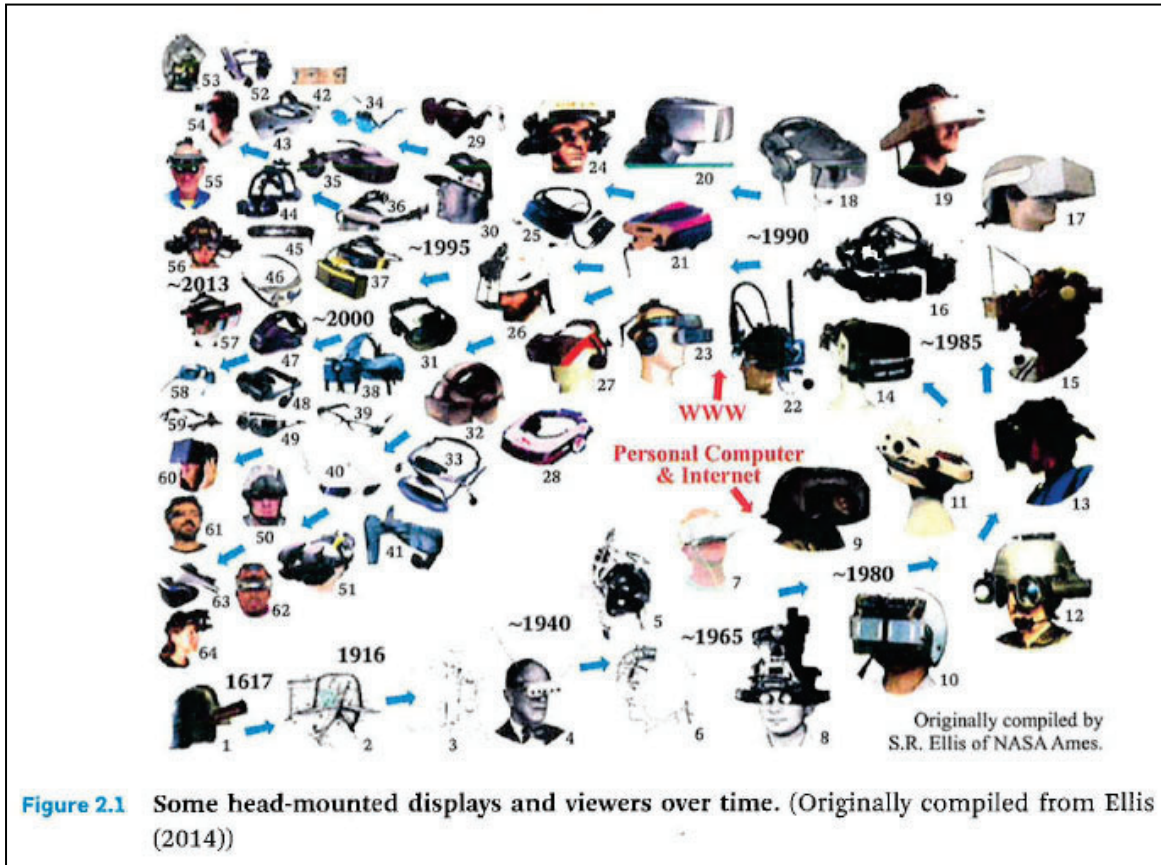
Ex. 1018 (“Learning Virtual Reality”), 19 (“Through a partnership with Samsung, Oculus technology has been incorporated into the Gear VR, a revolutionary headset ... with new head-tracking technology, placed in a custom headset that houses a mobile phone with a high-resolution display.”), 20 (“In 2014 Google introduced Cardboard VR, which allows users to experience virtual reality using pretty much any mobile phone.”).

51. In May of 2019 Oculus released two headsets on the same day: the Rift S and Quest. Ex. 1022 (“Five Years of VR: A Look at the Greatest Moments from Oculus Rift to Quest 2”); Ex. 1023 (“Oculus Rift S, Oculus Quest Hit May 21, Pre-Orders Open”). This was also announced by Microsoft itself, on YouTube, as seen below:



Ex. 1024 (“Oculus Quest Basics Tutorial”).

52. The image below, from Ex. 1025 (“The VR Book: Human-Centered Design for Virtual Reality”) depicts some of the many different types of HMDs that were known before 2022:



Ex. 1025 (“The VR Book: Human-Centered Design for Virtual Reality”),  
FIG. 2.1 (discussing various types of HMDs).

53. At least as of 2022, such AR and VR systems would have been well-known to POSITAs. See Ex. 1018 (“Learning Virtual Reality”), 141-47 (compiled list, as of 2015, of headsets, input devices, software development kits (“SDKs”), other related AR and VR technology, and “noteworthy companies” in its appendix).

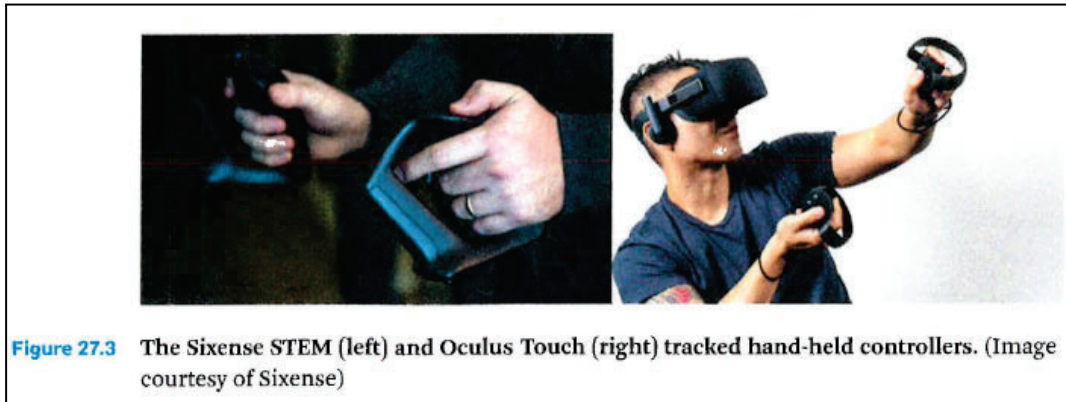
**B. Ability to Interact with Virtual Objects**

**1. Handheld Controllers**

54. Handheld controllers were commonly known and used as input devices in AR and VR systems before 2022, and when tracked, were used to allow the user to point at, select, and manipulate virtual objects in virtual environments.

55. To enhance user interaction, AR and VR systems commonly used handheld controllers with motion tracking to allow users to interact with virtual objects. “Tracked hand-held controllers [we]re typically 6 DoF devices,” sometimes “known as ‘wands’ in the VR research community where they ha[d] been used for decades.” Ex. 1025 (“The VR Book: Human-Centered Design for Virtual Reality”), 314, 308 (“VR hand tracking should have a minimum of 6 DoF”); Ex. 1027 (“A Survey of Augmented Reality”), 167-69 (describing 6DoF “wand type pointing devices” and “joysticks” that allow users to “point at or manipulate virtual objects”). Such tracked handheld controllers were “easy to use for many 3D tasks due to their natural, direct mapping to hand motion.” Ex. 1025 (“The VR Book: Human-Centered Design for Virtual Reality”), 314-15.

56. Tracked handheld controllers, like those shown below, “enhance[] presence through physical touch,” “facilitate communication with the virtual world,” and “make spatial relationships seem more concrete to the user”:



*Id.*, 315 (describing, in 2015, “integrated analog sticks (as on the Sixense STEM and Oculus Touch controllers as shown in Figure 27.3)”), FIG. 27.3.

57. It was well known that handheld controllers were used to allow a user to select and manipulate virtual objects. Typical controller gestures included pointing or moving the controller to the virtual object, then pressing a button on the controller to select or grab the object, and moving the controller to manipulate (e.g., move, throw, or aim) the object. Ex. 1028 (“Exploiting Proprioception in Virtual-Environment Interaction”), 70-71 (describing “[o]bject selection/manipulation where “[u]sers select and manipulate objects with their dominant hand” and “[t]he default form of manipulation is unconstrained 6DoF manipulation”). These are forms of “direct manipulation,” which include “pushing an object, and selection via hand pointing.” Ex. 1025 (“The VR Book: Human-Centered Design for Virtual Reality”), 299. As “different tasks may require different interaction techniques,” some techniques may require a sequence of operations, e.g., “a specific manipulation technique only occurs after a specific selection technique”—that is, the user first

selects an object with the controller and then moves that object using the controller. *Id.*, 300; Ex. 1029 (“ISAAC: A Meta-CAD System for Virtual Environments”), 548 (“To select an object, the user points the laser beam at a desired object and clicks on a button on the input device”).

58. In 1996, Mark Mine taught the use of a virtual laser beam emanating from a handheld controller to select menu items, and identified this approach could be advantageous over the use of the tip of a finger, by reducing the problem from one of 3D interaction to 2D interaction. Ex. 1030 (“Working in a Virtual World: Interaction Techniques Used in the Chapel Hill Immersive Modeling Program”), 9 (“When a control panel becomes active it attaches to the user's left hand. To interact with the panel he uses a laser beam emanating from his right hand. Using a laser beam reduces the control panel interaction task from three dimensions to two. This helps speed up menu/widget interaction. Widget selection techniques in menu systems that require the user to co-locate a hot point (such as the tip of his finger) with a widget in three-dimensional space are difficult to use and suffer from the lack of haptic feedback we depend upon when pushing a button in the real world.”)

59. Pointing with hands or handheld controllers “is one of the most fundamental and often-used patterns for selection.” Ex. 1025 (“The VR Book: Human-Centered Design for Virtual Reality”), 327, 328 (“When hand tracking is available, hand pointing with a ray extending from the hand or finger is the most

common method of selection.”). Pointing offers advantages, such as not requiring the user to travel to be close to the object to be selected, as would be required for hand selection. *Id.*, 325-27 (“The Pointing Pattern is typically better than the Hand Selection Pattern unless realistic interaction is required.”), 347 (referencing paper that “found pointing to take less time and to be more preferred by users”). Pointing can be used to select objects by having the user point to an object to select, and then applying a direct hand manipulation, e.g., selection via a user-controller trigger, which offers the user both a clear sense of actuation, and tactile feedback that the actuation has occurred. *Id.*, 327. Tracked handheld controllers also exhibit improved accuracy and stability when pointing at distant objects compared to pointing with bare hands. This is primarily because vision-based (camera) estimation of the configuration of a person’s bare hand is relatively noisy and unstable, depending on skin tone, lighting, and other factors that are difficult or impossible to control, and the effects of angular noise or error when pointing are directly magnified with distance, making placing the “tip” of a virtual ray on a distant object very difficult. Handheld controllers on the other hand typically use active components for the tracking, e.g., employing LEDs embedded in the controller that are more clearly imaged by the cameras, resulting in greater accuracy and stability. On the other hand, when interacting with things that are within arm’s reach, the task typically involves positioning the user’s hand, which is more accurately tracked up close than angular

(orienting) a hand. In other words, tracking bare hands to support interaction with near objects can work relatively well, whereas using a tracked handheld controller will typically work better for interaction at a distance.

60. Tracked handheld controllers enabled dynamic gestures, which “consist of one or more tracked points,” e.g., “making a gesture with a controller.” *Id.*, 296. Tracked handheld controllers also allowed conveying spatial information related to the gesture. For example, “gestures can manipulate (e.g., push/pull), indicate (e.g., point or draw a path), describe form (e.g., convey size), describe functionality (e.g., twisting motion to describe twisting a screw), or use objects.” *Id.*, 296.

61. Tracked handheld controllers were known to be intuitive and easy to use “due to their natural, direct mapping to hand motion.” *Id.*, 314; *see also id.*, (“[b]ecause the controllers are tracked, they can be visually co-located with the real hands”).

62. The earliest use of handheld controllers for interactive computer graphics was at least in 1980. A March of 1980 technical report by Frederick P. Brooks at the University of North Carolina at Chapel Hill (UNC) described their use of an electromechanical remote manipulator arm to interact with computer graphics models of molecules. Ex. 1036 (“Interactive Graphics for Molecular Graphics System”). I have personal memories of using this ARM (the Argonne Remote Manipulator) when I was a graduate student at UNC in the early 1990s. A picture of

Declaration of Gregory Welch, Ph.D. in Support of  
Petition for *Inter Partes* Review USP No. 11,656,742

a student using the ARM, reproduced below, appeared in a 1990 publication from the ACM SIGGRAPH conference. Ex. 1037 (“Project GROPE – Haptic displays for scientific visualization”), FIG. 1.

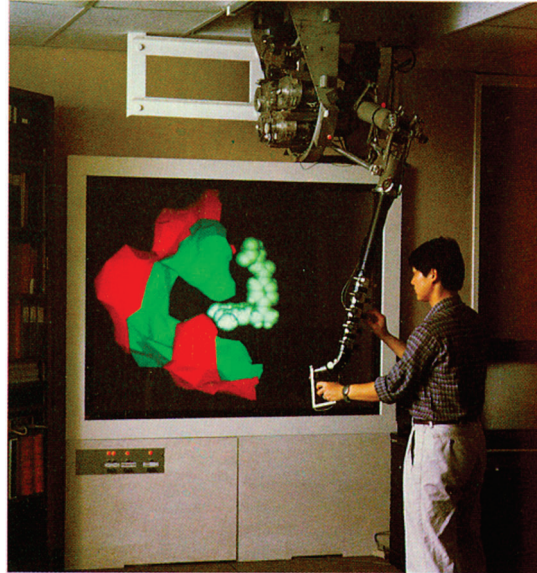
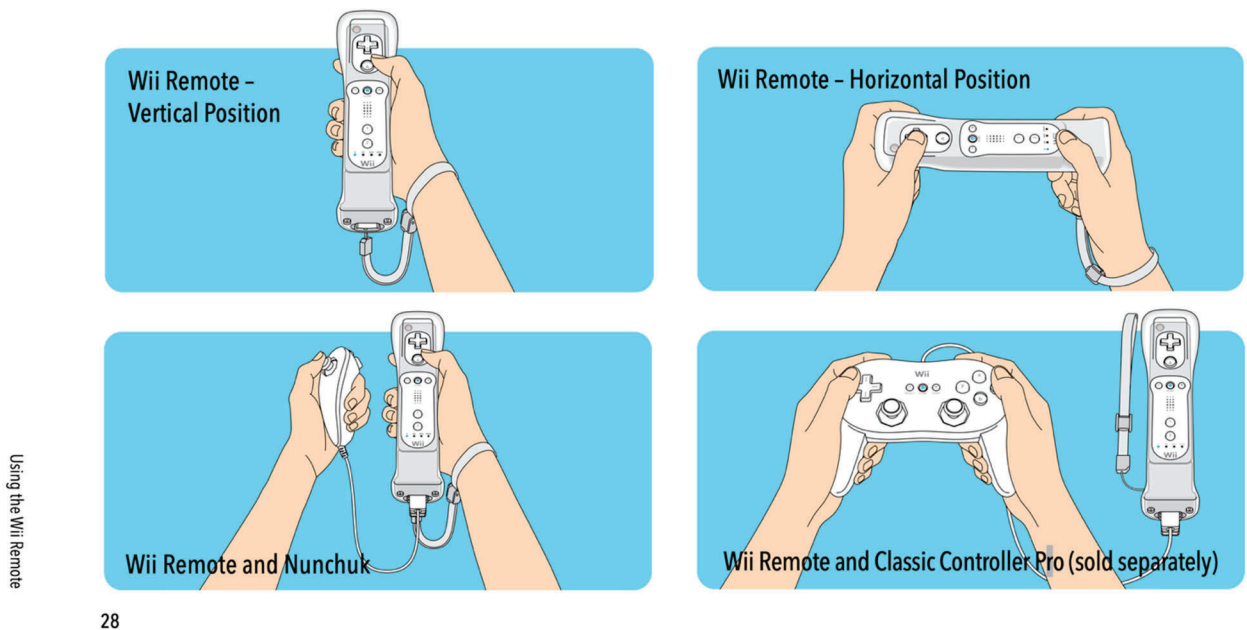


**Figure 1.** GROPE-III haptic display system in use.



Ex. 1039, (“In Pictures: The Nintendo Wii”).

63. In 2005–2006, Nintendo announced and then released the Nintendo Wii and the associated wireless controller — the Wii Remote, often called the “Wiimote.” *Id.* The Nintendo Wii is an interactive computer graphics system that embodies 2D interaction in a plane as promulgated by Mark Mine (see above) because it is easier to point at a 2D object than to position your hand or a controller in 3D. This is particularly so for an object that is not close, such as the TV (display) being used by the Wii system. The figure below showing the Wii Remote is reproduced from a 2009 version of the *Wii Operations Manual: System Setup*. Ex. 1040 (“Wii Operations Manual: System Setup”), 28.



64. Around 2016, Oculus released their own wireless “Touch” controllers for use with their Oculus Rift VR headsets. These controllers used a combination of

inertial and optical sensing to track their 3D position and 3D orientation. The figure below, which is reproduced from Ex. 1042 (“How Oculus Plans to Fix One of VR’s Biggest Problems”), shows someone using the controllers with an Oculus headset.



65. Finally, well before 2020 there existed multiple means for detecting whether a user’s hand was in contact with a controller, and even how it was in contact. For example, in 2011 Hyunyoung Song et al. published a paper and presented at the ACM CHI 2011 conference that taught the use of capacitive sensing of a user’s grip on a computer stylus. Ex. 1051 (“Grips and Gestures on a Multi-Touch Pen”). Specifically, they designed and prototyped a plastic cylindrical enclosure with a flexible matrix of capacitive-sensing electrodes wrapped around the surface, and then fitted the assembly around a standard Wacom Intuos/Cintiq grip pen. *Id.* The authors state that “our multi-touch sensor captures **contacts** from different sections of the hand (e.g., finger tips and sides, web of the thumb, palm, etc.” (emphasis added). *Id.*, 1326. Figure 1 from their paper is reproduced below.

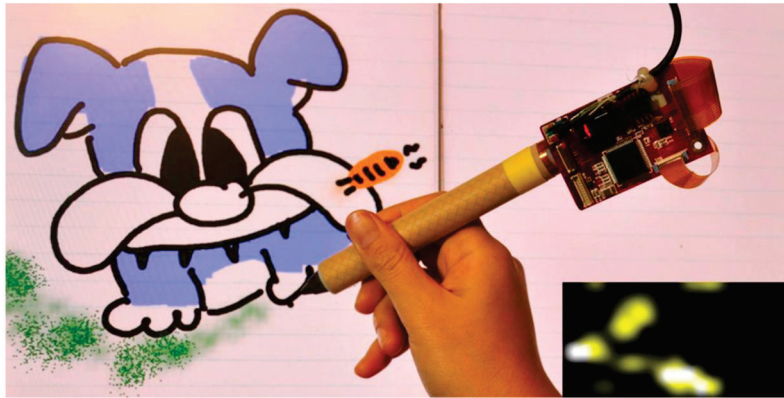


**Figure 1. Our MTPen prototype. Inset image shows touch data imaged by the multi-touch sensor around the barrel.**

66. In 2012, researchers from Disney Research, the University of Tokyo, and the HCI Institute at Carnegie Mellon University collaborated to develop a swept frequency capacitive sensing technique that could “not only detect a touch event, but also recognize complex configurations of the human hands and body.” Ex. 1052, 1 (“Touché: Enhancing Touch Interaction on Humans, Screens, Liquids, and Everyday Objects”). The authors demonstrated their technique to sense contact with and touch patterns on different physical objects. *Id.*, 1-10. Figure 6 and Figure 8 from their paper, showing touch sensing of a door knob and a touchscreen device respectively, are reproduced below. *Id.*, Figs. 6 and 8.



**Figure 6: Capacitive profiles for making objects touch and grasp sensitive (doorknob example).**



**Figure 8: Capacitive profiles for enhancing touchscreen interaction with a hand posture sensing.**

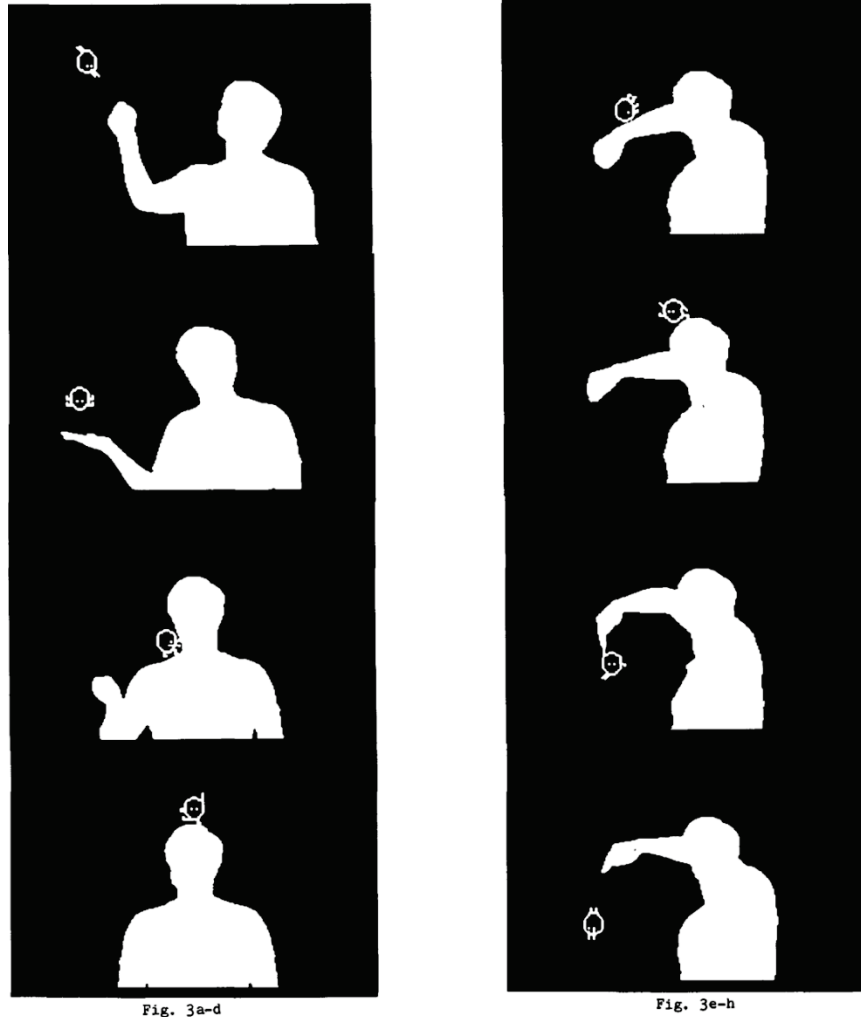
67. In 2019, researchers from the Korea Advanced Institute of Science and Technology (KAIST) published a paper about their “DexController”—a hand-held controller with a pressure-sensitive surface designed to recognize different grasp-poses (e.g., a “precision grip” and a “power grip”), and to detect grasp-force. Ex. 1053 (“DexController : Designing a VR Controller with Grasp Recognition for Enriching Natural Game Experience”). Rather than measuring changes in capacitance as the above work did, they used of copper strips wrapped in one direction around the surface of an acrylic cylinder, a layer of Velostat over that, then copper strips wrapped in an orthogonal direction around the Velostat. *Id.*, 4. They then measured changes of resistance between the two layers of strips of copper. *Id.* This is in fact the same method used by me and a fellow student for *The Pressure Sensitive Touch-Pad* for our senior design project, *The Easy Chair: A Microprocessor-Controlled Wheelchair for Children With Muscular Disorders*. Ex. 1054 (“The Pressure Sensitive Touch-Pad”); Ex. 1055 (“The Easy Chair”).

Finally, as I discuss above, Oculus released their own wireless “Touch” controllers for use with their Oculus Rift VR headsets around 2016. Ex. 1056 (“Review: Oculus Touch”). These were production handheld controllers that used capacitive sensing to determine whether fingers were touching the different controller inputs. *Id.*, 2. Similarly, in 2019 Valve began selling the “Valve Index Controllers” that used capacitive and force sensing to determine how the hand was holding/releasing the controller, including touch and pressure sensing. Ex. 1057 (“Valve Software Index”). The Valve Index Controllers included capacitive sensing integrated into the thumbstick, trackbutton, trigger, grip, and buttons. *Id.*, 21.

## **2. Hand Gestures (Natural User Interfaces)**

68. Over the past several decades systems evolved that directly tracked the hands and fingers of a user, *without* the use of a controller. For example, from at least 1977–1985 Myron Krueger developed what he called Responsive Environments, and an “artificial reality” he called Videoplace. Ex. 1043 (“Responsive Environments”); Ex. 1044 (“VIDEOPLACE - An Artificial Reality”). Krueger’s systems combined 2D video of a person with 2D computer graphics imagery to create one of the first examples of full-body graphical human-computer interaction. In the later years he used the 2D camera imagery of the person (in front of a neutral background) to automatically determine the relationship between the person and the computer graphics (virtual) objects, allowing the person to move and

interact with the computer graphics. The figure below (*id.*, FIGs. 3a-h), shows some examples of people using their hands and bodies to interact with the computer graphics.



69. Commercially available hand tracking in modern Virtual Reality systems goes back at least to 2019, when the Oculus Quest became the first to offer bare hand tracking — no controllers needed. Ex. 1045 (“Surprise! Oculus Quest Becomes First VR Set with Native Hand Tracking—This Week”); Ex. 1047 (“Oculus Quest Hand-tracking Starts Rolling Out This Week”). The image below

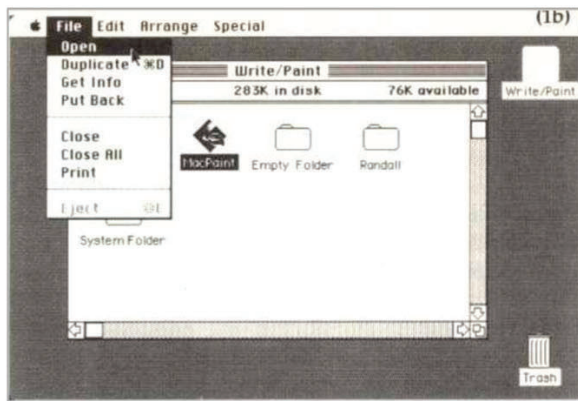
shows how a user's hands could be used to launch an application from a palette of application icons. Ex. 1045 ("Surprise! Oculus Quest Becomes First VR Set with Native Hand Tracking—This Week").



### **C. Interaction and Selection Movements**

70. It was well known before 2022 to provide a user with 2D panels of buttons appearing in 3D space, from which they could select/activate buttons using different interaction modalities, including the use of their hands and handheld controllers. As shown in the figure below, both the Apple Macintosh (1984) and Microsoft Windows (1990) used 2D panels of icons (image-based buttons). The user would interact with the icons using a 2D mouse, double-clicking an icon to launch the corresponding application.

**Apple Macintosh**  
**MacPaint Program Icon (Williams, 1984)**



Figures 1a-1h: Working with Mac Paint on the Macintosh computer. See text for details.

**Microsoft Windows 3**  
**Program Manager Icons (Press, 1990)**

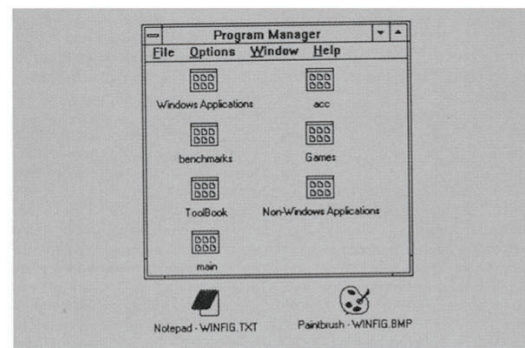
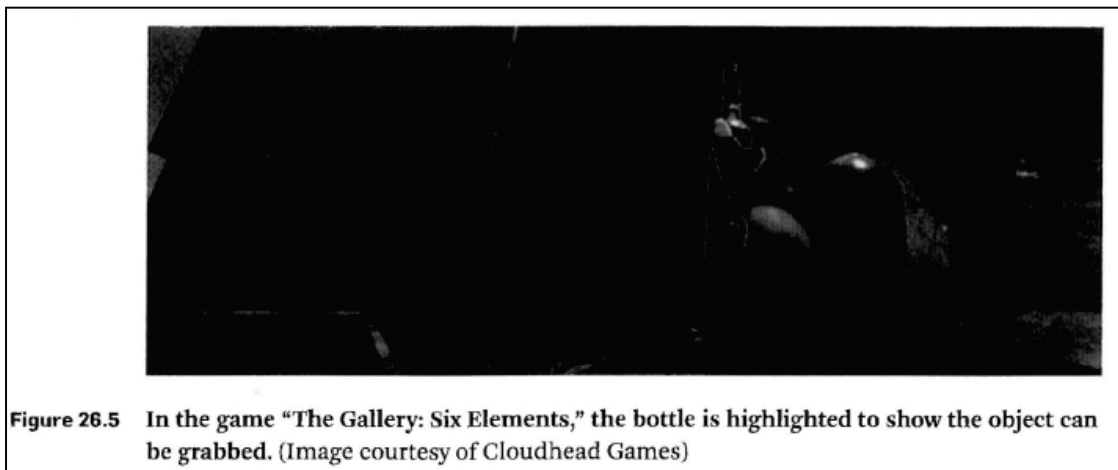


**FIGURE 3.** The Program Manager. Most users will launch programs from the Program Manager. Each icon represents a group of related programs and files. Double clicking on a group icon opens a child window, which is clipped by the Program Manager window. The group windows cannot be nested, and the icons shown below the window represent programs that are active, but minimized.

71. This graphical user interface approach has persisted through all manner of personal computers and smart devices (e.g., the Apple iPhone), and naturally is used in virtual reality systems. In his 1998 Ph.D. dissertation, Mark Mine teaches that the use of graphical icons in panels in virtual reality is motivated by their familiarity to users. *See, e.g., Ex. 1028* (“Exploiting Proprioception in Virtual-Environment Interaction”), 75 (“The advantage of using control panels is that they are familiar to users.”). *See also, Ex. 1029* (“ISAAC: A Meta-CAD System for Virtual Environments”), 551 (“ISAAC includes more complex functions in its two-dimensional control panels. Two-dimensional control panels are the virtual equivalent of conventional work-station pull down menus and dialog boxes. Built upon UNC’s Immersive Widgets library, ISAAC’s two-dimensional control panels include: single-shot buttons, on/off buttons, radio buttons, sliders, dials, scrollable lists, popup menus and displays (readouts for sliders and dials).”). Indeed, as shown

in the image above from Ex. 1045 (“Surprise! Oculus Quest Becomes First VR Set with Native Hand Tracking—This Week”), a user of the Oculus Quest VR headset could use their hands to launch an application or invoke different functionality from a palette of icons well before 2022. *See also* Ex. 1029 (“ISAAC: A Meta-CAD System for Virtual Environments”), 551 (“ISAAC includes more complex functions in its two-dimensional control panels. Two-dimensional control panels are the virtual equivalent of conventional work-station pull down menus and dialog boxes. Built upon UNC’s Immersive Widgets library, ISAAC’s two-dimensional control panels include: single-shot buttons, on/off buttons, radio buttons, sliders, dials, scrollable lists, popup menus and displays (readouts for sliders and dials).”).

72. It was also well known before 2022 that, in association with virtual object selection in three-dimensional virtual environments, feedback could be provided to a user, e.g., haptic, visual, or audio feedback when a user points to or selects an object:



Ex. 1025 (“The VR Book: Human-Centered Design for Virtual Reality”), 356 (disclosing use of these forms of feedback “to signify touching of objects”), 305 (“Highlighting is visually outlining or changing the color of an object ... Highlighting is also used to convey that an object is able to be selected or grabbed when the hand is close even though a collision has not yet occurred,”), FIG. 26.5.

73. This technique of highlighting items when they become the focus of a user traces back to at least 1986. Specifically, in a 1986 paper titled “Designing menu selection systems,” Ben Shneiderman wrote: “There is a great sense of satisfaction in being able to move the cursor around the screen; the menu item is highlighted clearly on the screen and in the user’s mind, and screen space is conserved since item numbers are not needed. In fact, highlighting, underscoring, boxes, pointers, color, or inverse video can be used to visually indicate the item that has been selected.” Ex. 1031 (“Designing Menu Selection Systems”), 68.

74. It was also well known well before 2022 to make virtual buttons appear to be three-dimensional (3D), whether selected or not. *See, e.g.*, Figure 5 from Mine ISAAC 1997 reproduced below. Note the shadows along the bottom and right edges of the buttons, giving the perception of buttons that stand out from (are proud of) the basic plane in which the buttons appear, being illuminated from a light source and is above and to the left.



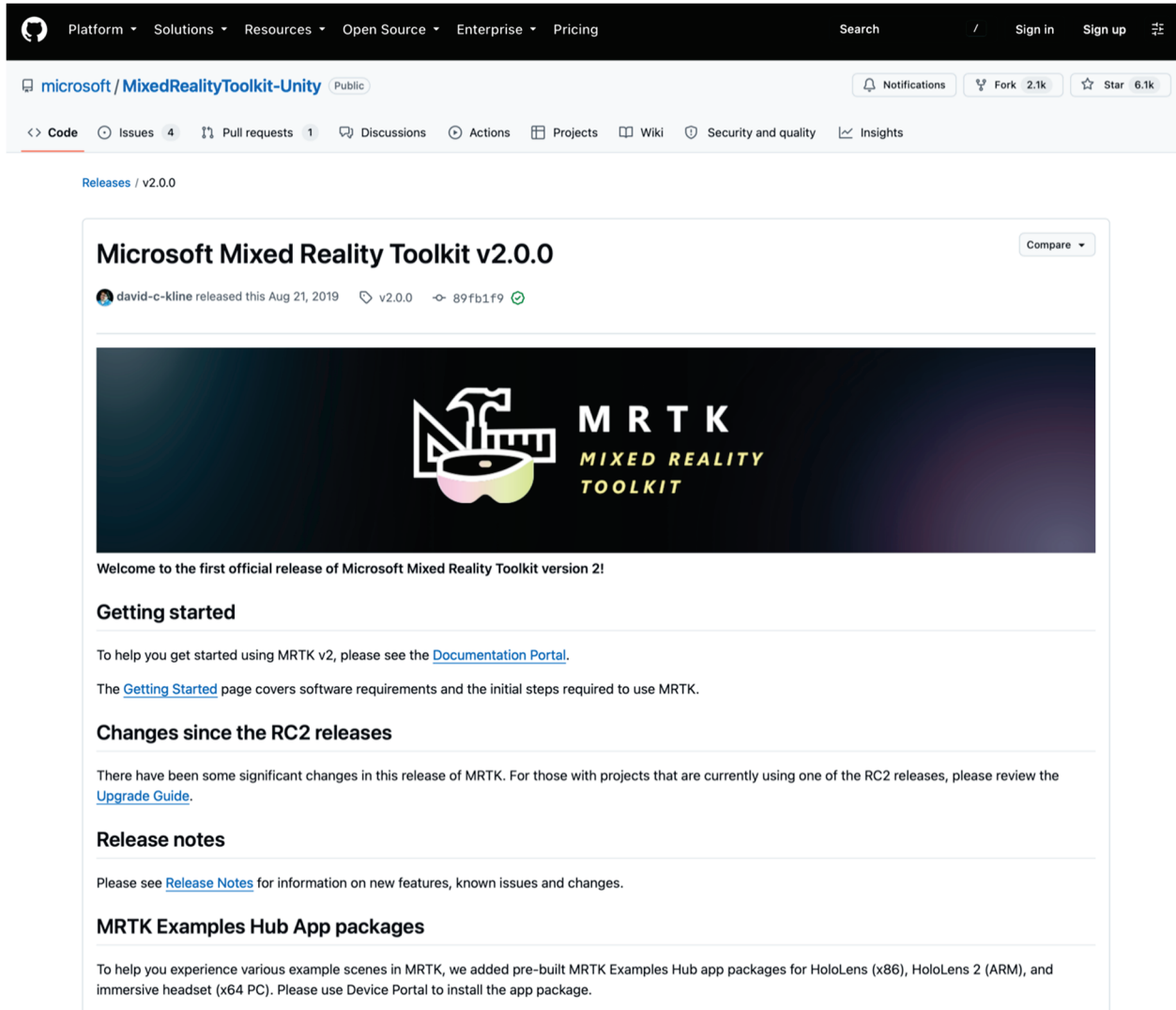
**Figure 5** Two-dimensional control panel

Ex. 1029 (“ISAAC: A Meta-CAD System for Virtual Environments”), FIG.

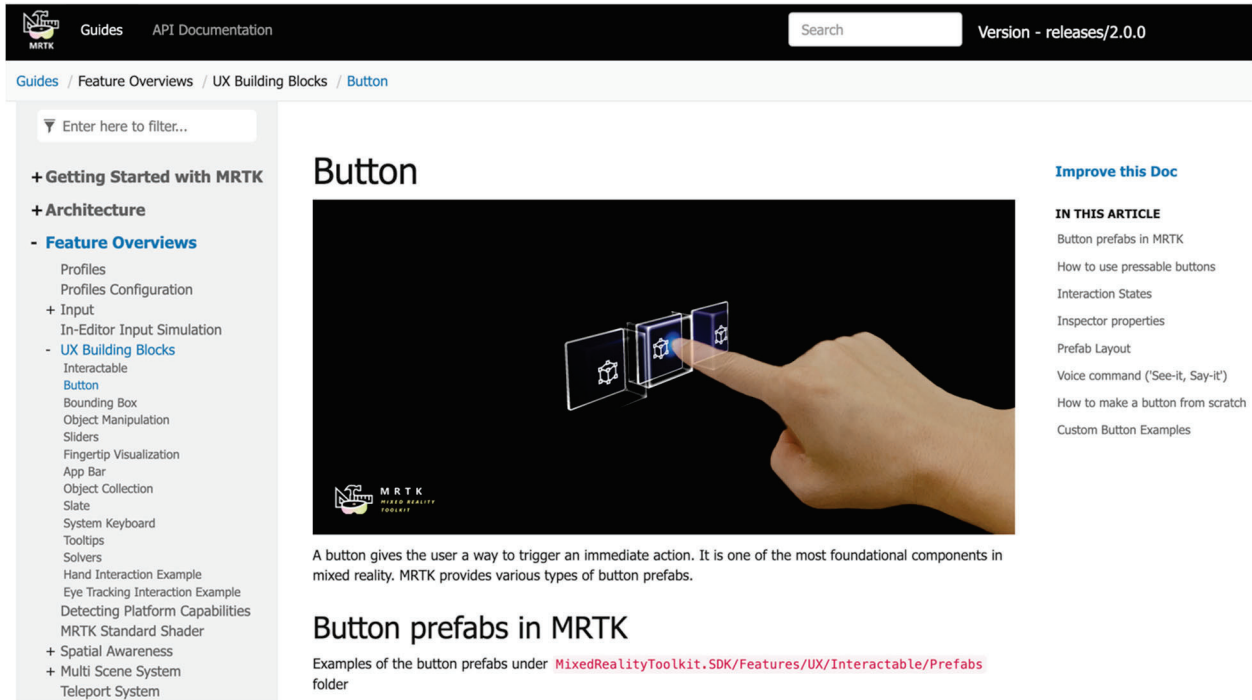
5.

75. It was also well known before 2022 to make buttons exhibit or change 3D shape when they are made the focus of interaction by a user, e.g., when the user points at a button. For example, on August 21, 2019, Microsoft released the Microsoft Mixed Reality Toolkit (MRTK) v2.0.0. *See* screenshot from the GitHub site below. Ex. 1032 (“Mixed Reality Toolkit v2.0.0”). Under the heading “MRTK Examples Hub App packages” it indicates support for “immersive headset (x64 PC)” which includes “OpenVR headsets (HTC Vive / Oculus Rift),” as seen below. Ex. 1033 (“Mixed Reality Toolkit v2.0.0 README”); *see also* Ex. 1032 (“Release Mixed Reality Toolkit v2.0.0”).

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76. Included in the MRTK at the time of release (August 21, 2019) was the ability to create virtual objects with button behaviors, including the ability to “trigger an immediate action.” See Ex. 1034 (“Mixed Reality Toolkit – Button”) (“A button gives the user a way to trigger an immediate action. It is one of the most foundational components in mixed reality. MRTK provides various types of button prefabs.”)



*Id.*

77. The MRTK also supports the ability to change appearance and shape when used, including changing the size and offset of button objects to make them statically or dynamically appear 3D, e.g., how its 3D shape changes when a user makes the button the focus of an interaction such as by pressing/pointing to it. *See*, e.g., “Adding visual states and handle far interaction events” (“Interactable is a script that makes it easy to create a visual states for the various types of input interactions. It also handles far interaction events. Add Interactable.cs and drag and drop the cube object onto the **Target** field under **Profiles**. Then, create a new Theme with a type **ScaleOffsetColorTheme**. Under this theme, you can specify the color of the object for the specific interaction states such as **Focus** and **Pressed**. You can also control

Scale and Offset as well. Check **Easing** and set duration to make the visual transition smooth.” (emphasis in original).) The associated portion of the guide, including the associated figure, is reproduced below with annotations (red boxes) added to indicate options for changing the static (Default) 3D appearance—how the button appears when it is not the focus of an interaction, and dynamic (Focus) shape 3D appearance—how its 3D shape changes when a user makes the button the focus of an interaction such as by pointing to it.

The screenshot shows the MRTK documentation page for the 'Button' component. The page title is '4. Adding visual states and handle far interaction events'. The left sidebar contains a navigation menu with sections like 'Getting Started with MRTK', 'Architecture', 'Feature Overviews', 'Contributing', and 'Planning'. The main content area shows the 'PressableButtonCube (2)' component settings. The 'Theme' is set to 'PressableButtonCubeTheme (Theme)'. The 'Theme Property' is 'ScaleOffsetColorTheme'. The 'Easing' is set to 'Easing' and 'Duration' is 0.3. The 'Animation Curve' is set to 'Animation Curve'. The 'Default' state is highlighted with a red box, showing 'Scale' and 'Offset' values. The 'Focus' state is also highlighted with a red box, showing 'Scale' and 'Offset' values. The 'Pressed' state is also highlighted with a red box, showing 'Scale' and 'Offset' values. The 'Color' is set to 'Color'. The 'Voice command' is set to 'Voice command ("See-it, Say-it")'. The 'How to make a button from scratch' section is also visible on the right.

4. Adding visual states and handle far interaction events

**Interactable** is a script that makes it easy to create a visual states for the various types of input interactions. It also handles far interaction events. Add **Interactable.cs** and drag and drop the cube object onto the **Target** field under **Profiles**. Then, create a new Theme with a type **ScaleOffsetColorTheme**. Under this theme, you can specify the color of the object for the specific interaction states such as **Focus** and **Pressed**. You can also control Scale and Offset as well. Check **Easing** and set duration to make the visual transition smooth.

**Profiles**

PressableButtonCube (2)

Target: PressableButtonCube (2)

Theme: PressableButtonCubeTheme (Theme)

PressableButtonCubeTheme (Click to edit)

Theme Property: ScaleOffsetColorTheme

Material ColorId: Color

Easing: Easing

Duration: 0.3

Animation Curve: Animation Curve

Default

Scale: X 1 Y 1 Z 1

Offset: X 0 Y 0 Z 0

Color: Color

Focus

Scale: X 1 Y 1 Z 1

Offset: X 0 Y 0 Z 0

Color: Color

Pressed

Scale: X 1 Y 1 Z 1

Offset: X 0 Y 0 Z 0

Color: Color

**Improve this Doc**

**IN THIS ARTICLE**

- Button prefabs in MRTK
- How to use pressable buttons
- Interaction States
- Inspector properties
- Prefab Layout
- Voice command ("See-it, Say-it")

**How to make a button from scratch**

1. Creating a Pressable Button with Cube (Near)
2. Adding visual feedback to the basic cube button
3. Adding audio feedback to the basic cube button
- >4. Adding visual states and handle far interaction events

Custom Button Examples

*Id.*, section 4 (annotated).

78. It was also well known to render a graphical representation of a hand or controller both where the physical hand (or controller) is located and at the target of the pointing. Ex. 1025 (“The VR Book: Human-Centered Design for Virtual Reality”), 356 (disclosing the rendering the same hand simultaneously in two places), 305 (“Ghosting is a second simultaneous rendering of an object in a different pose than the actual object. In some cases it is appropriate to render the hand twice—both where the physical hand is located and where the physics simulation states the hand is located. Ghosting is also often used to provide a clue of where a virtual object will be snapped into place if released. Be careful of using ghosting for training applications as users can depend on ghosting as a crutch that will not be available for the real-world task.”)

**D. Interaction with Objects Near and Far**

79. It was well known before 2022 to use handheld controllers and bare hands to interact with both proximal virtual objects—objects within the user’s physical reach, and distal virtual objects—virtual objects appearing beyond the physical reach of the user. It was well known to use interactions methods that differ when the interactions were proximal or distal. The types of virtual objects were unlimited, including for example virtual primitive blocks, virtual furniture, virtual molecular models, and virtual menus and buttons that invoke various functionality.

80. The use of different user interaction techniques depending on whether the target of manipulation is proximal (nearer) or distal (farther) dates back at least to the 1990s. There were tradeoffs in interaction technique choices, which depended on the circumstances of use and the available types of interaction. For example, in a 1996 Technical Report titled *Working in a Virtual World: Interaction Techniques Used in the Chapel Hill Immersive Modeling Program*, Mark Mine teaches the use of a “laser beam emanating from his right hand” when a control panel (e.g., a virtual panel with buttons and sliders) is away from (not collocated with) the right hand, e.g., when the control panel is “attache[d] to the user's left hand.” *See* Ex. 1030 (“Working in a Virtual World: Interaction Techniques Used in the Chapel Hill Immersive Modeling Program”), 9 (“When a control panel becomes active it attaches to the user's left hand. To interact with the panel, he uses a laser beam emanating from his right hand. Using a laser beam reduces the control panel interaction task from three dimensions to two. This helps speed up menu/widget interaction.”). Mine discusses how this “laser beam” approach has several advantages, including that it simplifies things for the user by transforming a 3D selection problem into a 2D selection problem. *Id.* The technique is depicted in Figure 6 of Ex. 1030 (“Working in a Virtual World: Interaction Techniques Used in the Chapel Hill Immersive Modeling Program”), reproduced below in (a), and described as reproduced below in (b).

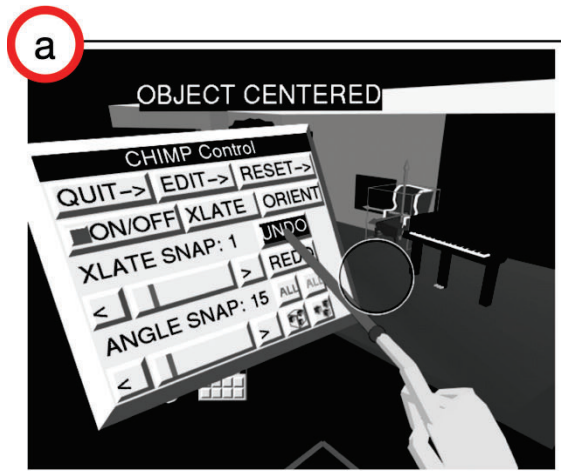


Figure 6: Environment control panel

b

The environment control panel (figure 6) provides access to functions such as:

- high level editing functions (such as cut, copy, and paste)
- functions to reset object scale, user position and environment state (to return it to the state found at program startup)
- undo/redo functions.

*Id.*, FIG. 6 at 9, annotated (a), and the associated description at 10, annotated (b).

81. In 1997, Mark Mine taught direct and indirect techniques for the manipulation of “objects at-a-distance; selecting and manipulating them using a laser beam emanating from his hand.” *See*, Ex. 1029 (“ISAAC: A Meta-CAD System for Virtual Environments”), 548 (“Once the user has placed an object in the environment he can position, orient and scale it using direct and indirect manipulation techniques. The user interacts with objects *at-a-distance*; selecting and manipulating them using a laser beam emanating from his hand. To select an object, the user points the laser beam at a desired object and clicks on a button on the input device. The user can select any object visible in the environment for interaction. In ISAAC you manipulate objects using direct gestural interaction (i.e. ISAAC maps movements of your hand directly to movements of the object). Alternately you can manipulate

objects indirectly using the laser beam and special manipulation widgets.”  
(emphasis in original)).

82. Mark Mine also taught what he described as “action-at-a-distance” (AAAD) to extend a user’s normal reach. *Id.*, 549 (“An excellent way to augment the direct manipulation of objects (i.e. reaching out and grabbing something) is to extend your normal reach using some form of action-at-a-distance (AAAD). During AAAD interaction, you select objects using a laser beam emanating from your hand (see Figure 1). Once selected you can then remotely manipulate an object by moving your hand (with your hand motion mapped to object motion). Alternately you can use the laser beam to interact with some form of constrained manipulation widget.” Figure 1 from Ex. 1029 (“ISAAC: A Meta-CAD System for Virtual Environments”) is reproduced below.

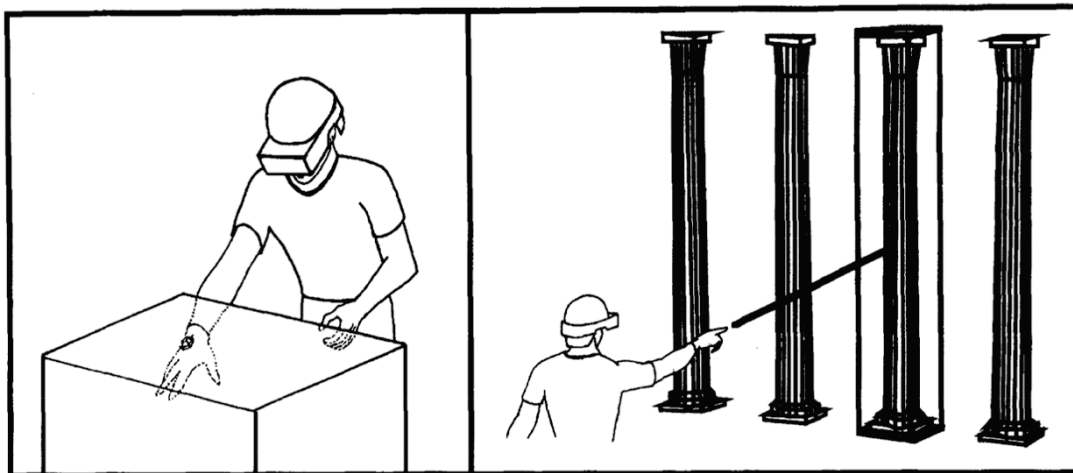


Figure 1 Local versus action-at-a-distance

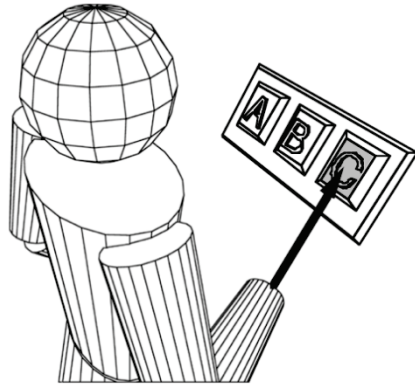
*Id.*

83. In Mine ISAAC 1997, Mark Mine further describes the use of the laser beam metaphor to select items in a two-dimensional control panel. *Id.*, 551 (“To simplify and speed up interaction with the two-dimensional control panels ISAAC uses a point-and-shoot paradigm. The user selects a virtual control panel button or slider by pointing at it using a laser beam emanating from his hand (Figure 5). To activate it he must then click on a physical button on his input device.”). Mark Mine goes on to again identify an advantage of this approach, as opposed to direct manipulation with the hand. *Id.*, (“Only the two-dimensional location of the intersection of the laser beam with the control panel plane is used for the selection of control panel widgets; the user does not have to be able to reach a button to invoke it.”); *see also id.*, 552 (“To use a constrained motion widget you first select a widget by pointing at it with the laser beam, grab it (indicated by pressing a button on the input device), and then (depending on the widget selected) use the widget to move the object along a line, in a plane or rotate it about one of its axes.”).

84. In his 1998 Ph.D. dissertation, Mark Mine discusses why control panels (like application menus) are advantageous but also problematic. *See*, e.g., Ex. 1028 (“Exploiting Proprioception in Virtual-Environment Interaction”), 75 (“The advantage of using control panels is that they are familiar to users. The disadvantage is that the invocation of a control panel to change modes breaks the flow of work in an application. This is particularly true in a virtual environment, since control panels

are difficult to locate and they are more difficult to use due to the lack of 2D constraints and haptic feedback.”). He goes on to describe one fundamental way to improve the situation—transforming the 3D problem into a 2D problem. *Id.*, 75 (“One way to compensate for the lack of haptic feedback in a virtual environment is to limit the number of degrees of freedom that the user has to specify in order to interact with the menu. To use a 2D menu, for example, a user should only have to specify two dimensions. Forcing the user to position his hand in three-dimensions in order to press a virtual button slows down menu interaction and increases user frustration.”). For interactions with 2D control panels he teaches that *laser beams* and *occlusion selection* are two effective techniques. *Id.*, (“In my experience two effective techniques for interacting with 2D control panels are laser beams and occlusion selection. With laser beams the cursor location (i.e. the point of interaction on the control panel) is based upon the intersection of a laser beam attached to the user's hand and the control panel (Figure 6.4). With occlusion selection the cursor location tracks the point on the control panel which visually lies behind some point on the user's virtual hand, such as his fingertip (Figure 6.5). Laser beams minimize the required user hand motion but amplify tracking system noise due to lever arm effects.”). However, he also indicates that holding one's hand up in line with the target can be fatiguing. *Id.*, 75–76 (“Occlusion selection techniques are more precise but are more fatiguing due to the need to hold one's hand up over the control panel

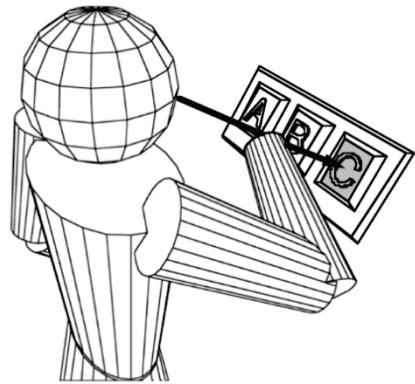
and the larger hand motions required to reach all points on the control panel.”); *id.*,  
Figures 6.4 and 6.5, reproduced below.



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**Figure 6.4:** Interacting with a control panel using a laser beam.

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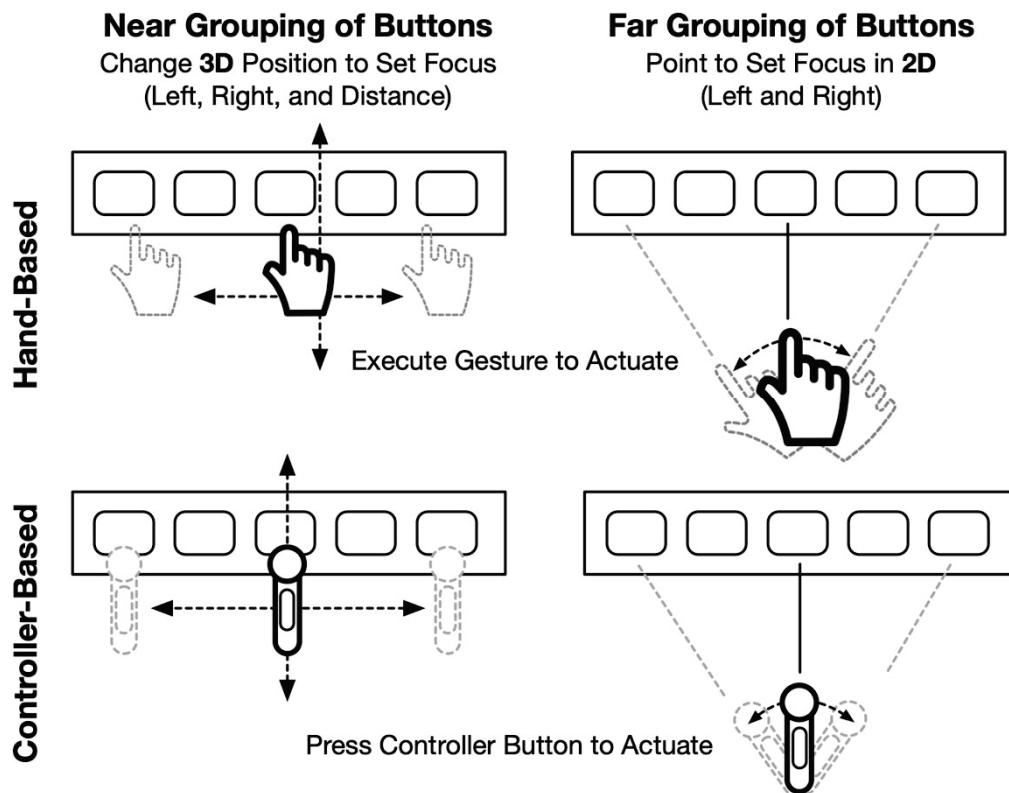
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**Figure 6.5:** Interacting with a control panel using occlusion selection.

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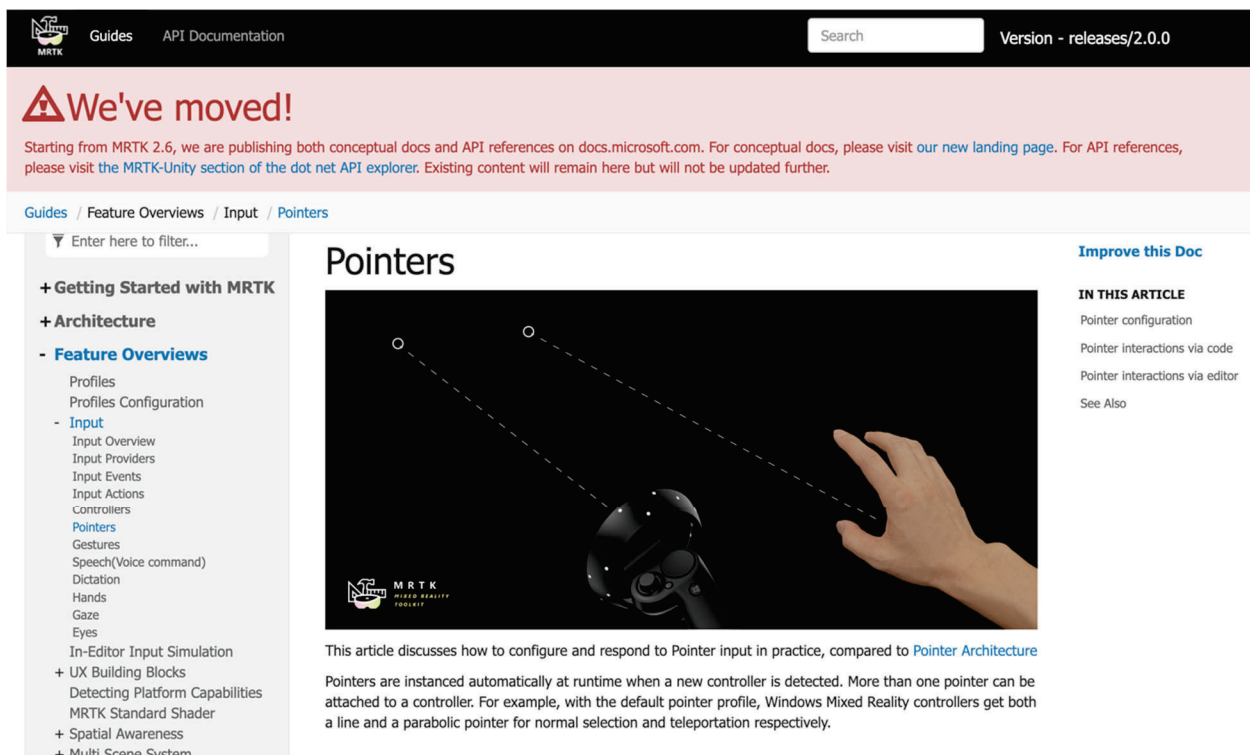
85. There are two related issues with using one’s hand or a handheld controller to directly select items from a control panel, e.g. to touch, push, or pull on the items. First, just as Mark Mine reports that it can be fatiguing to suspend and position one’s hand all over a control panel when using occlusion selection techniques (*id.*), it can be fatiguing to suspend and position a handheld controller all over a control panel. Using a ray casting or laser-based approach transforms the

explicit positioning on the control panel into rotational pointing, which “avoids this potentially tiring situation by allowing users to select objects with their hands resting comfortably at their side” (*id.*, 81), even though the control panel is farther from the user’s hand. Forcing a user to use their hand (or controller) using the occlusion selection technique—or by positioning the hand (or controller) directly on the buttons of the control panel, would likely occlude the very buttons the user is trying to select, thus adding possible uncertainty and confusion in the selection process. I have depicted these circumstances in the figure below.



86. As I indicated above, on August 21, 2019, Microsoft released the Microsoft Mixed Reality Toolkit (MRTK) v2.0.0 which addressed some of the

issues outlined by Mark Mine. The MRTK explicitly supported numerous types of “pointers,” including pointing and selecting with the user’s bare hands, that could be used in a variety of ways, though most naturally (identified by the MRTK explicitly) near and far manipulation circumstances. Below is a screenshot from the Pointers section of the developer guides from 2019. Ex. 1035 (“Mixed Reality Toolkit – Pointers”).

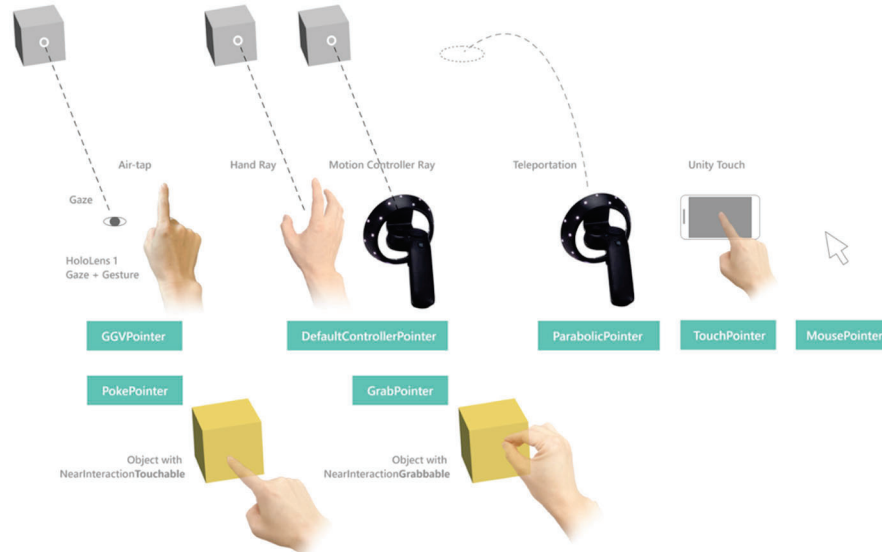


*Id.*

87. As can be seen in the screenshot, “[p]ointers are instantiated automatically at runtime when a new controller is detected.” *Id.* The default instances are shown in a figure under the heading “Default pointer classes” on the same page. This figure is reproduced below.

### Default pointer classes

The following classes are the out-of-box MRTK pointers available and defined in the default *MRTK Pointer Profile* outlined above. Each pointer prefab provided under *Assets/MixedRealityToolkit.SDK/Features/UX/Prefabs/Pointers* contains one of these pointer components attached.



*Id.*, “Default pointer class” at “Pointers.”

88. As can be seen in the above figure, MRTK affords a developer a rich set of pointers and associated selection paradigms so the developer can choose what makes sense for their situation. The pointer paradigms include hand-based rays and motion controller-based rays, direct touch on touch-sensitive smart devices (“Unity Touch”), and both “touchable” and “grabbable” paradigms for proximal (near) interactions. *Id.*

89. The MRTK guide on Pointers also explicitly describes both “Far pointers” and “Near pointers.” With respect to the “Far pointers” guide (Microsoft Mixed Reality Toolkit (MRTK) v2.0.0 guides at “Default pointer class” under Far pointers) the guide describes software classes for LinePointer,

ShellHandRayPointer, GGVPPointer, TouchPointer, and MousePointer. *Id.* The LinePointer class implements a “laser” pointing approach, and “draws lines from the source of the input (i.e. the controller) in the pointer direction.” *Id.* The guide goes on to say that “[f]or motion controllers like in Oculus, Vive, Windows Mixed Reality, the rotation will match the rotation of the controller. For other controllers like HoloLens 2 articulated hands, the rotation matches the system-provided pointing pose of the hand.” *Id.* A POSITA would appreciate that rotating one’s hand to position the tip of a pointer is different from, and in many cases easier than, directly positioning one’s hand or handheld controller. The “Far pointers” section of the “Pointers” guide is reproduced below.

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## Far pointers

### LinePointer

A base pointer class, draws lines from the source of the input (i.e. the controller) in the pointer direction. Generally, children classes such as the `ShellHandRayPointer` and the teleport pointers are instantiated and utilized (which also draw lines to indicate where teleportation will end up at) instead of this class which primarily provides common functionality.

For motion controllers like in Oculus, Vive, Windows Mixed Reality, the rotation will match the rotation of the controller. For other controllers like HoloLens 2 articulated hands, the rotation matches the system-provided pointing pose of the hand.



### ShellHandRayPointer

The implementation type, which extends from `LinePointer`, used as the default for the *MRTK Pointer Profile*. The *DefaultControllerPointer* prefab implements the `ShellHandRayPointer` class.

### GGVPointer

Also known as the Gaze/Gesture/Voice pointer, the GGVPointer powers HoloLens 1-style look and tap interactions, primarily via Gaze and Air Tap or Gaze and voice Select interaction. The GGV pointer's position and direction is driven by the head's position and rotation.

### TouchPointer

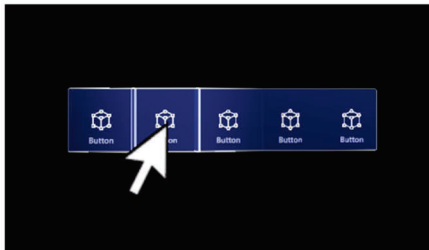
The TouchPointer is responsible for working with Unity Touch input (i.e. touchscreen). These are 'far interactions' because the act of touching the screen will cast a ray from the camera to a potentially far location in the scene.

### MousePointer

The MousePointer powers a screen to world raycast for far interactions, but for mouse instead of touch.

#### NOTE

Mouse support is not available by default in MRTK but can be enabled by adding a new *Input Data Provider* of type `MouseDeviceManager` to the MRTK input profile.



*Id.*, “Default pointer class” at “Far pointers.”

90. With respect to the “Near pointers” the guide (Microsoft Mixed Reality Toolkit (MRTK) v2.0.0 guides at “Default pointer class” under “Near pointers”) the guide describes software classes for PokePointer and SpherePointer. *Id.* These “pointers” reflect relatively direct interaction with the virtual objects, e.g., choices

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on a control panel or application launch panel. The “Near pointers” section of the “Pointers” guide is reproduced below.

#### Near pointers

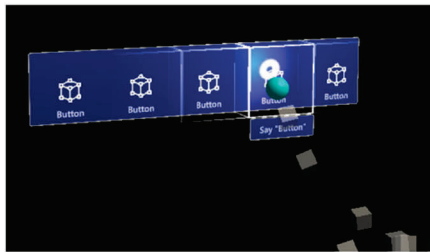
##### PokePointer

The PokePointer is used to interact with game objects that support “near interaction touchable,” which are GameObjects that have an attached **NearInteractionTouchable** script. In the case of UnityUI, this pointer looks for NearInteractionTouchableUnityUIs. The PokePointer uses a SphereCast to determine the closest touchable element and is used to power things like the pressable buttons.

When configuring the GameObject with the **NearInteractionTouchable** component, make sure to configure the *localForward* parameter to point out of the front of the button or other object that should be made touchable. Also make sure that the touchable's *bounds* matches the bounds of the touchable object.

Useful Poke Pointer properties:

- *TouchableDistance*: Maximum distance a which a touchable surface can be interacted with
- *Visuals*: Game object used to render finger tip visual (the ring on finger, by default).
- *Line*: Optional line to draw from fingertip to the active input surface.

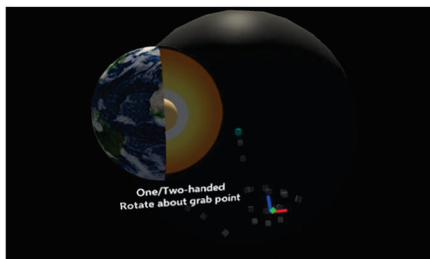


##### SpherePointer

The SpherePointer uses **UnityEngine.Physics.OverlapSphere** in order to identify the closest **NearInteractionGrabbable** object for interaction which is useful for “grabbable” input like the **ManipulationHandler**. Similar to the **PokePointer** / **NearInteractionTouchable** functional pair, in order to be interactable with the Sphere Pointer, the game object must contain a component that is the **NearInteractionGrabbable** script.

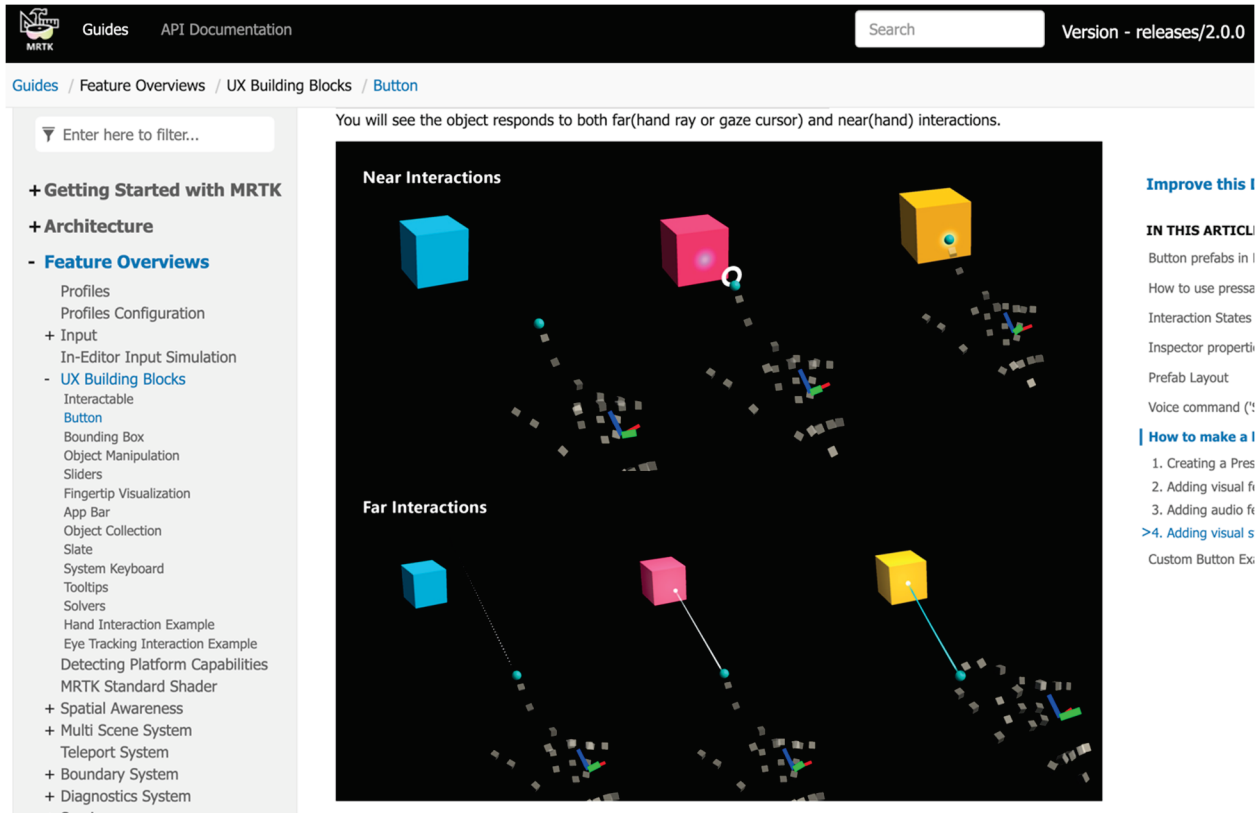
Useful Sphere Pointer properties:

- *Sphere Cast Radius*: The radius for the sphere used to query for grabbable objects.
- *Debug Mode*: If true, draw the sphere that is used to query for grabbable objects.



*Id.*, “Default pointer class” at “Near pointers.”

91. Finally, the MRTK guide on Buttons (see above) indicates that button objects will “respond[] to both far (hand ray or gaze cursor) and near (hand) interactions.” Ex. 1034 (“Mixed Reality Toolkit – Button”).



*Id.*

## **E. Virtual Reality World Switching**

92. As evidenced at least by the work I describe above, and the prior art I rely on for my opinions in this matter, the idea for using menus, buttons, and other graphical user interface objects to launch applications from within a virtual world was well known before 2020. And methods for doing so were a natural extension of the application launching methods used in 2D user interfaces going back to at least the Apple Macintosh (1984) and Microsoft Windows (1990) as I indicate above. Even today, on our personal computers and our smart devices (e.g., tablets and smart phones), we enjoy the ability to quickly tap to launch a new application, and to swipe

on a screen to switch between running applications. In effect, people use multiple applications concurrently, rapidly launching and switching between them to support rapid multitasking.

93. However, in most previous work the user's existing environment remained stable, persisting through the launch or change of applications. For example, in the case of virtual reality a new application might open new windows in the virtual environment the user is currently experiencing. For example, if they are experiencing a virtual zoo, and they open a Contacts application, that application might open a window showing the user's friends, while the user remains in the virtual zoo. Similarly, when a user of a personal computer or smart device launches or switches applications, the room they are in does not change—only the windows and other graphical elements displayed on the devices change.

94. Virtual reality is powerful in that it affords the opportunity for a user's entire "world" to change when they launch or switch to another application. For example, the user who is experiencing the virtual zoo could launch a virtual baseball game application that completely replaces the zoo virtual environment they were in, with a new baseball stadium environment. Switching worlds like this on occasion might be fine, but users today (even before 2020) are accustomed to being able to multitask—to rapidly launch and switch between applications corresponding to different tasks, and it turns out that rapidly switching between entire virtual worlds

can be very difficult and disorienting, given the relatively high-dimensional space of a full virtual world switch—at least six degrees of freedom (6D) in virtual reality compared to the 2D or even 1D switching when using personal computers or smart devices. The difficulty in switching involves both how to choose which world to launch or switch to, and how to actually make the change with minimal cognitive disruption.

95. To address this, one of my Ph.D. students has been working on what we call world switching. In a paper presented at the 2026 ACM CHI conference, we described an exploratory study of user interface techniques designed to support efficient switching between virtual worlds. Ex. 1058 (“From One World to Another: Interfaces for Efficiently Transitioning Between Virtual Environments”). We developed eight different interfaces that allowed users to preview and select among available virtual worlds, including techniques based on “portals” and “worlds-in-miniature” (WiMs)—a concept explored by Mark Mine in Ex. 1030. I have reproduced Figure 2 from the Gottsacker paper below. *Id.*, Fig. 2.



Figure 2: Eight virtual world switching interfaces evaluated in our study. Two preview patterns are used: (1) Portal and (2) World-in-Miniature (WiM). Four interaction techniques were derived: (a) Gallery, (b) Head Palette, (c) Hand Palette, and (d) World Wheel. The selected environment is indicated by a yellow arrow—(a) and (d)—or a blue spherical cursor—(b) and (c). The latter is highlighted with a yellow circle for clarity.

96. Our study results showed, among other things, that WiMs helped users rapidly acquire high-level spatial information about the available worlds while searching, while portals facilitated rapid reorientation when transitioning into a different world. Based on the results, we identified considerations and recommendations for the design of future world-switching interfaces. My student is now developing a broader theoretical framework for world switching to help developers and designers understand the many factors and tradeoffs involved in designing future world-switching techniques.

## VII. OVERVIEW OF THE '742 PATENT

97. In forming my opinions, I have reviewed U.S. Patent No. 11,656,742, prosecution history of the '742 patent, and its parent patent, U.S. Patent No. 11,531,448 (“the '448 patent”). *See* Ex. 1001, 1002, 1048.

### A. Overview

98. In my opinion, the '742 patent is directed to well-known interfaces for selecting applications in VR environments, describing the claimed interfaces and methods in just over four columns. Ex. 1001, 1:61-67.

99. The '742 patent complains that “[i]n conventional VR systems, such as the Meta Quest 2 platform, users can use either a physical controller or their hands to select and activate applications...in an application selection interface.” *Id.*, 1:27-31. In such systems, “when the user is using a physical controller they move the controller or use buttons, joystick, scrolling or similar input controls on the controller to select and launch an application.” *Id.*, 1:31-34. In contrast, “[i]f a user is using their hands to interact with the application interface,...the user can make a pinch or similar pointing gesture to simulate laser pointing from the fingertips of the hand...for selecting an application for launch from the display.” *Id.*, 1:38-45.

100. An alleged problem with these conventional systems is that when selecting an application with a hand, “the laser pointing effect can be slow to be recognized or not even recognized, difficult to quickly and accurately choose an

application for launch, and be less intuitive for moving between application selection,” particularly when an icon to be selected appears to be far away from the hand. *Id.*, 1:51-55. The ’742 patent addresses this problem by using a hand to interact with icons that appear closer and a physical controller to interact with icons that appear farther.

101. “When a user initially does not use or switches away from using a physical controller, to use a user’s hands ... , [an] application selection interface that is better and more intuitively adapted for hand interaction and control is displayed to the user.” *Id.*, 2:15-20. The “different application selection interface for use with a user’s hands in a VR environment ... may be presented to appear to be directly acted upon by the user hands, such as pushing or pulling the selected application to launch the application.” *Id.*, 2:21-28.

## **B. Prosecution History**

### **a. The Parent ’448 Patent**

102. In preparing my opinions, I have also reviewed U.S. Patent No. 11,531,448, which is the parent patent of the ’742 patent. *See* Ex. 1048.

103. The original claim 1 of the ’448 patent was generally directed to application selection interfaces in a virtual reality environment comprising a group of icons in which one icon launches a software application by pushing, pulling, tapping, pressing or sliding action of a body part of the user directly on the icon. Ex.

1050, 24. On July 26, 2022, the Examiner issued a non-final office action, finding claim 1 anticipated by Fukushima and the remaining claims obvious in view of Fukushima and other prior art. *Id.*, 41-65.

96. On October 18, 2022, the Applicant responded by amending claim 1 as follows:

1. An application selection interface comprising:

a first grouping of a plurality of software application icons displayed in a virtual reality environment to a user using a virtual reality hardware device, wherein the first grouping appears closer to a body part of the user that is tracked by a camera of the virtual hardware device to interact with the first grouping than another second grouping of software application icons that is displayed to the user when the user is using a physical controller in the virtual reality environment; and

at least one software application icon of the first grouping of the plurality of software icons operatively linked to launch a respective software application when interacted with by a pushing, pulling, tapping, pressing or sliding action of [[a]] the body part of the user directly on the application icon.

*Id.*, 284.

104. The Applicant stated that “[t]he proposed amendment ... highlights that the invention of claim 1 is directed to the interface of the first group of icons used with the body part control ***appearing closer*** to the user’s body part that is tracked by a camera, as compared to the distance of the second grouping of icons displayed as an application interface when a physical controller is used by the user.” *Id.*, 289.

105. On November 2, 2022, the Examiner issued a Notice of Allowance. *Id.*,  
308. On December 20, 2022, the '448 patent issued.

**b. The '742 Patent**

106. In my opinion, there was no substantive review of the '742 patent during prosecution. The PE2E Prior Art Search History confirms that the Examiner did not perform any searches targeted at this additional feature with no searches including the terms “closer,” “near,” “far,” “local,” “distant,” or equivalent terms.

107. The Examiner only allowed the claims of the '742 patent after the Applicant agreed to amend “the first application software” to “the first application software icon” in claim 1 and to file a terminal disclaimer to overcome a double patenting rejection for claims 1-20. Ex. 1002, 229, 314.

**VIII. OVERVIEW OF THE PRIOR ART**

**A. Tang (Ex. 1005)**

108. Tang recognizes that virtual objects “beyond the reach of the user ... may be difficult or tiresome for the user to control.” Ex. 1005, [0023]. In contrast, a user has “greater ability to make fine movements/selections with respect to a virtual interaction object 58 ... in proximity to the user’s hand.” *Id.*, [0029]. Thus, Tang discloses a VR system implemented through an HMD that allows the user to interact with virtual objects by switching between a “far interaction mode” and “near interaction mode.” *Id.*, Abstract. A user can interact with the virtual objects using

a “user-input devices such as a...game controller” in far interaction mode, and can use a “gesture, such as a ... tap gesture” or “a pressing motion by a finger” in near interaction mode. *Id.*, [0049], [0026], [0035].

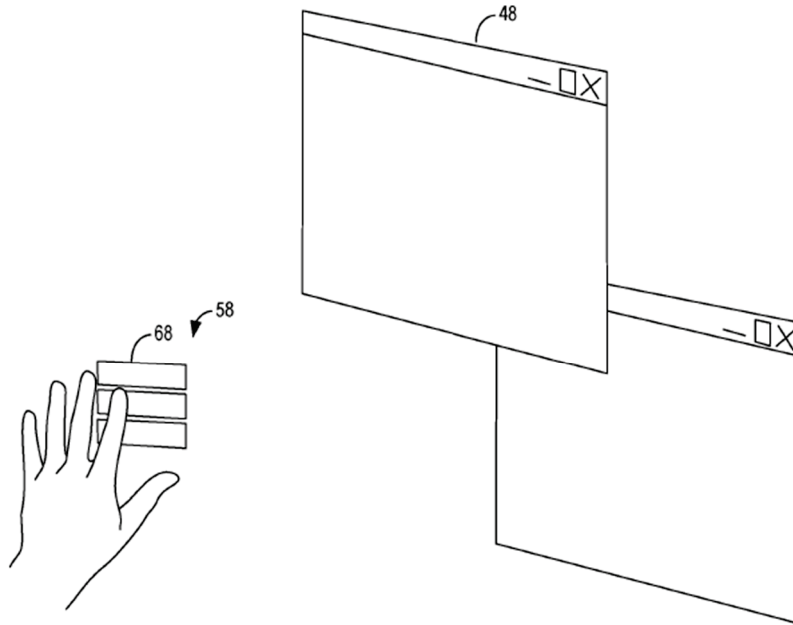


FIG. 7

Ex. 1005, FIG. 7.

109. In operation, Tang’s HMD “display[s] a virtual object 48 at least partially within a field of view 50 of a user,” identifies “a plurality of control points 52 associated with the virtual object 48,” and determines whether they fall beyond “a predetermined threshold distance 54 from the user.” Ex. 1005, [0021]. When the object is out of comfortable reach, the system invokes the far interaction mode and, upon a “trigger input 56” from the user, invokes a near interaction mode that displays a “virtual interaction object 58 within the predetermined threshold distance 54”—a

nearby, resized proxy the user can manipulate more precisely. *Id.*, [0024]-[0025], [0031].

110. Tang discloses a range of such interaction objects, “includ[ing] . . . a pinchable object 62, handles 70 . . . , at least one virtual button 64, a bounding box 72, a control widget 66, and a context menu 68,” selectable through gestures or “user-input devices such as a . . . game controller.” *Id.*, [0028], [0049], FIGS. 5A-5F.

## **B. Mine (Ex. 1006)**

### **a. Overview**

111. Mine discloses “a virtual reality (VR) technique, which make a user feel a space different from a real space using a head-mounted display (HMD).” Ex. 1006, [0003], [0024]; Ex. 1047, [0002], [0013]. A user can “control [] selecting CG [computer graphics] or moving the position of CG in the composite image displayed on the HMD” using controller 120 or through hand gestures. Ex. 1006, [0043]; Ex. 1047 [0032]. Mine discloses that the controller 120 “includes a button enclosing an optical trackpad (‘OTP’)” and can “determine[] whether the hand of the user is in [physical] contact with the OTP” and therefore whether the controller 120 is in use. Ex. 1006, [0028], [0072]; Ex. 1047, [0017], [0061]; FIG. 6.

112. Mine discloses that, upon detecting that the controller is not in use, the system controls the HMD through camera-based hand interaction instead. Mine's

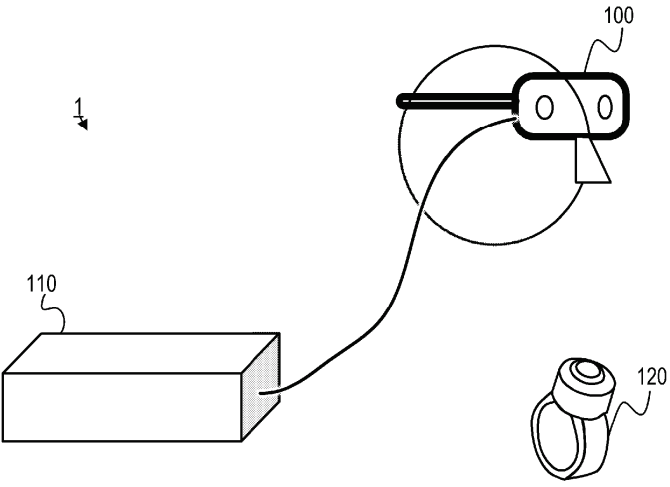
image processing device 110 selects among “three modes”—an “OTP control mode” in which the HMD is controlled by physical operation of the controller 120, a “ray control mode,” and a “tracking control mode,” the latter two controlling the HMD “in accordance with a state of a hand of [the] user determined based on imaging by an imaging device.” Ex. 1006, [0043]-[0045], [0008]; Ex. 1047, [0032]-[0034], [0007]. Where the system “determine[s] whether the hand of the user is in contact with the OTP” and finds it is not, it proceeds to select one of the camera-based hand modes rather than the controller mode. Ex. 1006, [0072]-[0073]; Ex. 1047, [0061]-[0062].

**b. Mine’s Japanese Priority Application Provides Written Description Support for Claim 1**

113. I have been asked to provide my opinion as to whether Mine’s Japanese priority application provides support for a claim in Mine. I have reviewed Mine’s Japanese priority application. *See* Ex. 1047. In my opinion, Mine’s Japanese application provides written-description support for claim 1 of Mine, as detailed below in the chart.

| <b>Mine, Claim 1 (Ex. 1006)</b>                                                      | <b>Mine Priority (Ex. 1047)</b>                                                                                                                                                                                                                            |
|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>[1.pre]</b> A control device for controlling an electronic apparatus, comprising: | <i>See, e.g.,</i> [0007], [0013], [0014], Fig. 1, claim 1, and citations below.<br><br><b>[0007]:</b> “One aspect of the present invention is: a control device for controlling an electronic device, comprising: a selection means for selecting either a |

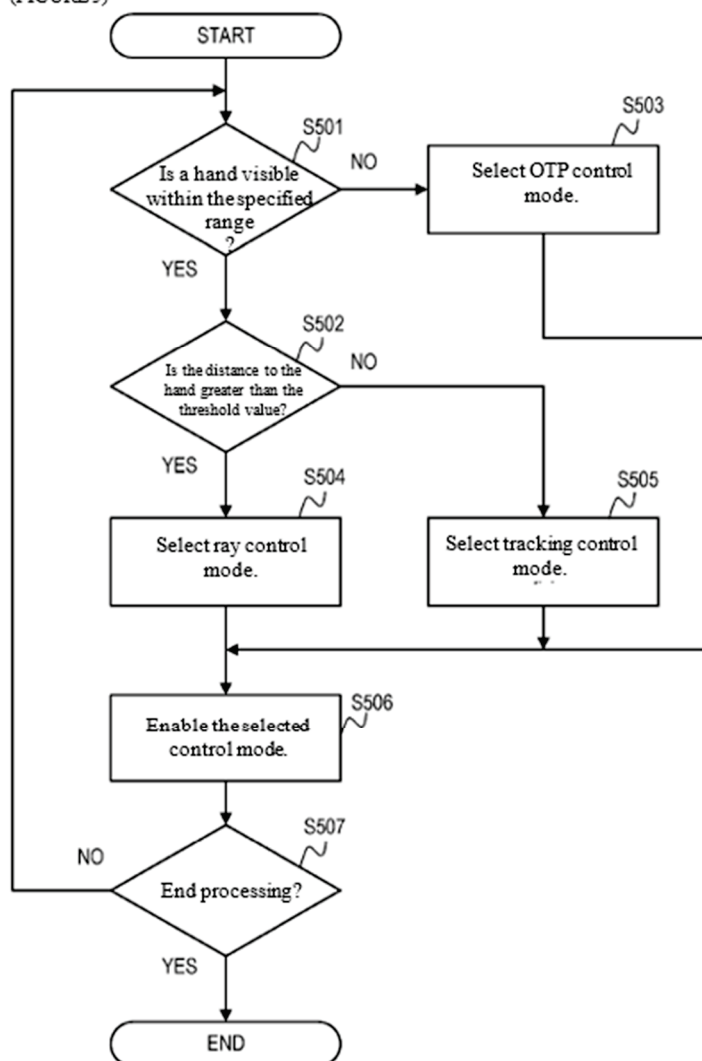
|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
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|  | <p>first control mode or a second control mode as the control mode for controlling the electronic device, based on a state of a specific body part of a user; and a control means that 1) will perform control of the electronic device in accordance with the state of the specific body part of the user, which is determined based on imaging by imaging means when the selection means has been used to select the first control mode; and 2) will perform control of the electronic device in accordance with an operation involving physical contact by the user with a specific operation member when the selection means has been used to select the second control mode.”</p> <p><b>[0013]:</b> “HMD 100 is a head-mounted display device (electronic device) that may be worn on the user's head. HMD 100 displays a composite image, which is a combination of an image captured by HMD 100 of the area in front of the user and content such as CG (computer graphics) in a form corresponding to the orientation of HMD 100.”</p> <p><b>[0014]:</b> “Image processing device 110 is a control device (electronic device) that controls HMD 100. Image processing device 110 is, for example, a smartphone, a tablet terminal, or a PC (personal computer). Image processing device 110 may be connected to HMD 100 wirelessly or via a wired connection. Image processing device 110 generates a composite image by combining a captured image and CG, and transmits the composite image to HMD 100. Each component of image processing device 110 may also be included in HMD 100.”</p> <p><b>FIG. 1:</b></p> |
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|                                                                           | <p>【書類名】 図面<br/>【図 1】</p>  <p><b>Claim 1:</b> “A control device for controlling an electronic device, comprising: a selection means for selecting either a first control mode or a second control mode as the control mode for controlling the electronic device, based on a state of a specific body part of a user; and a control means that 1) will perform control of the electronic device in accordance with the state of the specific body part of the user, which is determined based on imaging by imaging means when the selection means has been used to select the first control mode; and 2) will perform control of the electronic device in accordance with an operation involving physical contact by the user with a specific operation member when the selection means has been used to select the second control mode.”</p> |
| <p><b>[1.a]</b> one or more processors and/or circuitry configured to</p> | <p>See, e.g., [0044], Fig. 5, and citations below.</p> <p><b>[0044]:</b> “Referring to the flowchart in Figure 5, the mode selection process for selecting a control mode to be used to control HMD 100 from among the three control modes (operation modes) will be described. When the user starts using HMD 100, the processing of this flowchart starts. The flowchart of Figure 5 is</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

implemented by control unit 211 (a processor or the like) executing a program.”

**FIG. 5:**

(FIGURE 5)



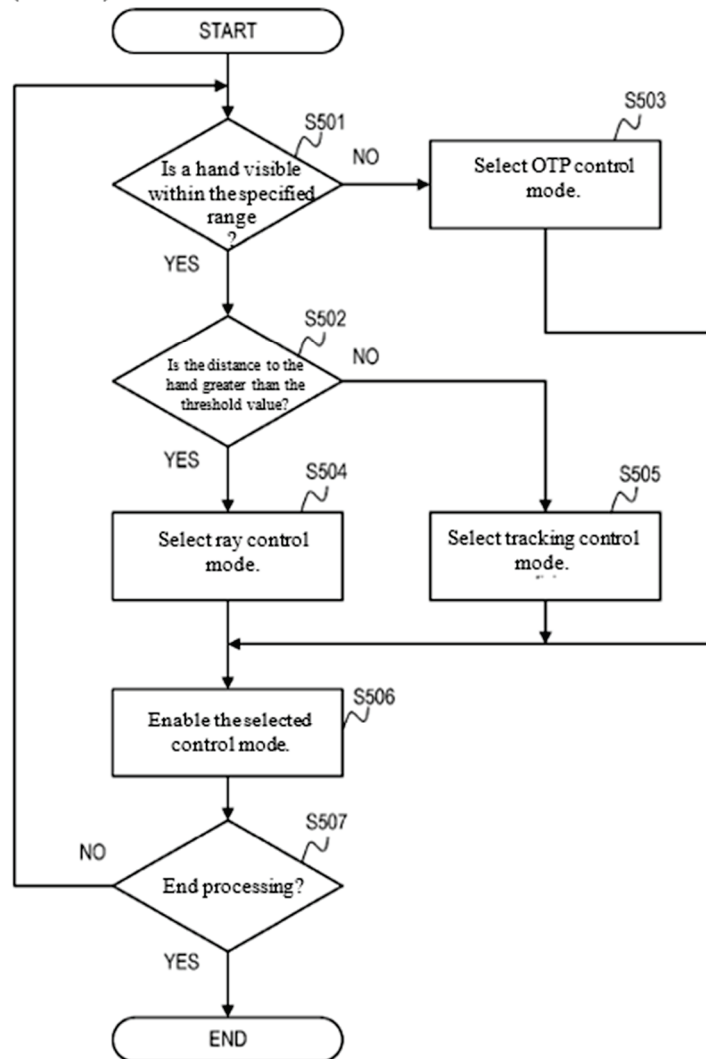
[1.a.1] perform selection processing ...; and

See, e.g., [0007], [0044], Fig. 5, claim 1, and citations below.

[0007]: “One aspect of the present invention is: a control device for controlling an electronic device, comprising: a selection means for selecting either a first control mode or a second control mode as the

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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|  | <p>control mode for controlling the electronic device, based on a state of a specific body part of a user; and a control means that 1) will perform control of the electronic device in accordance with the state of the specific body part of the user, which is determined based on imaging by imaging means when the selection means has been used to select the first control mode; and 2) will perform control of the electronic device in accordance with an operation involving physical contact by the user with a specific operation member when the selection means has been used to select the second control mode.”</p> <p><b>[0044]:</b> “(Regarding the mode selection process) Referring to the flowchart in Figure 5, the mode selection process for selecting a control mode to be used to control HMD 100 from among the three control modes (operation modes) will be described. When the user starts using HMD 100, the processing of this flowchart starts. The flowchart of Figure 5 is implemented by control unit 211 (a processor or the like) executing a program.</p> <p><b>FIG. 5:</b></p> |
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(FIGURE 5)

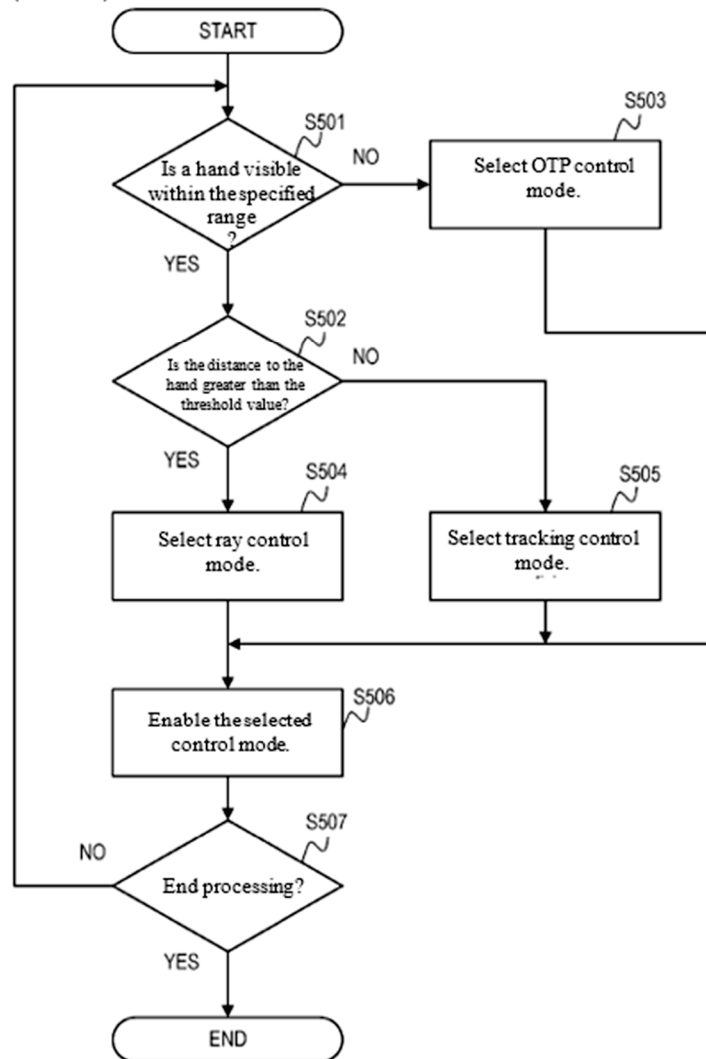


**Claim 1:** “A control device for controlling an electronic device, comprising: a selection means for selecting either a first control mode or a second control mode as the control mode for controlling the electronic device, based on a state of a specific body part of a user; and a control means that 1) will perform control of the electronic device in accordance with the state of the specific body part of the user, which is determined based on imaging by imaging means when the selection means has been used to select the first control mode; and 2) will perform control of the electronic device in

|                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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|                                                              | accordance with an operation involving physical contact by the user with a specific operation member when the selection means has been used to select the second control mode.”                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>[1.a.2]</b> perform control processing to                 | <p><i>See, e.g., [0079], and citations below.</i></p> <p><b>[0079]:</b> “Each functional unit of each of the above-described embodiments (and modifications) may or may not be implemented as separate hardware. The functions of two or more functional units may be implemented by common hardware. Each of the multiple functions of one functional unit may be implemented by separate hardware. Two or more functions of one functional unit may be implemented by common hardware. Furthermore, each functional unit may or may not be implemented by hardware such as an ASIC, FPGA, or DSP. For example, the apparatus may include a processor and a memory (storage medium) in which a control program is stored.”</p>                                                                                                                                                                                                                           |
| <b>[1.a.2.i]</b> 1) control the electronic apparatus..., and | <p><i>See, e.g., [0007], [0039], [0055], [0058], Fig. 5, claim 1, and citations below.</i></p> <p><b>[0007]:</b> “One aspect of the present invention is: a control device for controlling an electronic device, comprising: a selection means for selecting either a first control mode or a second control mode as the control mode for controlling the electronic device, based on a state of a specific body part of a user; and a control means that 1) will perform control of the electronic device in accordance with the state of the specific body part of the user, which is determined based on imaging by imaging means when the selection means has been used to select the first control mode; and 2) will perform control of the electronic device in accordance with an operation involving physical contact by the user with a specific operation member when the selection means has been used to select the second control mode.”</p> |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
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|  | <p><b>[0039]:</b> “The third control mode is a control mode for controlling HMD 100 using hand tracking according to the position of the user’s hand (hereinafter referred to as the “tracking control mode”). If image processing apparatus 110 is set to the tracking control mode, control unit 211 determines (recognizes) the position of the hand based on the orientation, color, and shape of the user’s hand appearing in the capture image. Then, control unit 211 controls HMD 100 according to the position of the hand in the space represented by the composite image (specifically, the distance between the hand and the CG).”</p> <p><b>[0055]:</b> “The state of the user's hand (whether the user's hand is captured within a predetermined range, and the distance between imaging unit 202 and the user's hand) tends to reflect the user's intentions regarding how they wish to control HMD 100. Therefore, according to Embodiment 1, because it is possible to switch to a control mode that matches the user's intention, it becomes possible to control HMD 100 according to a control mode that matches the user's intentions.”</p> <p><b>[0058]:</b> “Also, in Step S501, if it is determined that the user's hand is captured within a predetermined range, the processing Step of S502 may not be performed, and the processing of Step S504 or S505 may be performed. For example, if it is determined in Step S501 that the user's hand is captured within a predetermined range, control unit 211 may select a control mode that was set in advance by the user from among the ray control mode and the tracking control mode.”</p> <p><b>FIG. 5:</b></p> |
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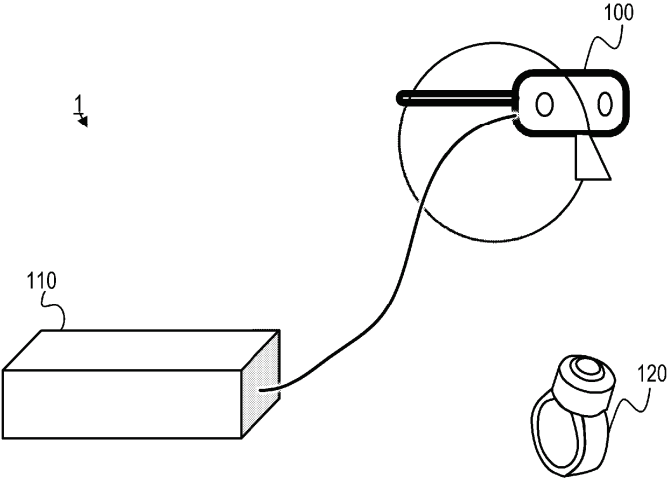
(FIGURE 5)



**Claim 1:** “A control device for controlling an electronic device, comprising: a selection means for selecting either a first control mode or a second control mode as the control mode for controlling the electronic device, based on a state of a specific body part of a user; and a control means that 1) will perform control of the electronic device in accordance with the state of the specific body part of the user, which is determined based on imaging by imaging means when the selection means has been used to select the first control mode; and 2) will perform control of the electronic device in

|                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
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|                                                           | accordance with an operation involving physical contact by the user with a specific operation member when the selection means has been used to select the second control mode.”                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>[1.a.2.ii]</b> 2) control the electronic apparatus..., | <p><i>See, e.g., [0007], [0033], claim 1, and citations below.</i></p> <p><b>[0007]:</b> “One aspect of the present invention is: a control device for controlling an electronic device, comprising: a selection means for selecting either a first control mode or a second control mode as the control mode for controlling the electronic device, based on a state of a specific body part of a user; and a control means that 1) will perform control of the electronic device in accordance with the state of the specific body part of the user, which is determined based on imaging by imaging means when the selection means has been used to select the first control mode; and 2) will perform control of the electronic device in accordance with an operation involving physical contact by the user with a specific operation member when the selection means has been used to select the second control mode.”</p> <p><b>[0033]:</b> “The first control mode is, as described above, a control mode that controls HMD 100 in response to an operation on the OTP of the controller 120 (an operation involving physical contact by the user) (hereinafter referred to as the “OTP control mode”). If image processing device 120 is set to the OTP control mode, control unit 211 controls HMD 100 according to user operations on the OTP.”</p> <p><b>Claim 1:</b> “A control device for controlling an electronic device, comprising: a selection means for selecting either a first control mode or a second control mode as the control mode for controlling the electronic device, based on a state of a specific body part of a user; and a control means that 1) will perform control of the electronic device in</p> |

|                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                               | <p>accordance with the state of the specific body part of the user, which is determined based on imaging by imaging means when the selection means has been used to select the first control mode; and 2) will perform control of the electronic device in accordance with an operation involving physical contact by the user with a specific operation member when the selection means has been used to select the second control mode.”</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <p><b>[1.b.1]:</b> wherein the specific operation member is included in a controller, and</p> | <p>See, e.g., [0015], [0017], [0033], Fig. 1, claim 12, and citations below.</p> <p><b>[0015]:</b> “Controller 120 is a device for performing various controls of HMD 100. If image processing device 110 is in a specific control mode, when a user operation is performed on controller 120, HMD 100 is controlled in response to the user operation. For example, as shown in Figure 1, controller 120 has a ring-like (ring-type) shape such that it can be worn on a user’s finger. If controller 120 can be worn on a user’s finger, the user can move their hand freely while wearing controller 120. Controller 120 also has a button with a built-in optical trackpad (hereinafter referred to as “OTP”). Controller 120 performs wireless communication via Bluetooth with image processing device 110.”</p> <p><b>[0017]:</b> “Controller 120 may include any operating member instead of the OTP, as long as the user can perform operations by physical contact. For example, controller 120 may include any of a touchpad, a touch panel, a directional pad, a joystick, or a trackpad device instead of the OTP.”</p> <p><b>[0033]:</b> “The first control mode is, as described above, a control mode that controls HMD 100 in response to an operation on the OTP of controller 120 (an operation involving physical contact by the user) (hereinafter referred to as the “OTP control mode”).</p> |

|                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                            | <p>If image processing device 110 is set to the OTP control mode, control unit 211 controls HMD 100 according to user operations on the OTP.”</p> <p><b>FIG. 1:</b><br/>【書類名】 図面<br/>【図 1】</p>  <p><b>Claim 12:</b> “The control device described in any one of Claim 1 through Claim 11, wherein the specific operation member is included in a controller, and the controller is in a form capable of being held or worn by a user's hand.”</p>                                                                                                                                                                                            |
| <p><b>[1.b.2]:</b> the controller is wearable on the hand of the user.</p> | <p>See, e.g., [0015], [0016], claim 12, and citations below.</p> <p><b>[0015]:</b> “Controller 120 is a device for performing various controls of HMD 100. If image processing device 110 is in a specific control mode, when a user operation is performed on controller 120, HMD 100 is controlled in response to the user operation. For example, as shown in Figure 1, controller 120 has a ring-like (ring-type) shape such that it can be worn on a user's finger. If controller 120 can be worn on a user's finger, the user can move their hand freely while wearing controller 120. Controller 120 also has a button with a built-in optical trackpad (hereinafter referred to as “OTP”). Controller 120 performs</p> |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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|  | <p>wireless communication via Bluetooth with image processing device 110.”</p> <p><b>[0016]:</b> “For example, a menu including a pointer may be displayed on HMD 100 if the user long-presses the OTP button. After that, the user can align the pointer with a desired item by placing their finger on the OTP and sliding it in any direction. Then, the user can perform a confirmation operation to decide the selection of that item by pressing down on the OTP button. While the shape of controller 120 has been described as ring-shaped, it is not limited to this. For example, the shape of controller 120 may be a wearable shape that can be worn on the hand, such as a glove. In this way, controller 120 is preferably in a form that can be held by the user's hand or worn on the hand such that it is easy for the user to use”</p> <p><b>Claim 12:</b> “The control device described in any one of Claim 1 through Claim 11, wherein the specific operation member is included in a controller, and the controller is in a form capable of being held or worn by a user's hand.”</p> |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**C. Ravasz (Ex. 1007)**

114. Ravasz discloses “an artificial reality environment” implemented through an HMD. Ex. 1007, Abstract. A user can interact with the UI elements within a UI icon array using controllers 114, or the UI elements within a “UI menu 124 [that]...appear[s] to be larger, and thus closer to the user” using pre-defined gestures. *Id.*, [0087].

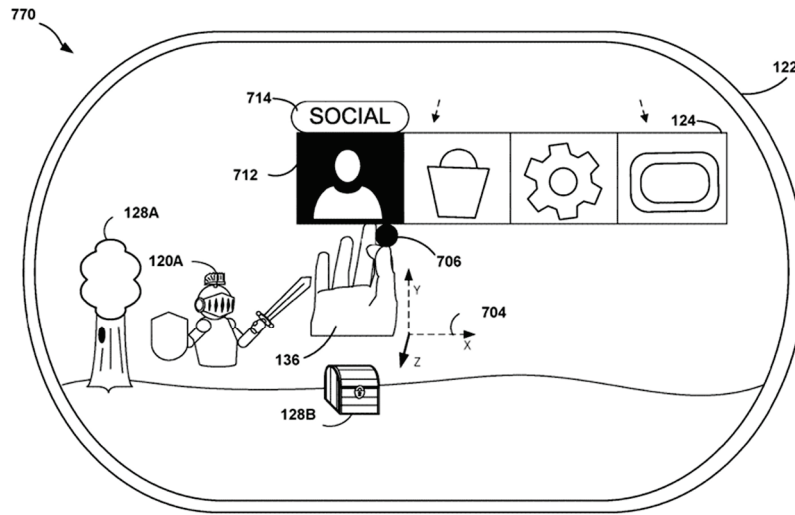


FIG. 7E

Ex. 1007, FIG. 7E.

115. In operation, Ravasz detects a “menu activation gesture”—a hand held “in a substantially upturned orientation” with “a finger and the thumb . . . positioned in a pinching configuration” which in response renders a “UI menu 124” in proximity to the user’s virtual hand. Ex. 1007, [0071], [0073], FIG. 7A. The menu items may “correspond to applications,” with the menu “divided into two portions,” one representing “favorite applications” and the other “applications currently running within the artificial reality system.” *Id.*, [0089]. Ravasz also discloses a “UI icon array” “representing applications available or running in the artificial reality system.” *Id.*, [0089], FIGS. 7F-7G. The user performs a “selection gesture” on UI elements which “cause[s] an application to be instantiated, or . . . a currently running application to be brought into the foreground.” *Id.*, [0076]-[0077]. Ravasz

also discloses that the HMD “receive[s] user inputs from controllers 114 held by [a] user.” *Id.*, [0040], FIG. 1B.

## **IX. CLAIM CONSTRUCTION**

116. I have applied the plain meaning of the terms and phrases in the claims in my analysis, as a person of ordinary skill in the art would have understood those terms and phrases at the relevant time (around 2022). I understand that the Board will construe the claims using the same claim construction standard that would be used in district courts. My declaration will establish that the prior art meets each of the claim limitations under its plain meaning construction.

## **X. OPINIONS ON GROUND 1: TANG WITH RAVASZ RENDERS OBVIOUS CLAIMS 1-11**

### **A. A POSITA Would Have Been Motivated to Combine**

117. In my opinion, a POSITA would have been motivated to combine Tang’s virtual object interface using far and near interaction modes in a virtual reality environment using controllers or hand input with Ravasz’s ability to launch software applications and modify configurable settings as UI menu elements.

118. The two references apply to the same user control design problem, where Ravasz teaches how a gesture-driven interface detects a user’s hand input in association with an action associated with a UI element in a menu including launching an application, and Tang teaches a near interaction mode supporting direct manipulation of virtual object with hands when within a proximal reach envelope,

and a far interaction mode supporting the use of hands or controllers for pointing-based interactions when objects are otherwise out of reach. Ex. 1005, [0021]-[0026], [0049], [0052], [0059]; Ex. 1007, [0004], [0046]; *see also* §§ VIII.A, VIII.C. A POSITA designing an application interface would have recognized that combining Tang and Ravasz would produce an interface that both positions virtual objects within reach and supports the launching of a corresponding application when the virtual object in a group of buttons of menu is engaged, and a POSITA would have been motivated to combine them for at least those reasons.

119. As I explained in the Technology Overview above, using different interaction techniques depending on whether a virtual object is proximal (within the user's reach) or distal (beyond the user's reach) was a well-established design paradigm in the art dating to at least the 1990s. *See* §§ VI.A (Technology Underlying Virtual Reality), VI.D (Interaction with Objects Near and Far). A POSITA would therefore have approached the combination of Tang's proximal/distal rendering with Ravasz's gesture- and controller-driven interaction on a menu as an application of familiar and complementary techniques already understood in the art.

120. Further, as I explained in the Technology Overview above, before 2022, a user of the Oculus Quest VR headset could use their hands to interact with a proximal palette of icons to launch an application or invoke different functionality. *See* Ex. 1045. A POSITA would therefore have approached the use of Ravasz's

teachings of a selection of “applications available or running in the artificial reality system” (Ex. 1007, [0089]) as an application of familiar and complementary techniques already understood in the art.

121. Further, both references are directed to the user experience in virtual reality. Ex. 1005, [0016] (“The inventors have recognized a challenge associated with user manipulation of virtual objects in a virtual reality (VR) or an augmented reality (AR) environment.”); Ex. 1007, [0004] (“In general, this disclosure describes artificial reality systems and, more specifically, graphical user interface elements and techniques for presenting and controlling the user interface elements within an artificial reality environment.”). In my opinion, a POSITA implementing Tang’s virtual reality system would naturally look at other virtual reality systems that focus on the user experience, like Ravasz, to improve the implementation disclosed in Ravasz. A POSITA working on either system would therefore have been solving the same core engineering problem (how to map camera-tracked hand input onto graphical UI elements rendered at a chosen distance from the user). Both references are in the same field and are directed to the same problem, such that a POSITA working on either would have consulted the other as a matter of course. In my opinion, a POSITA would have considered contemporaneous gesture-interaction and menu-display system when designing an application selection interface.

122. Both references also disclose systems that include similar components. Tang discloses virtual objects that may be displayed to the user and provides the ability to display objects closer to the user for ease of interaction, particularly with gestures. Ex. 1005, [0016]. Ravasz similarly discloses “artificial reality systems ... that generate and render graphical user interface elements for display to a user in response to pre-defined gestures by the user, such as particular motions, configurations, positions, and/or orientations of the user’s hands, fingers, thumbs or arms, or a combination of pre-defined gestures” that would be easier to use on closer UI elements. Ex. 1007, [0005]. Therefore, a POSITA implementing Tang would look to other references such as Ravasz, to improve the virtual objects that the user can interact with using those gestures. Both systems are built upon a head-mounted display, an electronic display presenting virtual content, outward-facing cameras, and a gesture-recognition capability that senses hand movement to drive interaction. Ex. 1005, [0017]-[0020]; Ex. 1007, [0044]-[0045], [0055]. As such, in my opinion, a POSITA would have viewed the combination as assembling familiar, compatible parts.

123. Further, a POSITA would have been motivated to make this modification because Tang describes a system with the ability to execute or switch between multiple applications or programs but leaves the details of that functionality to an implementer who would naturally look at known design options such as a menu

with application-launching and configurable-settings elements as taught by Ravasz. Tang's system includes "one or more programs stored in the memory." Ex. 1005, [0017]. Tang explains that the system "may be configured to execute instructions that are part of one or more applications [or] programs." *Id.*, [0041]; *see also id.*, Abstract ("configured to execute one or more programs"). Of particular importance, Tang's system is flexible and allows "different programs [to] be instantiated from the same application" or "the same program [to] be instantiated by different applications." *Id.*, [0047]. As such, Tang's system allows a user to instantiate a program from an application that serves like an operating system, or to switch to a new instantiation of a program directly from another application that is running.

124. Tang's system also allows the user to change the settings of the system. For example, Tang allows the user to adjust when a virtual object is displayed. Tang explains "generation and display of virtual interaction object 58 may also happen automatically depending on the settings of the system 10 as more of the control points 52 are outside of the user's field of view 50 and/or the predetermined threshold distance 54." *Id.*, [0030]. Tang also allows the user to adjust the number of control points for a virtual object to be outside the predetermined threshold before the far interaction mode is invoked. Tang explains "[t]he predetermined threshold subset may be one control point, or a minimum percentage of control points, such as 10%, 25%, 50%, etc." *Id.*, [0023].

125. Tang does not provide the details of how to instantiate or launch a program either from the operating system application or from a different program, or how to configure the system settings, but it would have been natural to do so from Tang's grouping of buttons or context menu as that was part of the known functionality of such features, as taught by Ravasz.

126. Ravasz describes typical VR systems, like Tang, that launch applications and configure systems, explaining in its Background that “[t]ypical artificial reality systems include one or more devices for rendering and displaying content to users” and “[d]uring operation, the user typically interacts with the artificial system to select content, launch applications or otherwise configure system.” Ex. 1007, [0003]. Ravasz further explains “in some examples, provide a computer platform for executing an operating system 305, which may be an embedded, real-time multitasking operating system, for instance, or other type of operating system. In turn, operating system 305 provides a multitasking operating environment for executing one or more software components 307, including application engine 340.” *Id.*, [0049]. Ravasz acknowledges that “[a] technical problem with some HMDs is the lack of input devices ... to position a selection user interface element within a menu.” *Id.*, [0007]. Ravasz describes “[a] technical solution to ... include a menu that can be activated and interacted with using one hand.” *Id.* In particular, the menu elements can be associated with “pre-defined

gestures [that] ... launch applications, modify configurable settings, ... or perform other actions.” *Id.*, [0063].

127. Ravasz application-launching and configurable-settings menu elements naturally complement Tang’s system which also includes a grouping of virtual buttons 64, context menu 68, and far context menu, and disclosures related to configuring the system settings and instantiating programs while in other programs. Further, Ravasz taught an operating system and multitasking operating environment that would readily support switching between applications similar to Tang’s disclosure that a program could be instantiated from a different application. Ex. 1007, [0049]; Ex. 1005, [0047]. Tang and Ravasz also share similar applications. For example, both Tang and Ravasz teach a social media application in the artificial or virtual reality environment. Ex. 1005, FIG. 6; Ex. 1007, FIGs. 7C-7E.

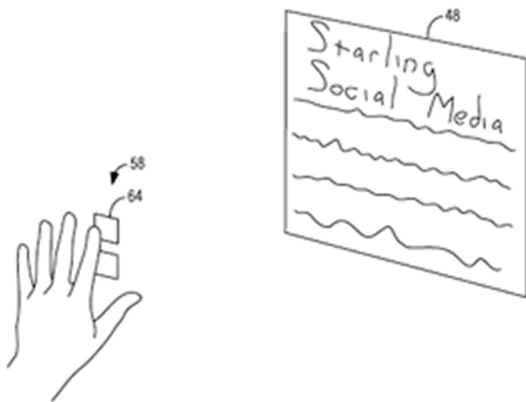


FIG. 6

Ex. 1005, Fig. 6

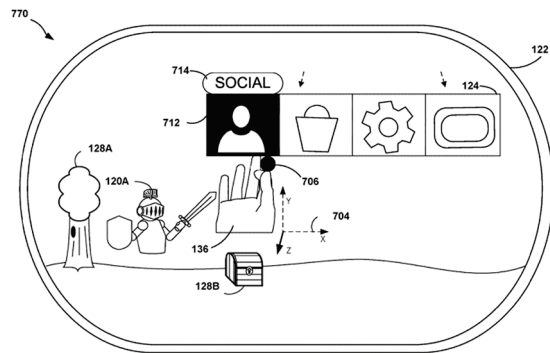


FIG. 7E

Ex. 1007, Fig. 7E

128. Tang and Ravasz also teach similar programs that use multiple windows to display content. Ex. 1005, [0029] (“a user may be working with one or more windows in a VR or AR environment”); FIG. 7, Ex. 1007 [0022] (“artificial reality system **10** presents and controls user interface elements specifically designed for user interaction and manipulation within an artificial reality environment, such as ... content display windows and the like.”).

129. The ability to easily launch an application, switch to another application, or modify settings, as taught by Ravasz in Tang’s grouping of buttons or context menus would have increased versatility, lowered friction, improved workflow, and enhanced the user experience. For example, the concept of world switching (launching or switching to an application from another application through a menu option) would have supported a user’s ability to multitask as I discussed in the Technology Overview above. *See* § VI.E (Virtual Reality World Switching); *see also* Ex. 1007, [0049] (HIVID 112 ... in some examples, provide a computer platform for executing an operating system 305, which may be an embedded, real-time multitasking operating system [which]... provides a multitasking operating environment”). Such functionality would have allowed users to easily share information from the system on social media, such as key milestones in a virtual game or a link identified through a virtual browser. *See* Ex. 1005, FIG. 6; Ex. 1007, FIGS. 7C-7E.

130. This functionality would have also allowed the user to adjust the system settings to the user's preference. For example, if the user is having trouble controlling objects in near interaction mode, the user could adjust the settings to have the all of the control points (instead of some of the control points) of the virtual object within the predetermined threshold distance before invoking near interaction mode.

131. Moreover, a POSITA implementing the grouping of buttons or context menu of Tang would naturally look at similar references like Ravasz that provide detail on what actions are performed when the virtual objects in the buttons or context menu are tapped or pressed. As shown in Figures 5C and 5F, the virtual objects in the grouping of buttons and context menu are literal black boxes.

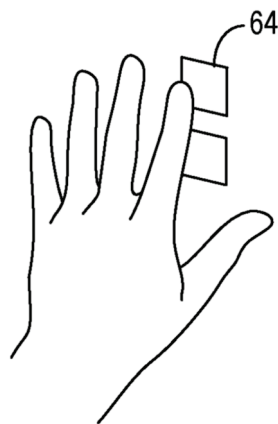


FIG. 5C

Ex. 1005, FIG. 5C.

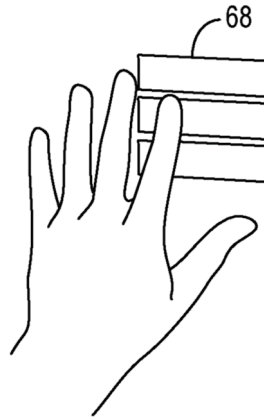


FIG. 5F

Ex. 1005, FIG. 5F.

Ravasz discloses that the UI menu icon actions can include modifying system settings or launching applications (Ex. 1007, FIGs. 7A-7G), including a “social” software application, which Tang and Ravasz both share (Ex. 1005, FIG. 6; Ex. 1007, FIG. 7E).

**B. A POSITA Would Have Had a Reasonable Expectation of Success**

132. In my opinion, a POSITA would have had a reasonable expectation of success in modifying Tang’s virtual objects in a grouping of buttons or context menu with Ravasz’s ability to launch software applications and modify configurable settings. A POSITA would have recognized that combining these teachings would be an assembly of known components and known interaction techniques. The combination reuses each reference's existing sensing and display subsystems in the

manner each already teaches, requires no new hardware, and does not alter the internal operation of either system's gesture recognition or rendering pipeline.

133. First, both references in my opinion use similar components in virtual reality, which would have made the combination of the disclosures more straightforward. Tang discloses inward and outward-facing cameras (30/32), gesture recognition modules 24, and inertial measurement units 36. Ex. 1005, [0020], [0017], [0019]. Ravasz discloses image capture devices 238, gesture detector 324, and motion sensors 206 to determine user gestures. Ex. 1007, [0045], [0008]. Because Tang and Ravasz utilize similar components in a similar way to detect interactions, the systems would use similar inputs and outputs to interact with the respective virtual objects and UI elements. Specifically, Tang includes all the hardware components needed to render and interact with virtual objects to launch applications and modify configurable settings as taught by Ravasz. Ex. 1005, [0020], [0017], [0019]. Therefore, a POSITA would have known that combining these references would have been a simple modification of similar components. Both systems capture hand movement through cameras and motion sensors and interpret it to drive interaction with virtual UI elements.

134. In my opinion, a POSITA would have understood the modification to be straightforward because a gesture-recognition pipeline both references disclose already emits a discrete selection or trigger event, and a rendering pipeline of the

kind both references disclose already accepts a target depth at which to place a UI element. As such, a POSITA would have expected Tang's proximal icon rendering to operate on Ravasz's gesture-detected input without redesigning either system's sensing or display architecture.

135. As I explained in the Technology Overview above, head-mounted displays incorporating outward-facing cameras, motion tracking, and gesture-recognition capabilities were mature and well-understood components long before the priority date. *See* § VI.A (Technology Underlying Virtual Reality). A POSITA would therefore have regarded the sensing and display subsystems that both references disclose as conventional, well-characterized building blocks, further supporting the expectation that they could be combined.

136. Second, both references disclose similar hand gestures that can be used to interact with objects and elements in the virtual reality environment, which would make the combination of the two systems simply a matter of programming for a POSITA. Tang discloses that the gesture recognition module 24 can detect predetermined gestures that can be used to interact with objects such as a grouping of buttons or context menu. Ex. 1005, [0018], [0026], [0029]. Similarly, Ravasz discloses that the gesture detector 324 can detect pre-defined gestures that can be used to interact with the UI menu. Ex. 1007, [0063], [0064]. Associating Tang's virtual objects with Ravasz's ability to launch applications or modify settings would

have already been within the software structure of Tang, and well within the skill set of a POSITA. Because Tang already renders selectable virtual objects and, through its gesture-recognition module, detects when a user selects one. Ravasz, in turn, teaches operatively linking a selectable UI element to a software action, so that selecting the element causes the system to launch an application or activate a setting. Because Tang's system already produces a discrete selection event for a chosen object, associating that event with Ravasz's launch-or-activate function would map the existing selection output to the corresponding software action, which in my opinion is the kind of routine binding of a UI element to a function call that Tang's architecture is built to support. Thus, in my opinion, a POSITA would have recognized this as a straightforward software integration well within ordinary skill, requiring no change to Tang's underlying detection or rendering and no new hardware.

137. Therefore, in my opinion, a POSITA would have understood that Tang's system already included all the necessary hardware components, inputs and outputs, and software structure to implementing ability to launch applications and modify settings.

**C. Independent Claim 1:**

**1. 1[pre]: “A virtual reality environment selection interface comprising:”**

138. I have been asked to assume a scenario where the preamble is limiting. As to that scenario, it is my opinion that Tang discloses the preamble.

139. In my opinion, Tang discloses a *virtual reality environment* that displays virtual objects to a user and allows the user to select those objects (*selection interface*).

140. First, Tang’s system expressly provides a “*virtual reality* (VR) *environment* [that] may be populated with an array of virtual objects with which a user may interact.” Ex. 1005, [0002]. An interface provides a mechanism that allows a user to communication with a system. A POSITA would have understood that Tang discloses a head mounted display (HMD) system that provides an interface because a user can communication with the system through virtual objects that a user can select and interact with. Tang describes “a computing system **10**” that “includes a head mounted display (HMD) device **14** including a display **16** and a processor **12**,” that is “configured to execute one or more programs stored in the memory.” Ex. 1005, [0017]. The HMD processor is further “configured to display a virtual object **48** ... on display **16**.” Ex. 1005, [0021].

141. Moreover, Tang discloses “a plurality of control points associated with the virtual object.” *Id.*, Abstract. When “the control points associated with the

virtual object are further than a predetermined threshold distance from the user,” Tang’s system “invoke[s] a far interaction mode for the virtual object.” *Id.* Tang discloses that “in the far interaction mode the available interactions with the virtual object 48 may be limited, and in some situations may only include ... display of a far context menu due to the distance at which the virtual object is displayed.” *Id.*, [0022]. A user can “select the virtual object **48**” (*selection interface*) in a “far interaction mode” through input from the user. *Id.*, [0026]; *see also* [0022]-[0025], [0029], FIG. 6.

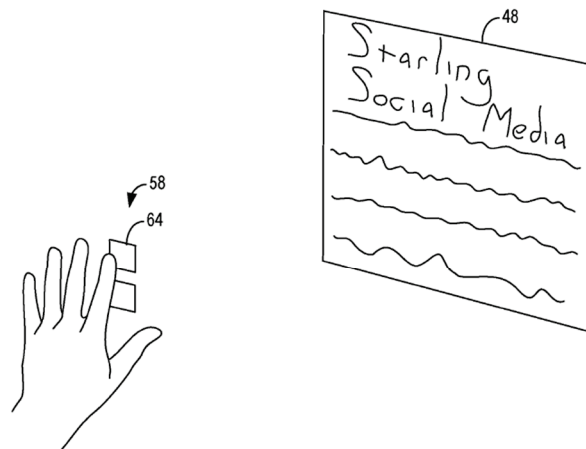


FIG. 6

Ex. 1005, FIG. 6.

142. It is well-known in the art that object selection requires some mechanism for the identification of the object to be selected and some signal to indicate the actual act of selection. *See* Ex. 1009, 8. This signal is typically in the

form of a button press from a controller or gesture detected by tracking movements from the user. *See id.* In Tang, the control points provide the mechanism for the identification of the object and the user input, such as a button press or gesture, provides the actual act of selection.

143. Tang itself explains that its system can be implemented as an application-programming interface which allows communication with the system. *See* Ex. 1005, [0038] (“[These] methods and processes may be implemented as a computer-application program or service, an application-programming interface (API), a library, and/or other computer-program product.”).

144. Additionally, Tang teaches that users can interact with virtual objects in a near interaction mode using hand gestures made directly on the virtual object. Tang discloses that in “a near interaction mode,” the “virtual interaction object [is] within the predetermined threshold distance from the user.” Ex. 1005, [0003]. A “processor 12 may be configured to execute control of the virtual object 48 according to gestures of the hand of the user.” *Id.*, [0026]. “The predetermined gesture may be a...tap gesture.” *Id.*, [0026]. “The plurality of gestures may further include a pressing motion by a finger, a circular motion by the hand or a finger, a wrist flick, a rotation of the hand and/or arm, and/or a snap, to name a few additional examples.” *Id.*, [0028].

145. Thus, in my opinion, Tang discloses the preamble a *virtual reality environment selection interface*.

**2. 1[a.i]: “a first software application icon”**

146. In my opinion, Tang in view of Ravasz renders obvious this limitation.

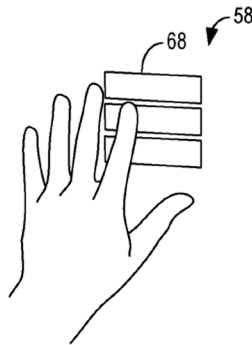
147. In the combination, a virtual object among Tang’s plurality of virtual objects (virtual objects 48 and virtual interaction objects 58) in the group of virtual buttons 64 or context menu 68, when combined with Ravasz’s application-launching menu functionality, is a *first software application icon*. The group of buttons and context menu include virtual objects that would correspond to an action that launches an application implemented in software.

148. Tang explains that its system generates multiple virtual objects, describing that “the virtual interaction object may be one of a plurality of virtual interaction objects that the processor is configured to generate.” Ex. 1005, [0053]. Tang describes virtual objects having broad functionality including “at least one virtual button 64 ... and a context menu 68.” Ex. 1005, [0028], FIGs. 5C, 5F. A POSITA would have modified one of Tang’s virtual objects among the group of virtual buttons or context menu to launch a software application (*software applications icon*) as taught by Ravasz. See § X.A (Motivation to Combine).



FIG. 5C

Ex. 1005, FIG. 5C.



Ex. 1005, FIG. 7.

149. For example, Figure 7 depicts multiple virtual windows, each running an application, displayed together in the interface with their associated context menu controls. A POSITA would have understood that these buttons represent *software application icon[s]*.

150. Similar to Tang's group of virtual buttons 64 and context menu 68, Ravasz discloses "selection of UI element 126 of UI menu 124." Ex. 1007, [0032].

Ravasz discloses that menu items can “correspond to applications” and that the UI menu includes “icons representing applications available or running in the artificial reality system” (*software applications icon*) may be displayed to the user. Ex. 1007, [0089]. Ravasz further discloses that upon detecting a selection gesture, the system may “cause an application to be instantiated, or can cause a currently running application to be brought into the foreground.” *Id.*, [0076]. Specifically, Ravasz teaches that “in response to gesture detector 424 detecting one of the pre-defined gestures” on a UI element, “user interface engine 428 and/or application engine 440 may ... launch *application[s]*.” Ex. 1007, [0063].

151. A POSITA would have modified one of Tang’s virtual objects in view of Ravasz’s teachings to represent an application and launch that associated application. This is because Ravasz’s teachings regarding launching an application naturally apply to a button or menu option, such as the virtual buttons 64 or context menu 68. A control panel with virtual buttons or menu were well-known mechanisms to select and launch an application. *See* § VI.C (Interaction and Selection Movements). A POSITA would have modified one of Tang’s virtual objects to be a software application icon to launch respective the application as taught by Ravasz, resulting in *a first software application icon*. *See* §§ X.A-B.

152. Thus, in my opinion, Tang in view of Ravasz renders obvious the limitation a *first software application*.

**3. 1[a.ii]: “displayed in a virtual reality environment to a user using a virtual reality hardware device”**

153. In my opinion, Tang discloses this limitation.

154. The virtual object, among virtual buttons 64 or context menu 68, that launch an application (the combination I discussed in § X.C.2), are *displayed in a virtual reality environment to a user using* the HMD 14 described in Tang (*virtual reality hardware device*). Ex. 1005, [0020].

155. Tang describes “a head mounted display (HMD) device 14 including a display 16” that is worn by the user that presents the virtual objects to the user on “right and left near-eye displays.” *Id.*, [0017], [0020], [0021]. Thus, the HMD is a *hardware device* that is used to present a *virtual reality* to the user.

156. Tang discusses its system as operating in a “*virtual reality (VR) environment* [that] may be populated with an array of virtual objects with which a user may interact.” Ex. 1005, [0002]. This system “may take the form of one or more...wearable computing devices such as ... head mounted augmented/virtual reality devices,” such as “head mounted display (HMD) device 14.” *Id.*, [0039], [0017]. The HMD device 14 includes “a display 16 and a processor 12 and associated memory, the processor 12 being configured to execute one or more programs stored in the memory.” *Id.*, [0017]. Tang’s processor is “configured to display a virtual object 48 at least partially within a field of view 50 of a user on the

display 16,” and in the near interaction mode, the system displays virtual interaction objects 58 to the user within the virtual reality environment. *Id.*, [0021], [0025].

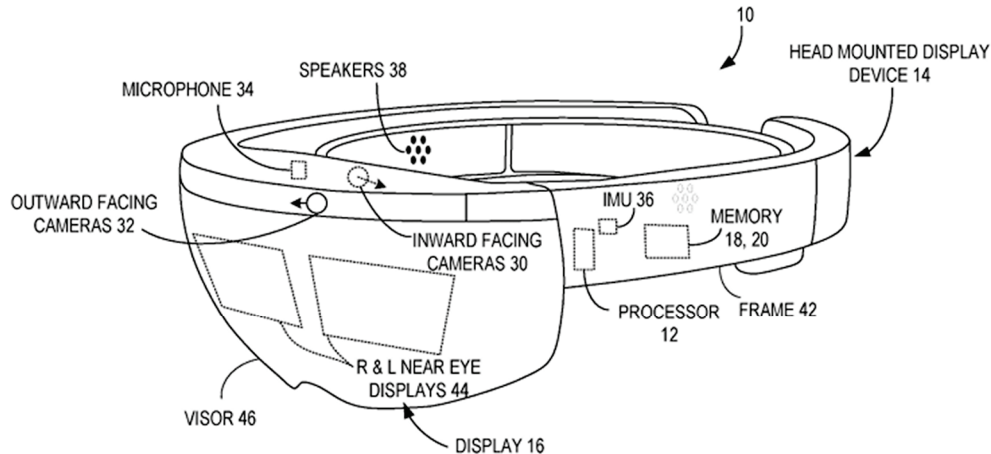


FIG. 2

Ex. 1005, FIG. 2.

157. Thus, in my opinion, Tang discloses the limitation *displayed in a virtual reality environment to a user using a virtual reality hardware device*.

**4. 1[a.iii]: “wherein the first software application icon appears closer to a body part of the user”**

158. In my opinion, Tang discloses this limitation.

159. The virtual object, among virtual buttons 64 and context menu 68, that launch applications (the combination I discussed in § X.C.2) (*wherein the software application icon*) are displayed within a predetermined threshold distance (*appears closer*) from the user, including the user’s hand (*to a body part of the user*).

160. Tang discloses a near interaction mode in which virtual objects, like virtual buttons 64 or context menu 68, are displayed within a predetermined threshold distance 54 from the user, and a far interaction mode in which virtual objects are displayed further than the predetermined threshold distance 54 from the user. Ex. 1005, [0003]; *see also id.*, [0031] (“The virtual interaction object **58** displayed within the predetermined threshold distance **54** from the user may be locked in location with respect the user. The predetermined threshold distance from the user may be in a range of 460 mm to 580 mm, typically as measured from the shoulder of the user. This distance represents an average distance from the shoulder of an average user to the grip center of a hand”).

161. Tang explains that “a plurality of control points [is] associated with the virtual object.” *Id.*, [0003]. When the system “determine[s] that one or more of the control points associated with the virtual object are further than a predetermined threshold distance from the user,” the system “invoke[s] a far interaction mode for the virtual object.” *Id.*; *see also id.*, [0033] (in the “far interaction mode,” “one or more of the control points **52** associated with the virtual object **48** are *further* than a predetermined threshold distance **54** from the user”). When the system “invoke[s] a near interaction mode,” the system will “display a virtual interaction object within the predetermined threshold distance from the user.” *Id.*, [0025] (“the processor **12** may be configured to invoke a near interaction mode and display a virtual interaction

object 58 *within* the predetermined threshold distance 54 from the user”). In near interaction mode, “all control points 52 may be within the user’s field of view 50 and within the predetermined threshold distance 54.” *Id.*, [0033]; *see also id.*, [0023] (describing “predetermined threshold” of control points within the threshold distance 54 for near interaction mode).

162. Tang describes that a user (while in the “far interaction mode”) can invoke the “near interaction mode” in response to the user’s trigger input 56 that causes the processor 12 to display virtual interaction objects “within the predetermined threshold distance 54 from the user.” *Id.*, [0024]-[0025]. In contrast, in the “far interaction mode,” a user’s distance to virtual object 48, is “further than a predetermined threshold distance 54 from the user.” Ex. 1005, [0033]. Tang discloses that the predetermined threshold distance is “with respect to various parts of the user,” and “measured from [ ] [any] point on the body of the user” (*body part of the user*). Ex. 1005, [0021]. A POSITA would have understood this to mean the display distance is defined relative to the user’s body, that is, relative to a body part of the user because the predetermined threshold distance is measured based upon a point on the user’s body. Tang confirms this stating that “virtual interaction object 58 displayed within the predetermined threshold distance 54” “may be in a range of 460 mm to 580 mm ... from the shoulder of the user,” which “represents an average

distance from the shoulder of an average user to the grip center of a hand.” *Id.*, [0031].

163. A POSITA would have understood the virtual object launching an application (*software application icon*) displayed “within the predetermined threshold distance” *appears closer to the body part of the user* than virtual objects displayed “further” from the user’s body such as in Figure 7. Tang is set at roughly arm’s length (“the average distance from the shoulder of an average user to the grip center of a hand” and “may be in a range of 460 mm to 580 mm ... from the shoulder of the user” (*id.*, [0031])) so an object is displayed within reach of their own hand and body, whereas an object displayed in the far interaction mode is rendered at a depth beyond that threshold and is perceived as further away. A POSITA would have thus understood that an object displayed within the threshold distance in comparison to an object displayed at a far display depth *appears closer to a body part of a user*.

164. Figure 7 of Tang illustrates this point, showing a virtual reality environment in which a user invokes the near interaction mode to display the virtual interaction objects 58 “near the user’s hand” (*closer to a body part of the user*). Ex. 1005, [0029]. Tang further discloses that the virtual object “displayed within the predetermined threshold distance 54 from the user may be locked in location with

respect [to] the user,” ensuring the grouping remains close to the user’s body. Ex. 1005, [0031].

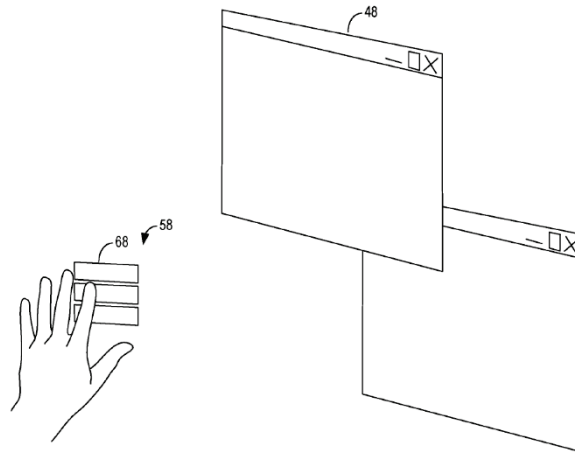


FIG. 7

Ex. 1005, FIG. 7.

165. Tang explains that the “advantage” of using the near interaction mode to display objects closer to the user includes “improved readability” and “greater ability to make fine movements/selections with respect to a virtual interaction object 58” “that is in proximity to the user's hand.” *Id.*, [0029]. A POSITA would have understood that the improved readability and fine movement control resulted from the object being rendered closer to the user’s hand, *appear[ing] closer to the body part of the user.*

166. As such, Tang discloses *a first software application icon* that is displayed “near to the user’s hand” and therefore *appear closer to a body part of the*

*user*, than, as I discuss later, the virtual objects displayed in the far context menu in the far interaction mode.

167. Thus, in my opinion, Tang discloses the limitation *wherein the first software application icon appears closer to a body part of the user*.

**5. 1[a.iv]: “[a body part of the user] that is tracked by a camera of the virtual reality hardware device to interact with the first software application icon”**

168. In my opinion, Tang discloses this limitation.

169. The user’s hand (*a body part of the user*) *is tracked by* outward facing cameras 32 (*a camera*) in HMD 14 (*of the virtual reality hardware device*) to recognize gestures (*to interact*) associated with the virtual object, among virtual buttons 64 or context menu 68 (the combination I discussed in § X.C.2) (*the first software application icon*).

170. As I discussed, Tang describes multiple cameras incorporated into the HMD that track the user’s gestures to allow the user to interact with virtual objects. Ex. 1005, [0016]-[0020]; *see also id.* [0016] (“[A] computing system that may facilitate user interaction with ... a distant object in a location that is proximal to the user”), FIG. 2.

171. Tang describes that these “outward facing cameras 32” (*a camera*) are among the sensors “incorporated within [the] housing of the HMD device 14.” *Id.*, [0019]-[0020]; FIG. 2. The outward facing camera is used to track the user’s

movements in a series of images over time. *Id.*, [0019] (“The processor **12** may further refine the 6 DOF output of the IMU **36** using visual tracking systems that search for movement of identified visual features in a series of images captured by the outward facing cameras **32** and generate an estimate of the relative movement of the HMD device **14** based upon the movement of these visual features within successive image frames captured by the outward facing cameras **32** over time.”).

172. For example, to detect body gestures, Tang’s “gesture recognition module 24” “process[es] image data of the user collected by outward facing cameras 32 when these cameras capture images of the user’s body or portions thereof, such as the user’s hands.” *Id.*, [0018]. This is shown below in FIG. 2, where the outward facing cameras are placed such that they are able to capture a user’s hands when the HMD is worn.

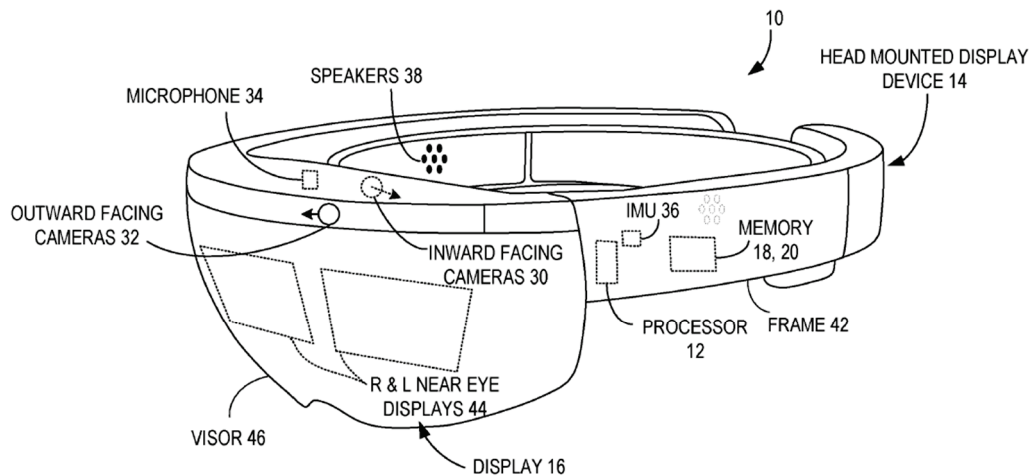


FIG. 2

Ex. 1005, FIG. 2.

173. The cameras of the gesture recognition module detect and recognize user interaction with the virtual object among the virtual buttons or context menu (*the first software application icon*), in particular, to allow the user to select application icons (virtual buttons 64 or context menu 68) as depicted in FIGs. 5 and 7. *Id.*, [0029]. For example, Tang explains that in near interaction mode, the user can make “fine movements/selections with respect to a virtual interaction object 58 ... in proximity to the user's hand” (*id.*, [0029]), such that a POSITA would have understood that the mechanism in Tang disclosed for detecting those hand movements and selections is the camera-based gesture recognition module 24 (*id.*,

[0018]). Therefore, a POSITA would have understood that the cameras track the user's hand to interact with the proximal grouping.

174. A POSITA would have understood the tracking to be for, at least in part, the purpose of interacting with virtual objects in near interaction mode, specifically including the virtual buttons or context menu, because Tang ties the near interaction mode to virtual objects rendered proximally so the user can act on them with fine hand movements, and the camera-based module 24 is the disclosed means by which those movements are captured and converted into a selection. The tracking and the proximal grouping are therefore two halves of a single interaction loop where the camera senses the hand, and the sensed hand acts on first software application icon.

175. A POSITA would have also understood this because Tang expressly describes “outward facing cameras 32” detecting, thus *tracking*, a “predefined gesture” like a user's hand gesture (trigger input 56) (*id.*, [0033]) to interact with virtual objects “selected.” *Id.*, [0022] (“[T]he user may be able to perform a predetermined gesture, such as pointing at the virtual object 48, pinching, swiping, and so forth, for example, in order to select the virtual object 48.”).

176. A POSITA would have understood that the HMD outward facing cameras would have detected the gestures to enable the user to interact with the virtual object in the virtual buttons 64 or context menu 68 (*first software application*

*icon*) that are in proximity to the user. *Id.*, [0026]. A POSITA would have understood that the system Tang uses to sense a hand gesture at a distant object would be used to sense the user's hand gestures at the proximal grouping because Tang describes a single gesture-recognition module 24 processing the outward-facing camera data for all hand-gesture input, not separate sensing systems for near and far interactions. *Id.*, [0018]-[0019].

177. Thus, in my opinion, Tang discloses the limitation *[a body part of the user] that is tracked by a camera of the virtual reality hardware device to interact with the first software application icon*.

6. 1[a.v]: “[first software application icon appears closer] than another second software application icon that is displayed to the user when the user is using a physical controller in the virtual reality environment”

178. In my opinion, Tang in view of Ravasz renders obvious this limitation.

179. In the combination, a virtual object in a far context menu in the far interaction mode with Ravasz's application-launching functionality is *another second software application icon*. This virtual object *is displayed to the user when the user* is using a user-input device (*physical controller*) *in the virtual reality environment*.

180. Tang teaches that “in the far interaction mode the available interactions with the virtual object 48 may be limited, and in some situation may only include selection, movement, resizing, and display of a far context menu.” Ex. 1005,

[0022]. As Tang explains, this is “due to the distance at which the virtual object is displayed.” *Id.*

181. Tang does not expressly teach that the virtual object in the far context menu launches an application, but this would have been obvious in view of Ravasz. Menu items that “correspond to applications” and a menu that includes “icons representing applications available or running in the artificial reality system,” as taught by Ravasz was a well-known design option at the time and such functionality in a menu would have been expected from a user. Ex. 1007, [0089]; *see also* § X.C.2 (Ground 1, Limitation 1[a.i]).

182. A POSITA would have been motivated to implement Tang’s virtual object in a far context menu to include Ravasz’s application-launching functionality (***second software application icon***) because Ravasz provides the details about menu actions that Tang leaves to a POSITA to implement. *See also* §§ X.A-B. Ravasz discloses an artificial reality system that renders user interface elements within a virtual reality environment on an HMD in which the user can interact with menus using gestures or physical controller. *See* §§ VIII.A (Tang), VIII.C (Ravasz). Specifically, Ravasz teaches that “in response to gesture detector 424 detecting one of the pre-defined gestures” on a user interface element, “user interface engine 428 and/or application engine 440 may ... launch applications.” Ex. 1007, [0063]. These two frameworks are complementary, such that a POSITA would have understood

that Ravasz teaches precisely the mechanism that could be used to launch an application from Tang's virtual object.

183. In my opinion, a POSITA would have understood that Tang already characterizes its own system as implementable as “a computer-application program ... [or] application-programming interface (API).” Ex. 1005, [0038]. A POSITA would have understood the virtual objects a Tang user selects to be the graphical entry points to those underlying programs, such that actuating a selected object is the act of invoking the program it represents. Moreover, because Ravasz supplies the express teaching that the detected gesture drives exactly that invocation in response to the same class of gesture Tang already detects, it would have been obvious to combine them for improved functionality. Thus, in my opinion, the combination applies Ravasz's known gesture-to-launch binding to the selectable objects Tang describes as software entry points, yielding the predictable result that selecting an object launches its application.

184. Further, Tang itself leaves the actions performed by actuating the virtual buttons 64 or virtual objects in context menu 68 for the implementer to decide. A POSITA would have understood that launching an application as taught in Ravasz was one of the well-known design options for such buttons or context menu.

185. Tang discloses an “input subsystem 310” that interfaces with “one or more user-input devices such as a keyboard, mouse, touch screen, or game controller” (*physical controller*). Ex. 1005 [0049]. Tang teaches using these user-input devices in the “far context menu” (*id.*, [0022]) (*when the user is using a physical controller in the virtual reality environment*), as opposed to their hands because “a significant number of control points 52 [of the virtual object 58] are beyond the reach of the user and thus may be difficult or tiresome for the user to control.” Ex. 1005, [0023]. A POSITA would have understood that some gestures used to “access[] a context menu, may even be impossible in situations where virtual content is displayed at a distance beyond the reach of a user.” Ex. 1005, [0016]; *see also* [0022]. Moreover, a POSITA would have understood that a user-input device, as opposed to just a user’s hands, such as a game controller, unlike a proximal hand gesture, is not limited by the user’s physical arm reach, and would therefore have understood such a device to be the means by which a user interacts with control points that are “beyond the reach of the user.” *Id.* A POSITA would have thus understood the far-mode virtual object to be one the user interacts with when operating through a physical controller rather than by proximal hand gestures.

186. As I explained in the Technology Overview above, handheld controllers were commonly known and used as input devices in AR and VR systems before the priority date, and when tracked were used to point at, select, and

manipulate virtual objects, including objects rendered beyond the user's physical reach. *See* § VI.B.1 (Handheld Controllers). A POSITA would have further understood that a physical controller was a conventional means of interacting with distal objects, while direct hand interaction was used for proximal objects. *See* § VI.D (Interaction with Objects Near and Far). A POSITA would therefore have understood Tang's disclosure of interacting with far-mode objects through a game controller or similar user-input device to reflect this well-known physical-controller-for-distal-objects and would have understood the far-mode grouping to be the grouping displayed to, and interacted with by, the user when operating a physical controller.

187. Tang discloses *[first software application icon appears closer] than another software icon* because the virtual object among in the group of buttons or context menu displayed to the user in a near interaction mode (*first software application icon*) is within a predetermined threshold distance from the user's body part whereas the virtual object in the far context menu (*second software application icon*) is further than the predetermined threshold distance. *See* § X.C.4 (Ground 1, Limitation 1[a.iii]). A POSITA would have understood that as I explained in the Technology Overview above, vision-based tracking of bare hands to support interaction with near objects can work relatively well whereas using a tracked

handheld controller will typically work better for interaction at a distance. See §§ X.B-D.

188. Thus, in my opinion, Tang in view of Ravasz renders obvious the limitation *[first software application icon appears closer] than another second software application icon that is displayed to the user when the user is using a physical controller in the virtual reality environment.*

**7. 1[b.i]: “the first software application icon operatively linked to launch a respective software application”**

189. In my opinion, Tang in view of Ravasz renders obvious this limitation.

190. In the combination, Tang’s virtual object among the group of virtual buttons 64 or context menu 68, with Ravasz’s application-launching functionality is the (the combination I discussed in § X.C.2) *(first software application icon) operatively linked to launch a respective software application.*

191. Like Tang’s virtual object, Ravasz discloses a virtual user interface (UI) element. Ravasz teaches that “in response to gesture detector 424 detecting one of the pre-defined gestures” (“selection gesture”) on a user interface element, “user interface engine 428 and/or application engine 440 may ... launch applications” *(operatively linked to launch a respective software application)*. Ex. 1007, [0063]; *see also id.*, [0047] (“In response to identifying a pre-defined gesture, control unit 210 takes some action, such as ... launching an application”); [0056] (“[C]ertain gestures may be associated with other actions, such as ... launching applications.”).

192. Ravasz describes its menu icons on which these gestures are performed to “correspond to applications,” including “favorite applications” or “applications currently running within the artificial reality system.” Ex. 1007, [0089]. A POSITA, in my opinion, would have understood this to mean that a menu icon launches the respective application that icon represents, which means *operatively linked to launch a respective software application*.

193. A POSITA would have been motivated to combine Tang’s virtual objects with Ravasz’s application-launching menu functionality because this would have broadened the capabilities of Tang’s system in a natural way. *See* § X.A. Both Tang and Ravasz discuss virtual reality world switching through the launch of applications within an application that would have allowed a user to multitask. Ex. 1005, [0047] (“It will be understood that different programs may be instantiated from the same application, .... Likewise, the same program may be instantiated by different applications.”); Ex. 1007, [0049] (“provide a computer platform for executing an operating system **305**, which may be an embedded, real-time multitasking operating system [which]... provides a multitasking operating environment for executing one or more software components **307**, including application engine **340**.”), [0051]; *see also* § VI.E (Virtual Reality World Switching).

194. In my opinion, a POSITA would have recognized that both references already treat virtual objects as interactive targets that respond to user gestures, so associating a launch response with the selection of such an object extends functionality the system already supports rather than introducing a foreign capability. Because Tang discloses that “[o]bjects that respond to user interaction in an intuitive and user-friendly manner may provide an improved experience for the user of the AR or V[R] system,” introducing functionality (launching an application from a menu element) that a user would expect from a system that allows for user manipulation of virtual objects. Ex. 1005, [0002], [0016]. Thus, in my opinion, a launch-on-selection response is precisely the intuitive, expected consequence a POSITA would have supplied to implement that improved experience, particularly since Tang already discloses “different programs may be instantiated from the same application,” Ex. 1005, [0047], and Ravasz’s operating system and multitasking operating environment readily support switching between applications, Ex. 1007, [0049].

195. In my opinion, a POSITA would have had a reasonable expectation of success in making this combination because both Tang and Ravasz disclose HMDs for use in a virtual reality environment that rely on interactions (gestures) with virtual objects to manipulate the environment. Ex. 1005, [0003]; Ex. 1007, [0005]; *see also* § X.B. Because the two references operate in the same technological environment

and employ compatible gesture-based interaction models, a POSITA would have expected the application-launching menu functionality of Ravasz to behave predictably when implemented within Tang's system, without altering the underlying architecture of either. A POSITA would have understood that the modification to Tang's virtual objects to incorporate application-launching menu functionality would be a straightforward software modification within the abilities of a POSITA. In my opinion, Tang's system already detects and responds to user selection of virtual objects as well as launching an application, so a POSITA would need only to associate a conventional application-launch routine with that existing selection event with a button or menu, which require no specialized techniques.

196. Thus, in my opinion Tang in view of Ravasz renders obvious *the first software application icon operatively linked to launch a respective software application.*

8. 1[b.ii]: “when interacted with by a pushing, pulling, tapping, pressing or sliding action of the body part of the user directly on the first software application icon,”

197. In my opinion, Tang discloses this limitation.

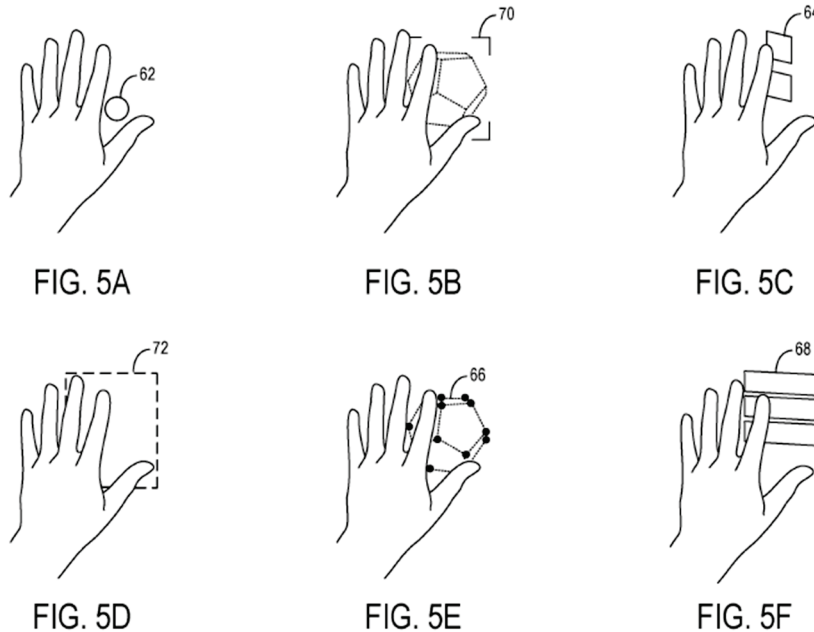
198. In my opinion, the software application associated with the virtual object is launched (the combination I discussed in § X.C.2) *when* the user's hand (*the body party of the user*) performs a *tapping or pressing* action (*interacted with*)

*directly* on a virtual object among the virtual button 64 or context menu 68 (***first software application icon***).

199. In Tang's near interaction mode, Tang displays the grouping within the threshold distance at roughly arm's length so the user can manipulate it by hand rather than at a distance. Ex. 1005, [0025], [0029], [0031]. A POSITA would have understood FIGs. 5-7 to depict a user pushing or tapping their hand on an application icon to interact with a first software application icon. *Id.*, FIGs. 5-7.

200. Moreover, as I explained in the Technology Overview above, direct hand interaction with proximal virtual buttons (including touching, poking, and pressing buttons rendered within the user's reach) was a well-known interaction technique before the priority date. *See* §§ VI.C-D (Interaction/Selection Movements), (Interaction with Objects Near and Far). A POSITA would thus have understood direct hand actuation of a proximal button to be a conventional interaction consistent with Tang's near interaction mode.

201. As shown below, Tang's Figures. 5-7 depict a user interacting with virtual objects, including virtual buttons 64 and context menus 68, by ***pushing***, ***tapping***, or ***pressing*** with their hand (***body part of the user***). *Id.*, [0028]-[0029]. In my opinion, a POSITA would have understood these figures to depict direct hand manipulation of the proximal object (the hand is at the object, acting on it) rather than interaction mediated by a pointer or ray at a distance.



Ex. 1005, FIGs. 5A-5F.

202. As seen here, Figures. 5A-5F show the user's hand positioned at the interaction object. Tang describes the near mode as enabling "find movements/selections with respect to virtual interaction object 58 . . . in proximity to the user's hand" (*id.*, [0029]) such that direct hand manipulation of the proximal object occurs rather than interaction at a distance.

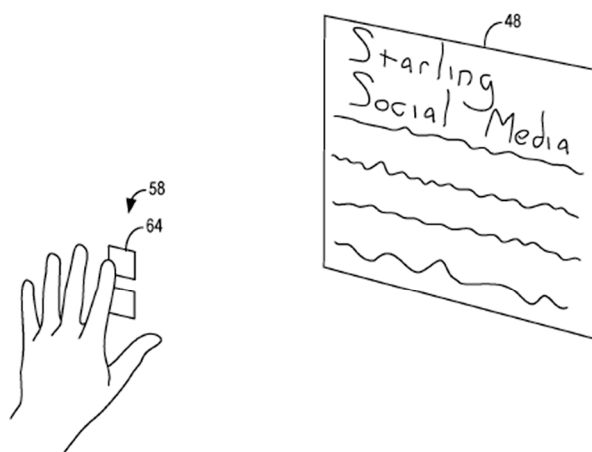


FIG. 6

Ex. 1005, FIG. 6.

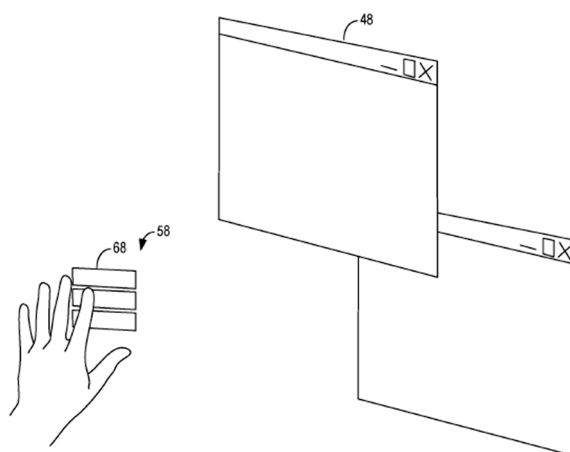


FIG. 7

Ex. 1005, FIG. 7.

203. Tang discloses “an array of virtual objects with which a user may interact.” Ex. 1005, [0002]. In Figures 5-7, Tang depicts a virtual hand in proximity

with virtual objects. *Id.*, FIGs. 5-7. Tang explains that “[t]he predetermined gesture [recognized by the gesture recognition module] may be a...tap gesture.” *Id.*, [0026]. “The plurality of gestures may further include a pressing motion by a finger, a circular motion by the hand or a finger, a wrist flick, a rotation of the hand and/or arm, and/or a snap, to name a few additional examples.” *Id.*, [0028]. A POSITA would have understood that upon a user *tapping* or *pressing* the virtual objects (including the *software application icon*) in the grouping of buttons or context menu as disclosed by Tang, it would have launched the associated application as disclosed by Ravasz .

204. A POSITA would have understood that the use of a “scrolling mechanism” requires that the user, for example, touch, tap, or slide their hand to interact with the virtual buttons (tapping or sliding of the body part of the user directly on the software application icon). Tang discloses this scrolling mechanism as “at least one virtual button 64” displayed in proximity to the user's hand. *Id.*, [0029]. A POSITA would have further understood that operating a scrolling mechanism displayed at the user's hand entails the user acting directly on the buttons with the hand via tapping or sliding them because Tang moves the mechanism into hand's reach so the user can operate it by direct hand action rather than at a distance. *Id.*, [0029].

205. Tang teaches that because “scrolling the virtual content at a distance beyond the user's reach may be difficult,” the system generates “display of the scrolling mechanism in proximity to the user's hand, thus easing the operation of scrolling.” *Id.* A POSITA would have understood that what “eas[es]” the operation is precisely the user’s ability to act on the buttons directly, where they are rendered at the hand, rather than through the indirect, distance-based interaction Tang describes as difficult. A POSITA would have understood that Tang’s interaction gestures for its objects (“pointing ..., pinching, swiping, and so forth” (*id.*, [0022])) are the exact direct hand actions that are means of interacting with the proximal objects. Thus, a POSITA would have recognized these gestures along with the “tap gesture” and “pressing motion by a finger” Tang discloses (*id.*, [0028], [0035]) as the means by which a user operates virtual buttons brought within reach at the hand.

206. Thus, in my opinion Tang discloses the limitation *when interacted with by a pushing, pulling, tapping, pressing or sliding action of the body part of the user directly on the application icon.*

9. 1[b.iii]: “wherein the first software application icon and the second software application icon are operatively linked to launch the same respective software application.”

207. In my opinion, Tang alone, or Tang in view of Ravasz renders obvious this limitation.

208. In the combination, the virtual object among the virtual buttons or context menu in the near interaction mode (*first software application icon*) and the virtual object in the far context menu in far interaction mode (*second software application icon*) can be the same (see Ex. 1005, FIGs. 3, 8), and therefore *operatively linked to launch the same respective software application*. A POSITA would have understood that if two icons are the same, they represent the same feature or functionality. A POSITA would also have understood that a user would expect two icons that are the same, as in Ex. 1005, FIGs. 3, 8, to produce the same outcome when interacted with. two virtual objects have the same appearance, a user would have expected them to launch the same application.

209. Tang teaches that “[a] potential advantage is that once the far interaction mode is invoked, the large virtual object 48 may be selected by the user to become a virtual interaction object 58 and thus be reduced in size for the convenience of the user.” Ex. 1005, [0030]. In my opinion, a POSITA would have understood the large and reduced size versions of the virtual object correspond to the same object or function, because the virtual object is merely changing in size and distance to the user as a result of the user moving from far interaction mode to near interaction mode where the system brings the virtual object closer to the user for ease of interaction. A POSITA would understand that merely changing the size of an icon would not necessarily change the meaning of the icon.

210. To the extent that Tang does not disclose this limitation, in my opinion, it would have been obvious in view of Ravasz. In Figure 7F, Ravasz illustrates “an example HIVID display 780 illustrating a UI menu 124 and UI icon array 720 in accordance with aspects of the disclosure. ... The images on the individual icons in icon array 720 can represent a current display of the corresponding application, or an image associated with the application.” Ex. 1007, [0089], FIG. 7F. A POSITA would have readily understood that the icons in UI menu 124 and UI icon array 720 (*first software application icon and second software application icon*) that are *operatively linked to launch the same application*, because their images are the same. As I discussed above, two icons that have the same image would be expected to produce the same outcome, here, launching the same application.

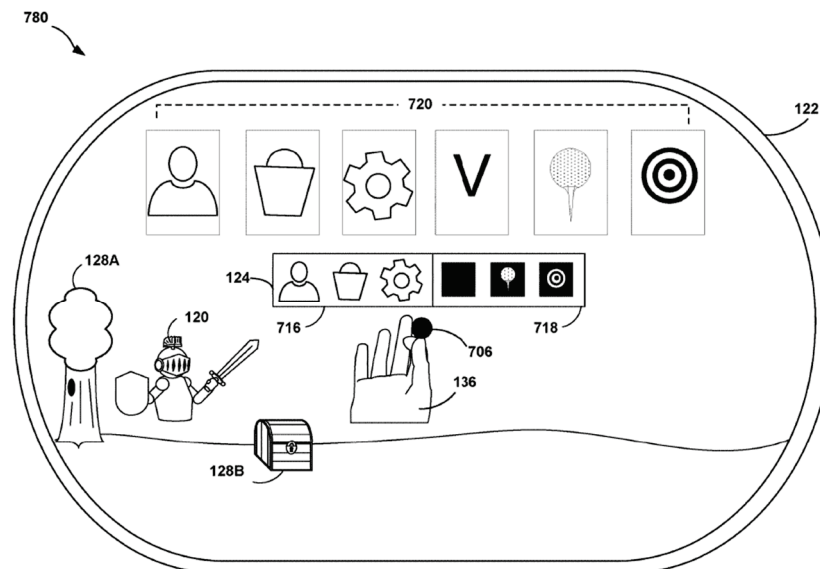


FIG. 7F

Ex. 1007, FIG. 7F.

211. In my opinion, a POSITA would have been motivated to combine Tang's resizing of virtual objects based on a far and near interaction mode with Ravasz's software application icons. A POSITA would have been motivated to make this combination because this would have been more convenient for the user, allowing them to interact with the system in the most user-friendly way for a near and far distance—namely, gestures and user-input devices, respectively. Ex. 1005, [0030]; *see* §§ X.A, X.C.6. Such functionality would also enhance the quality of the virtual reality environment, by allowing the user to interact with more objects in the virtual space around them.

212. In my opinion, a POSITA would have had a reasonable expectation of success in making this combination because both references contemplate displaying the same objects at two different distances from the user. Ex. 1005, [0025] (“The control widget 66 may be a resized copy of the virtual object 48, and all control points 52 may be within the user's field of view 50 and within the predetermined threshold distance 54.”), [0030], FIGs. 3 (shown below), 8; Ex. 1007, FIG. 7F, [0089]. This modification would have been a simple implementation of specific distance values and object size rendering, a mere programming change, which a POSITA would have been well equipped to do given their background and experience.

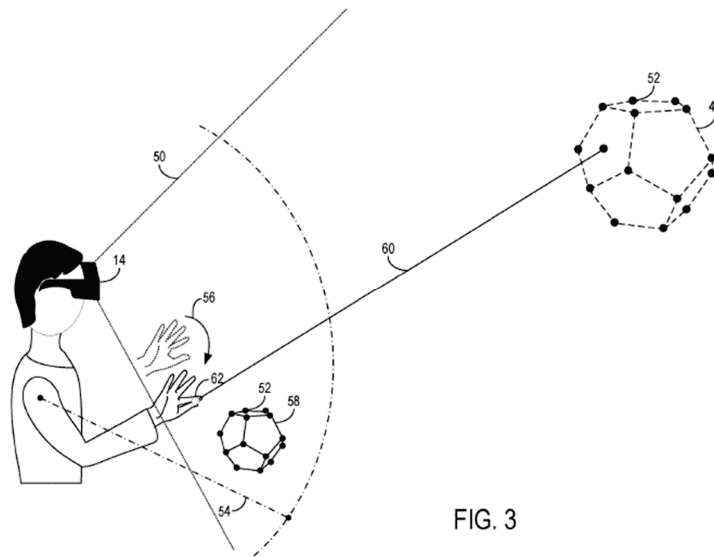


FIG. 3

Ex. 1005, FIG. 3.

213. As shown here, a user is seen viewing the same object at two distances, enabling them to interact with the object up close and at a distance.

214. Thus, in my opinion, Tang alone, or in view of Ravasz, discloses the limitation *wherein the first software application icon and the second software application icon are operatively linked to launch the same respective software application.*

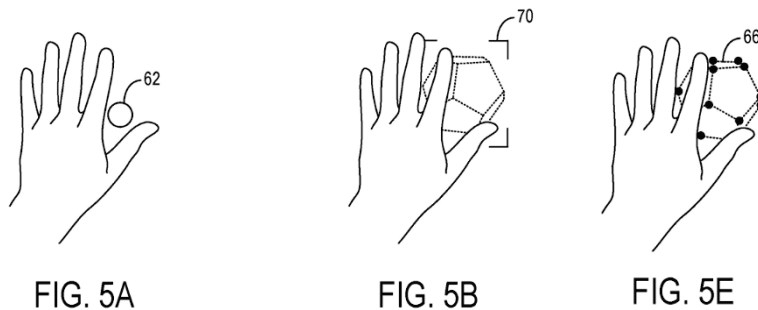
**D. Dependent Claims 2-7:**

1. **Claim 2: “The virtual reality environment selection interface of claim 1, wherein the first software application icon is displayed as a 3-dimensional button that launches the respective software application when pressed by the user’s hand or finger.”**

215. In my opinion, Tang alone, or Tang in view of Ravasz, renders obvious this limitation.

216. As I explained above, the virtual object among the buttons or context menu with application-launching menu functionality (the combination I discussed in § X.C.2) (*first software application icon*) *launches the respective software application when pressed by the user’s hand or finger* (the combination I discussed in §§ X.C.7-8).

217. Tang depicts and describes the manipulation of three-dimensional virtual objects in FIG. 5, including pinchable object 62, handles 70 associated with the virtual object 48, and control widget 66. Ex. 1005, [0028].



Ex. 1005, FIG. 5A, 5B, 5E.

218. In my opinion, because Tang discloses three-dimensional virtual objects, a POSITA would have understood and found it obvious to make the virtual objects among the virtual buttons or context menu three-dimensional. A POSITA would have recognized the virtual buttons and context menu to be additional three-dimensional virtual objects would have made the virtual reality environment more immersive. Because Tang already discloses rendering virtual objects in three dimensions, a POSITA would have understood that rendering the buttons or context menu in three dimensions (which are basic shapes), rather than as flat, two-dimensional planes, was a straightforward and expected design choice.

219. In my opinion, a POSITA would have been motivated to make the buttons three-dimensional because this would have enhanced the user experience by further immersing the user in a virtual world. In my opinion, a flat, two-dimensional control presented within an otherwise three-dimensional environment is visually inconsistent with its surroundings and detracts from the user's sense of immersion. Importantly, a POSITA would have understood that color alone is not a salient as a geometric shape difference. A POSITA would therefore have understood that rendering the buttons in three dimensions, consistent with other three-dimensional virtual objects and the surrounding environment, would have produced a more coherent and immersive experience, and would have resulted in more salient buttons. A POSITA would further have recognized three-dimensional buttons as providing

familiar visual affordances and feedback. Further, in my opinion, it was well known before the priority date to make buttons statically appear three-dimensional and to change their three-dimensional shape when made the focus of an interaction, such as when a user points at or presses them. *See* § VI.C (Interaction/Selection Movements). Thus, a POSITA would have understood these established three-dimensional button behaviors to reinforce the usability and coherence of the interface.

220. In my opinion, a POSITA would have had a reasonable expectation of success since Tang already discloses that virtual objects could be rendered as three-dimensional, and rendering three dimensional squares and rectangles would have been well within the skill of a POSITA as Tang describes. Tang's disclosure that objects 48 are rendered in three dimensions demonstrates that Tang's system already possessed the capability needed to render the buttons and context menu in three dimensions. Because the buttons and context menu comprise simple shapes that are geometrically simpler than the objects 48 Tang already renders, a POSITA would have expected the modification to succeed and to yield the predictable result of three-dimensional buttons and menus.

221. To the extent that Tang does not explicitly disclose this limitation, this would have been obvious in my opinion in view of Ravasz. Ravasz discloses "UI element 126" that may be depicted as "two-dimensional or three-dimensional

shapes, graphical input keys or keyboards” (*a 3-dimensional button*). Ex. 1007, [0026] (“UI element 126 may be a...three-dimensional shape that is manipulatable by a user”).

222. A POSITA would have been motivated to render Tang’s virtual objects as three-dimensional shapes as taught by Ravasz because this would have increased the type and variety of virtual objects that Tang supports, thus enhancing the user experience.

223. Further, a POSITA would have understood that a virtual object can be displayed as a 3-dimensional button. Tang discloses that its interaction objects include a “virtual button 64” (Ex. 1005, [0028]) that is a button and Ravasz provides a UI element that may be rendered in three dimensions. A POSITA would have understood that combining Tang’s virtual button 64 with Ravasz’s teaching that a UI element may be a three-dimensional shape yields a three-dimensional button, here, Tang’s button, rendered as the three-dimensional, hand-manipulable shape Ravasz describes.

224. In my opinion, a POSITA would have combined Tang’s virtual object with Ravasz’s three-dimensional UI elements. A POSITA would have been motivated to make this combination because this would have increased the type and variety of virtual objects that Tang supports, thus enhancing the user experience. Further, a POSITA would have understood that three-dimensional virtual objects

would have increased the amount of visual contrast between the objects and the background. This contrast would have been an alternative to providing contrast in other ways, such as through color which may not always be successful (as in the case of color-blind individuals). By rendering a UI element in three dimensions, it is “manipulatable by a user performing gestures to translate, scale, and/or rotate the shape” (Ex. 1007, [0026]), which aligns with Tang’s near-mode goal of direct hand manipulation of proximal objects (Ex. 1005, [0029]).

225. In my opinion, a POSITA would have had a reasonable expectation of success in making this combination. Tang already discloses virtual objects that are three-dimensional. *See id.*, FIGs. 5-7. Tang discloses that these virtual objects “may be at least one user interface selected from the group consisting of handles associated with the virtual object, at least one virtual button, a scrolling mechanism for virtual content, a bounding box, a control widget including one or more of the control points.” *Id.*, [0060]. Therefore, modifying the virtual interaction object to be depicted as a three-dimensional button would be a simple programming modification within the skills of a POSITA, because Tang already discloses rendering three-dimensional shapes that are more complex. Ex. 1005, [0060], FIGs. 5-7. For a POSITA, their education and/or experience with AR and VR systems would have provided them with the knowledge necessary for such a programming modification that would have been within their skill set. There were well-known virtual reality

toolkits available that would have allowed a POSITA to realize the combination of Tang and Ravasz. For example, at least as of 1999, the Microsoft Mixed Reality Toolkit (MRTK) was a readily-available and well-supported software toolkit that provided a broad and deep range of options for buttons and different corresponding mechanisms. *See* § VI.C (Interaction and Selection Movements).

226. Thus, in my opinion, Tang alone, or in view of Ravasz renders obvious *wherein the first software application icon is displayed as a 3-dimensional button that launches the respective software application when pressed by the user's hand or finger.*

2. **Claim 3/4: “The virtual reality environment selection interface of claim [2/1], further comprising up and down arrows displayed as buttons adjacent a grouping of a plurality of one or both of software application and virtual reality platform system setting icons that includes the first software application icon, wherein the up and down arrows are operatively linked to scrolling the plurality of one or both of software application and virtual reality platform system setting icons in the grouping when directly interacted with by a user's hand or finger.”**

227. In my opinion, Tang alone, or Tang in view of Ravasz renders obvious these limitations.

228. Tang’s virtual objects in a grouping of buttons or context menu that launch applications or modify settings is *a grouping of a plurality of one or both of software application and virtual reality platform system setting icons that includes the first software application icon.* As I explained above, virtual objects in the

group of buttons or context menu including the virtual object with application-launching functionality (the combination I discussed in § X.C.2) is ***software application ... icons that include the first software application***. As explained below, the group of buttons or context menu would have also included a virtual object with configurable-settings functionality (the combination discussed in § X.E.3) (***virtual reality platform system setting icon[]***).

229. Tang further discloses ***up and down arrows displayed as buttons adjacent a grouping ... wherein the up and down arrows are operatively linked to scrolling the plurality of one or both of software application and virtual reality platform system setting icons in the grouping when directly interacted with by a user's hand or finger*** because Tang discloses that virtual content, like the context menu, can be scrolled using adjacent buttons as shown in Figure 6 shown below. Ex. 1005, [0029], FIG. 6.

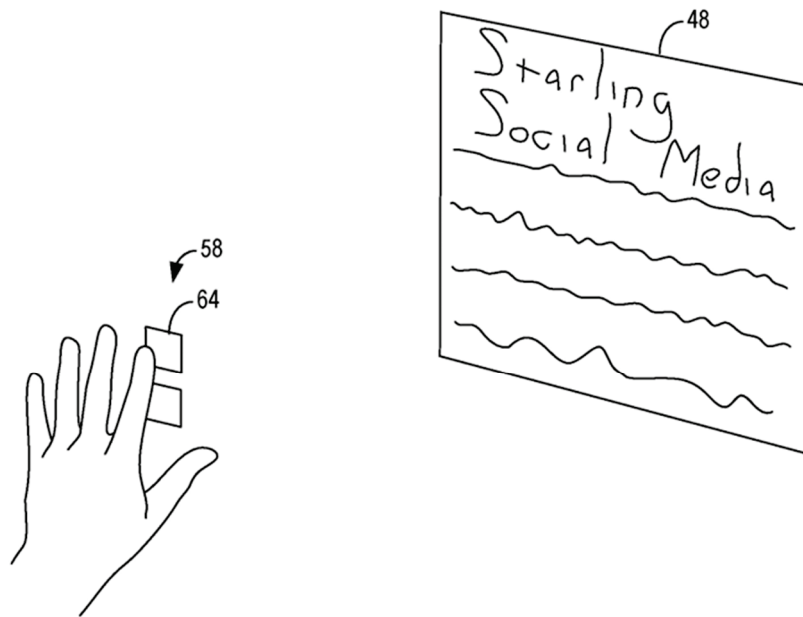


FIG. 6

Ex. 1005, FIG. 6.

230. Tang explains “[i]n the example of FIG. 6, two virtual buttons 64 are shown that may be a scrolling mechanisms for the virtual content.” *Id.*, [0029]. “[G]enerat[ing] display of the scrolling mechanism in proximity to the user’s hand, thus eas[es] the operation of scrolling the virtual content.” *Id.* A POSITA would have understood that the **up and down arrows are displayed as buttons**, specifically as the top and bottom **buttons** respectively as this is common way to display scrolling buttons to scroll up and down the content in user interfaces because it is intuitive and consistent with standard display practices. Indeed, before 2022, this had become the de facto standard for scrolling user interface elements. In the Technology Over

above I reproduce FIG. 5 from the 1997 paper by Mark Mine, Ex. 1029 (“ISAAC: A Meta-CAD System for Virtual Environments”), which shows exactly this, as I indicate in the annotated version of the figure below.



Figure 5 Two-dimensional control panel

Ex. 1029 (“ISAAC: A Meta-CAD System for Virtual Environments”), FIG. 5 (annotation added).

231. To the extent Tang does not disclose *up and down arrows*, this would have been obvious in view of Ravasz. Ravasz discloses “arrows may be used to indicate the direction that the user’s index finger and thumb should be moved” as a menu prompt. Ex. 1007, [0069]. A POSITA would have understood that such arrows provide the user with a concise, intuitive visual indication of the direction of intended interaction—that is, a way for the user to understand how to scroll up and down. In my opinion, a POSITA would have been motivated to render Tang’s

buttons as Ravasz's directional arrows, because doing so supplies the user with a clear, at-a-glance cue of the direction in which to move to navigate the menu, improving usability and reducing the likelihood of erroneous input. The use of up and down arrows for the purposes of scrolling was well-known at the time and standard.

232. A POSITA would have also had a reasonable expectation of success, since the use of arrows to indicate direction was well known in the art and could have been implemented through a simple programming change to render a virtual button as an arrow. Additionally, in my opinion, a POSITA would have had the skills necessary to implement a virtual button as an arrow because such an implementation would have been straightforward and commonly understood.

233. Thus, it is my opinion that Tang alone, or in view of Ravasz renders obvious the limitation *further comprising up and down arrows displayed as buttons adjacent the plurality of software application icons, wherein the up and down arrows are operatively linked to scrolling the plurality of software application icons when directly interacted with by a user's hand or finger.*

3. **Claim 5: "The virtual reality environment selection interface of claim 4, wherein the plurality of one or both of software application and virtual reality platform system setting icons in the grouping are displayed within an apparent distance of a user's arm length to the user."**

234. In my opinion, Tang discloses this limitation.

235. The virtual objects in a grouping of buttons or context menu that launch applications or modify settings (the combination I discussed in § X.D.2) is ***the plurality of one or both of software application and virtual reality platform system setting icons in the grouping.***

236. Tang discloses displaying the virtual objects in the group of buttons or context menu in near interaction mode at approximately arm's length. Ex. 1005, [0031]. Tang discloses a predetermined threshold distance 54 that the virtual objects among the group of buttons or context menu, which includes those that launch applications or modify settings (the combination I discussed above in § X.D.2), are displayed from the user (***icons are displayed within... to the user***). Ex. 1005, [0031]. This predetermined threshold distance “may be locked in location with respect to the user.” *Id.* Tang further discloses that this distance “may be in a range of 460 mm to 580 mm,” and that this distance represents an “average distance from the shoulder of an average user to the grip center of a hand” (***an apparent distance of a user's arm length to the user***). *Id.*

237. Further, in my opinion, a POSITA would have understood that because the HMD requires that the user's hand or arm be within the user's field of view to detect interactions with the virtual objects (buttons or context menu), that those virtual objects would be located ***within an apparent distance of a user's arm length to the user.***

238. Thus, is it my opinion that Tang discloses the limitation *wherein the plurality of one or both of software application and virtual reality platform system setting icons in the grouping are displayed within an apparent distance of a user's arm length to the user.*

4. **Claim 6/7: “The virtual reality environment selection interface of claim [1/2], wherein the first software application icon is displayed within an apparent distance of a user's arm length to the user.”**

239. In my opinion, Tang in view of Ravasz renders obvious these limitations for substantially the same reasons I discussed above in §§ X.C.2 (Ground 1, Limitation 1[a.i]), X.D.3 (Ground 1, Claim 5).

240. Tang's virtual object with Ravasz's application-launch functionality among the buttons or context menu in near interaction mode (*first software application icon*) (the combination I discussed in § X.C.2) is displayed within a predetermined threshold distance representing an “average distance from the shoulder of an average user to the grip center of a hand” (*displayed within an apparent distance of a user's arm length to the user*). Ex. 1005, [0031]; *see also* § X.D.3.

241. Thus, in my opinion, Tang in view of Ravasz renders obvious the limitation *wherein the first software application icon is displayed within an apparent distance of a user's arm length to the user.*

**E. Independent Claim 8:**

**1. 8[pre]: “A virtual reality environment selection interface comprising:”**

242. In my opinion, Tang discloses the preamble for substantially the same reasons as I discussed above in § X.C.1 (Ground 1, Limitation 1[pre]).

243. Tang discloses a *virtual reality environment* that displays virtual objects to a user and allows the user to select those objects (*selection interface*). *Id.*

244. Thus, in my opinion, Tang discloses the preamble *a virtual reality environment selection interface*.

**2. 8[a.i]: “a first software application icon”**

245. In my opinion, Tang in view of Ravasz renders obvious this limitation for substantially the same reasons as I discussed above in § X.C.2 (Ground 1, Limitation 1[a.i]).

246. A virtual object among Tang’s virtual buttons 64 or context menu 68 with Ravasz’s application-launching functionality is *a first software application icon*. *Id.*

247. Thus, in my opinion, Tang in view of Ravasz renders obvious the limitation *a first software application icon*.

**3. 8[a.ii]: “a first virtual reality platform system setting icon”**

248. In my opinion, Tang in view of Ravasz renders this limitation obvious.

249. In the combination, a virtual object among Tang's buttons 64 or context menu 68 with Ravasz's configurable-settings functionality is *a first virtual reality platform system setting icon*.

250. As I discussed in § X.A, Tang discloses the ability to configure the settings of its virtual reality environment system. For example, Tang allows the user to adjust when a virtual object is displayed. Tang explains "the generation and display of virtual interaction object 58 may also happen automatically depending on the settings of the system 10 as more of the control points 52 are outside of the user's field of view 50 and/or the predetermined threshold distance 54." *Id.*, [0030]. Tang also allows the user to adjust the number of control points for a virtual object to be outside the predetermined threshold before the far interaction mode is invoked. Tang explains "[t]he predetermined threshold subset may be one control point, or a minimum percentage of control points, such as 10%, 25%, 50%, etc." *Id.*, [0023].

251. Although Tang does not expressly describe that the user can configure the settings from the grouping of buttons or the context menu, in my opinion, this would have been obvious to a POSITA a well-known feature of a menu as discussed in Ravasz.

252. Ravasz discloses that a user interacts with "a graphical user interface, such as a menu or sub-menu ... to operate the artificial reality system" itself, or selectable and modifiable "individual user interface elements ... such as

[application] icon elements.” Ex.1007, [0026]. Thus, the user has the option to control (operate) the VR system (*virtual reality platform system*) or software applications within the VR environment. *Id.* In my opinion, a POSITA would have understood the distinction Ravasz draws here between operating the artificial reality system and interacting with an application to be the same distinction the claim draws between a system-setting icon and an application icon.

253. Ravasz further discloses “configurable” settings, which are *virtual reality platform system setting[s]*. For instance, “the artificial reality system can be configurable (for example, by the user) to determine a configuration of the left hand or the right hand.” *Id.*, [0067]. Such a configuration represents a modification of a system setting (e.g., left or right-handedness of the system). The user can also configure the HMD itself when gesture detector 424 detects a pre-defined gesture, such that the “user interface engine 428 dynamically generates a user interface ... allowing the user 110 to ... configur[e] HIVID 112” (*id.*, [0063]), which is a further alteration of the VR system settings. The “user interface engine 428 and/or application engine 440” can themselves “modify configurable settings” upon detection of particular pre-defined gestures by the user. *Id.*, [0063]. A POSITA would have understood these configurations to be a setting of the VR platform rather than any application running on it, because each governs how the systems captures input and behaves across the environment as a whole.

254. A POSITA would have understood a “configurable setting” to be a system setting (*virtual reality platform system setting*). For example, configuring the HMD (HIVID112) would encompass altering/operating the VR system settings. Ravasz shows “example HIVID displays illustrating positioning and interacting with UI menus,” in FIG. 7A-7G, including, system settings icons. *Id.*, [0019]. For instance, in FIG. 7B, Ravasz depicts menu item 708 labeled as a “Settings” icon. *Id.*, FIG. 7B, [0076]. In FIG. 7C, menu item 708 is illustrated using a traditional settings icon. *Id.*, FIG. 7C, [0076]; *see also id.*, FIG. 7G.

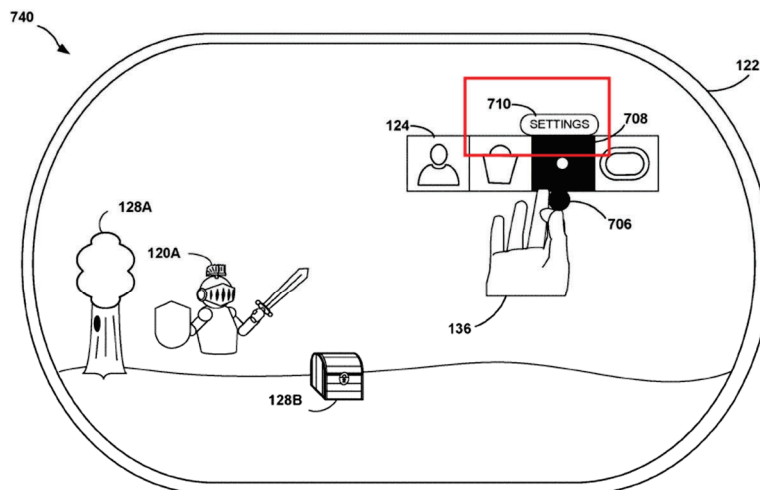


FIG. 7B

Ex. 1007, FIG. 7B (annotated).

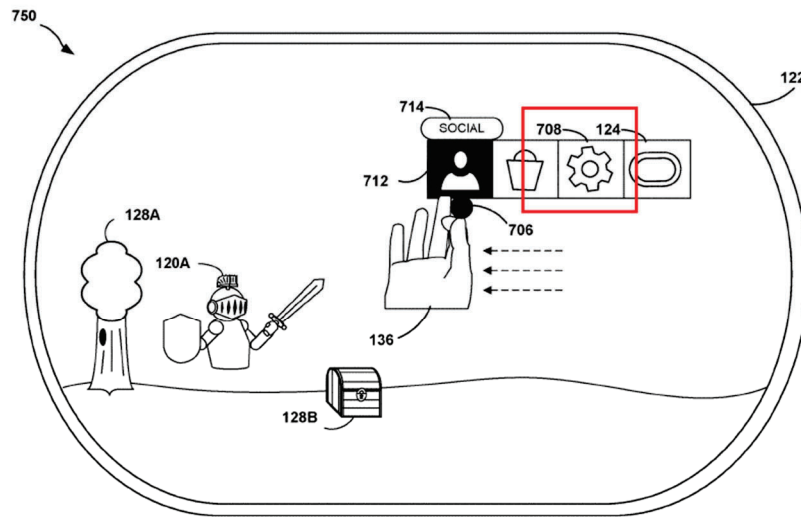


FIG. 7C

Ex. 1007, FIG. 7C (annotated).

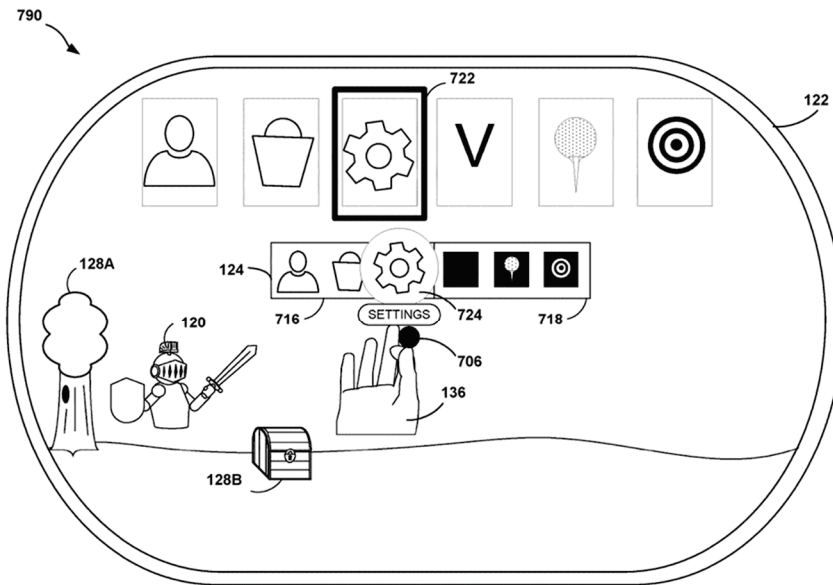


FIG. 7G

Ex. 1007, FIG. 7G.

255. As I discussed above, a POSITA would have been motivated to incorporate Ravasz's configurable-setting functionality into Tang's virtual objects

in the group of buttons or context menu for the reasons I discussed above in § X.A (Ground 1, Motivation to Combine). A POSITA would have been motivated to incorporate this functionality, because it would have provided the details for the functionality of Tang’s group of buttons or context menu that Tang leaves for the implementer. Further, a POSITA would understand that it would benefit the virtual reality environment system to allow the user to interact with *virtual reality platform system settings*, to have more control over the operation of the system. Giving the user in-environment access to system settings is a recognized benefit, letting the user configure the system without leaving the virtual environment or resorting to a separate interface.

256. A POSITA would have had a reasonable expectation of success in incorporating Ravasz’s system setting icons because this would have amounted to a simple programming change, within the abilities of a POSITA. *See* § X.B (Ground 1, Reasonable Expectation of Success). In my opinion, it was well-known to include a settings button as a part of a group of buttons or context menu as an option for the user in a consistent, easy to find location.

257. Thus, in my opinion, Tang in view of Ravasz renders obvious the limitation *a first virtual reality platform system setting icon*.

**4. 8[a.iii]: “displayed together in a virtual reality environment to a user using a virtual reality hardware device”**

258. In my opinion, Tang discloses this limitation.

259. As I explained previously, the application-launching virtual object and configurable-settings virtual object are among the grouping of buttons 64 or context menu 68, and are therefore *displayed together*. See § X.C.2 (Ground 1, Limitation 1[a.i]). A POSITA would have understood that if two objects are in a grouping, and the grouping is being displayed, the two objects (and the rest of the objects in the grouping) are being displayed together. Further, the virtual buttons 64 or context menus 68 are *displayed in a virtual reality environment to a user using* Tang’s HMD 14 (*virtual reality hardware device*) for substantially the same reasons as I discussed in § X.C.3 (Ground 1, Limitation 1[a.ii]). See also Ex. 1005, [0039] (Tang’s system “may take the form of one or more...wearable computing devices such as...head mounted augmented/virtual reality devices.”).

260. Thus, in my opinion, Tang discloses *displayed together in a virtual reality environment to a user using a virtual reality hardware device*.

5. **8[a.iv]: “wherein the first software application icon and the first virtual reality platform system setting icon appear closer to a body part of the user that is tracked by a camera of the virtual reality hardware device to interact with the first software application icon and the first virtual reality platform system setting icon”**

261. In my opinion, Tang discloses this limitation for substantially the same reasons as I discussed above § X.C.4 (Ground 1, Limitation 1[a.iii]) and § X.C.5 (Ground 1, Limitation 1[a.iv]).

262. The application-launching virtual object (the combination I discussed in § X.E.2) (***first software application icon***) and configurable-settings virtual object (the combination I discussed in § X.E.3) (***first virtual reality platform system setting icon***) are among the grouping of buttons 64 or context menu 68 in near interaction mode that are displayed within a predetermined threshold distance (***appear closer***) from the user. See § X.C.4 (Ground 1, Limitation 1[a.iii]). This predetermined threshold distance is an established range such that the objects are displayed near to the user's hand (***to a body part of the user***). See *id.*

263. In the Tang-Ravasz combination, the user's hand (***a body part of the user***) is tracked by outward facing cameras 32 (***a camera***) in HMD 14 (***of the virtual reality hardware device***) to recognize gestures (***to interact***). See § X.C.5 (Ground 1, Limitation 1[a.iv]). These gestures are associated with the application-launching virtual object (***first software application icon***) and configurable-settings virtual object (***first virtual reality platform system setting icon***) that are among the grouping of virtual buttons 64 or context menus 68. See *id.* A POSITA would have understood that if the gestures were associated with the objects, the user's hand (which is tracked by the cameras 32) would be making gestures for the purpose of interacting with the objects.

264. Thus, in my opinion, Tang discloses the limitation ***wherein the first software application icon and the first virtual reality platform system setting icon***

*appear closer to a body part of the user that is tracked by a camera of the virtual reality hardware device to interact with the first software application icon and the first virtual reality platform system setting icon than a second software application icon and second virtual reality platform system setting icon.*

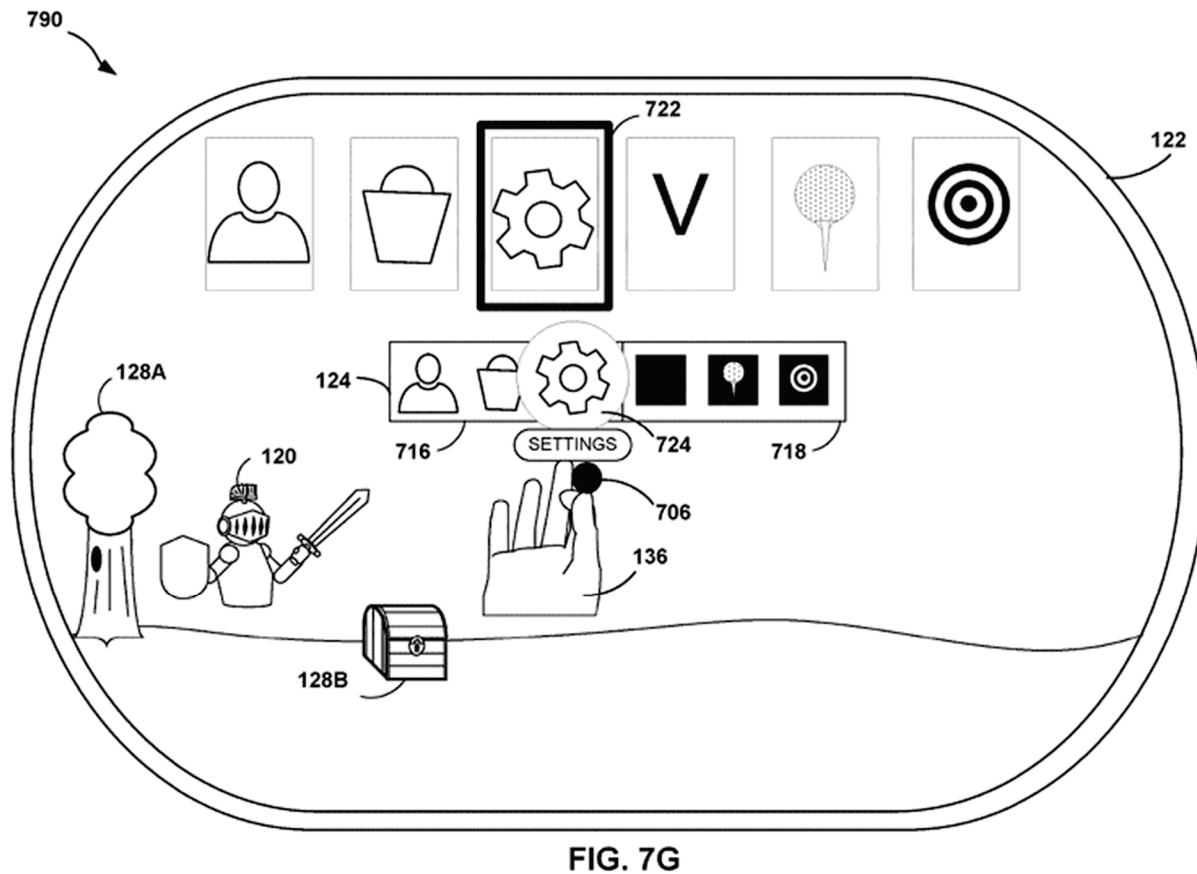
6. **8[a.v]: “than a second software application icon and a second virtual reality platform system setting icon that is displayed to the user when the user is using a physical controller in the virtual reality environment”**

265. In my opinion, Tang in view of Ravasz renders obvious this limitation.

266. As I explained above, the virtual objects in the group of buttons or context menu in near interaction mode with application-launching and configurable-settings functionality (the combination I discussed in §§ X.E.2-3) are displayed within a predetermined threshold distance (*appear closer*) *than* an application-launching virtual object in a far context menu in far interaction mode (*a second software application icon*) *that is displayed to the user when the user* is using a user-input device (*physical controller*) *in the virtual reality environment*. See §§ X.C.6 (Ground 1, Limitation 1[a.v]), X.E.5 (Ground 1, Limitation 8[a.iv]).

267. In the combination, the virtual objects in a far context menu in far interaction mode would have also included a virtual object with configurable-settings functionality (*a second virtual reality platform system setting icon*). Ex. 1005, [0063] (“[I]n the far interaction mode the available interactions with the virtual object **48** may be limited, and in some situations may only include

selection, movement, resizing, and display of a far context menu due to the distance at which the virtual object is displayed.”); Ex. 1007, [0026] (“[I]n response to gesture detector 424 detecting one of the pre-defined gestures, user interface engine 428 and/or application engine 440 may ... modify configurable settings”), FIG. 7G.



Ex. 1007, FIG. 7G.

268. In my opinion, a POSITA implementing Tang’s far context menu would naturally look to other similar VR systems like Ravasz that provide more detail on what actions (such launching application and modifying settings) could be

performed through a menu. *See* §§ X.E.2-3. A POSITA would have also been motivated to incorporate Ravasz’s configurable-settings functionality in Tang’s virtual object in the far context menu. This would have lowered the friction of switching to the context menu in near interaction mode and improved workflow by allowing the user to adjust the settings in fewer steps.

269. A POSITA also would have been motivated to combine, and would have had a reasonable expectation of success, for the same reasons discussed above with respect to the corresponding near-interaction virtual objects: Tang and Ravasz are both directed to virtual reality user interfaces presenting selectable menu elements, and applying Ravasz’s application-launching and settings functionality to the virtual objects in Tang’s far context menu is the use of a known technique on a known menu to yield the predictable result of a controller-operable menu element that launches an application or modifies a setting.

270. Thus, in my opinion, Tang in view of Ravasz renders obvious the limitation *than a second software application icon and a second virtual reality platform system setting icon that is displayed to the user when the user is using a physical controller in the virtual reality environment.*

**7. 8[b.i]: “the first virtual reality platform system setting icon being operatively linked to activate a setting”**

271. In my opinion, Tang in view of Ravasz renders obvious this limitation.

272. As explained above, the virtual object with configurable-settings functionality in the group of virtual buttons or context menu in near interaction mode is *the first virtual reality platform system setting icon*. See § X.E.3 (Ground 1, Limitation 8[a.ii]).

273. Ravasz discloses that the “user interface engine 428 and/or application engine 440” have an ability to “modify configurable settings, [and] start or stop processes or perform other actions.” Ex. 1007, [0063]. Therefore, Ravasz’s system has “settings” and “processes” (*setting*) that can be started or stopped. Ex. 1007, [0063]. A POSITA would have understood that a setting or a process is “started,” is one that is activated when engaged. Ravasz discloses that “in response to gesture detector 424 detecting one of the pre-defined gestures” on, for instance, a user interface element (*virtual reality platform system setting icon*), “user interface engine 428 and/or application engine 440 may ... modify configurable settings” (of which there is one *first virtual reality platform system setting icon*). Ex. 1007, [0063]; § X.E.3; *see also* Ex. 1007, [0047] (“In response to identifying a pre-defined gesture, control unit 210 takes some action, such as ... *modify[ing] configurable settings*.”). A POSITA would also have understood modifying a configurable setting encompasses “activating” it.

274. In my opinion, interacting with a system setting icon to *activate* it would have been obvious to a POSITA. Because Ravasz discloses users interacting

with software application icons to “launch” the associated applications (*see* §§ X.C.7-8), it would have been obvious to a POSITA that a user would interact with a *virtual platform system setting icon* (*see* § X.E.3) to similarly *activate* the system setting.

275. Thus, in my opinion, Tang in view of Ravasz renders obvious *the first virtual reality platform system setting icon being operatively linked to activate a setting*.

**8. 8[b.ii]: “when interacted with by a pushing, pulling, tapping, pressing or sliding action of the body part of the user directly on the first virtual reality platform system setting icon; and”**

276. In my opinion, Tang discloses this limitation for substantially the same reasons as I discussed above in § X.C.8 (Ground 1, Limitation 1[b.ii]).

277. In the combination, an action is performed when the user taps or presses using the user’s hand (*when interacted with by a pushing, pulling, tapping, pressing or sliding action of the body part of the user*) *directly on the* virtual object with configurable-settings functionality (the combination I discussed in § X.E.7) (*first virtual reality platform system setting icon*). *See* § X.C.8.

278. As I discussed in § X.E.8 (Ground 1, Limitation 8[b.i]), Ravasz teaches that “[d]etection of the selection gesture may cause the artificial reality system to perform some action” (Ex. 1007, [0076]) and “in response to gesture detector 424 detecting one of the pre-defined gestures ... modify configurable settings.” *Id.*,

[0063]. It would have been obvious to a POSITA that this pre-defined gesture could be tap or press of the virtual object representing the configurable settings to activate a setting, particularly since taps and presses were already being used in the combination to interact with other icons including launching applications. *See* §§ X.C.8 (Ground 1, Limitation 1[b.ii]), X.E.7 (Ground 1, Limitation 8[b.i]).

279. Thus, in my opinion, Tang discloses the limitation *when interacted with by a pushing, pulling, tapping, pressing or sliding action of the body part of the user directly on the first virtual reality platform system setting icon.*

9. 8[c]: “the first software application icon being operatively linked to launch a software application when interacted with by a pushing, pulling, tapping, pressing or sliding action of the body part of the user directly on the first software application icon.”

280. In my opinion, Tang in view of Ravasz renders obvious this limitation for substantially the same reasons as I discussed in §§ X.C.7-8 (Ground 1, Limitations 1[b.i]-1[b.ii]) and X.E.2 (Ground 1, Limitations 8[a.i]).

281. In my opinion, Tang’s virtual object among the buttons or context menu with Ravasz’s application-launching functionality (the combination I discussed in § X.E.2) (*first software application icon*) will launch an application when the user taps or presses the user’s hand directly on the virtual object (*operatively linked to launch a software application when interacted with a ... tapping [or] pressing ...*

*action of the body part of the user directly on the first software application icon).*

See § X.C.7-8.

282. Thus, in my opinion, Tang in view of Ravasz renders obvious the limitation *first software application icon being operatively linked to launch a software application when interacted with by a pushing, pulling, tapping, pressing or sliding action of the body part of the user directly on the first software application icon.*

**F. Dependent Claims 9-11:**

1. **Claim 9: “The virtual reality environment selection interface of claim 8, wherein the first virtual reality platform system setting icon is displayed as a 3-dimensional button that activates the setting when pressed by the user's hand or finger and the first software application icon is displayed as a 3-dimensional button that launches the software application when pressed by the user's hand or finger.”**

283. In my opinion, Tang in view of Ravasz renders obvious this limitation.

284. As I explained above, a virtual object in the group of buttons or context menu modifies system settings when pressed by the user's hand (the combination I discussed in §§ X.E.8-9) (*first virtual reality platform system setting icon ... activates a virtual reality platform system setting when pressed by the user's hand or finger*) and a virtual object in the group of buttons or context menu launches an application when pressed by the user's hand (the combination I discussed in § X.E.10) (*first software application icon ... launches a software application when*

*pressed by the user's hand or finger*). The application-launching virtual object (*first software application icon*) is displayed as a 3-dimensional button (the combination I discussed in § X.D.1).

285. In the combination, the configurable-settings virtual objection (*first virtual reality platform system setting icon*) would have been *displayed as a 3-dimensional button*. Tang discloses the manipulation of three-dimension virtual objects. Ex. 1005, [0028], FIG. 5. Ravasz also discloses “UI element 126 may be a...three-dimensional shape that is manipulatable by a user.” Ex. 1007, [0026]. A POSITA also would have been motivated to combine, and would have had a reasonable expectation of success, for the same reasons discussed above with respect to application-launching virtual objects. *See* § X.D.1.

286. In my opinion, a POSITA would have understood Tang's virtual button 64, rendered as the three-dimensional, hand-manipulable shape Ravasz describes, to be a three-dimensional button, and would have understood that pressing that button with the hand or finger modifies, thus activates, the setting it represents. A POSITA would understand that all icons displayed in the application selection interface would be the same, such that the button could be rendered in two-dimensional and three-dimensional form. A POSITA would understand that it would have been beneficial to have all icons displayed in the same grouping of buttons or context menu, such

that all icons would be rendered in three-dimensional form because it would be more aesthetically pleasing and therefore enhance the user experience.

287. Thus, in my opinion, Tang in view of Ravasz renders obvious the limitation *wherein the first virtual reality platform system setting icon is displayed as a 3-dimensional button that activates the setting when pressed by the user's hand or finger and the first software application icon is displayed as a 3-dimensional button that launches the software application when pressed by the user's hand or finger.*

2. **Claim 10/11: “The virtual reality environment selection interface of claim [9/8], wherein the first grouping of the plurality of icons are displayed within an apparent distance of a user's arm length to the user.”**

288. In my opinion, Tang in view of Ravasz renders obvious these limitations for substantially the same reasons as I discussed above in § X.D.3 (Ground 1, Claim 5).

289. As I explained above, the virtual objects in the grouping of buttons or context menu in near interaction mode (*first grouping of the plurality of icons*) are *displayed* within a predetermined threshold distance which “may be in a range of 460 mm to 580 mm,” representing an “average distance from the shoulder of an average user to the grip center of a hand” (*an apparent distance of a user's arm length to the user*). Ex. 1005, [0031]; see § X.D.3.

290. Thus, in my opinion, Tang in view of Ravasz renders obvious *wherein the first grouping of the plurality of icons are displayed within an apparent distance of a user's arm length to the user.*

## **XI. OPINIONS ON GROUND 2: RAVASZ WITH TANG RENDERS OBVIOUS CLAIMS 1-11**

### **A. A POSITA Would Have Been Motivated to Combine**

291. A POSITA would have been motivated to combine Ravasz's artificial reality system for interacting with numerous virtual user interface (UI) icons in a virtual reality environment with Tang's system that switches between a near and far mode to facilitate user interaction with virtual user interface elements ("distance interaction mode system") to facilitate user interaction with the UI icons when using the Ravasz's hand-held controllers.

292. Also, as I previously explained in the Technology Overview above, using different interaction techniques depending on whether a virtual object is proximal (within the user's reach) or distal (beyond the user's reach) was a well-established design paradigm in the art dating to at least the 1990s. *See* §§ VI.A (Technology Underlying Virtual Reality), VI.D (Interaction with Objects Near and Far). A POSITA would therefore have approached the combination of Tang's proximal/distal rendering with Ravasz's gesture- and controller-driven interaction as an application of familiar and complementary techniques already understood in the art.

293. As I discussed above in §§ X.A-B, a POSITA would have been motivated to combine because Ravasz and Tang are both directed to improving the user experience with virtual elements displayed in a virtual reality environment. *See* Ex. 1007, [0004] (a system with “graphical user interface elements and techniques for presenting and controlling the user interface elements within an artificial reality environment”); Ex. 1005, [0016] (a computing system to “facilitate user interaction” with objects “in an AR or V[R] environment”).

294. Tang recognizes a “challenge” for VR systems concerning the ability of users to interact with and/or manipulate virtual objects located further from the user in the VR environment. *See* Ex. 1005, [0016]. Tang solves this problem by designing a distance interaction mode system, whereby a user can interact with virtual objects in near and/or far interaction modes by triggering a change from one mode to the other upon certain user inputs. *See id.*, [0003] (system processor “configured to invoke a far interaction mode for the virtual object, and in the far interaction mode, receive a trigger input from the user” that “invoke[s] a near interaction mode and display[s] a virtual interaction object within the predetermined threshold distance from the user”); *id.*, [0016] (system that “facilitate[s] user interaction with a distant object in an AR or V[R] environment by displaying a virtual affordance” “in a location that is proximal to the user”).

295. In my opinion, a POSITA would have been motivated to implement Tang's distance interaction mode system in Ravasz's user interaction mode system to manage virtual elements displayed both near to and further from the user. Specifically, Tang's distance interaction mode system provides a mechanism that ensures virtual elements can be displayed further from the user when they are using Ravasz's hand-held controllers, and closer to the user when they are not, allowing the user to more easily interact with the virtual elements in either case. A POSITA would have understood that when a user is employing the physical controllers, it would have been preferable to display icons further from the user in the far interaction mode, because doing so would require less physical movement from the user to produce a given amount of virtual movement. A POSITA would have understood this to follow from the geometry of controller-based, angularly-directed interaction because the controller directs interaction according to the angle at which it is pointed relative to the user, a given change in that pointing angle sweeps across a proportionally greater span of the virtual environment as the interaction distance increases. As a result, when icons are displayed further from the user, only a small change in the controller's orientation is needed to traverse the same virtual distance, and the user's physical movement is only a fraction of the resulting relative movement of the virtual hand or cursor. A POSITA would have understood that reducing the magnitude of physical movement required of a user holding a physical

controller would, in turn, reduce the physical fatigue and strain associated with sustained controller use, thereby improving user comfort while interacting with virtual elements.

296. A POSITA would have understood the converse to hold when the user is not employing the physical controllers. Here, it would have been preferable to display icons closer to the user in the near interaction mode, so that the user could interact with the virtual icons directly and intuitively using their hands. A POSITA would have understood that the user's hand movement maps substantially one-to-one to the movement of the virtual hand where for a given distance the user's hand moves, the virtual hand moves a corresponding distance, such that displaying the icons within the user's physical reach allows the user to interact with them readily and without the strain of reaching toward objects positioned beyond arm's length.

297. A POSITA would also have understood that displaying icons further from the user when the user is using a physical controller would have resulted in less user movement to create the same virtual movement. In the near interaction mode, for every inch a user's hand (the control input) moves, the virtual hand moves the same relative inch. It would benefit the user to move into far interaction mode (moving the icons further away from the user) when using a physical controller, because it would decrease the amount of user movement needed to make virtual hand move the same distance. This is because the angle that the controller would be

pointed at, relative to the user, would stay the same as the icons move further away; at a further distance, the user movement would only be a fraction of the relative movement of the virtual hand. By reducing the movement the user has to take, while holding a physical controller, far interaction mode would reduce the strain on the user.

**B. A POSITA Would Have Had a Reasonable Expectation of Success**

298. In my opinion, a POSITA would have had a reasonable expectation of success in implementing Tang's distance interaction mode system with the user interface elements of Ravasz's virtual reality system because the modification would have been a simple change of programming to the HMD processor. Tang and Ravasz both disclose virtual reality systems that employ HMDs with processors that detect images of user movement using cameras and display virtual user interface elements to a user for interaction and so, are analogous art that describe structurally and functionally similar systems. See §§ X.A-B. The processor of Ravasz's HMD communicates with and receives input from the controllers. Ex. 1007, [0040] ("HIVID 112B may receive user inputs from controllers 114 held by user" "using near-field communication of short-range wireless communication" (e.g., Bluetooth)).

299. Ravasz already contemplates displaying virtual content further from a user. For example, using the "known orientation and position of [the] display"

relative to the HMD, the processor tracks the HMD position and “render[s] artificial reality content according to a current viewing perspective” of the HMD and the user. Ex. 1007, [0044]. Ravasz discloses that such a tracking system could be used, for example, to display virtual images “representative of the physical environment” (e.g., mixed reality), which would have been displayed further from than user interface elements. Ex. 1007, [0045]. As such, programming Ravasz’s processor to display virtual icon elements both close to and further from a user (in near and far interaction modes) would have been a straight-forward application, and the means to do so well-known to the POSITA at the time of invention for the purposes of user experience. *See* Ex. 1030, 9 (“When a control panel becomes active it attaches to the user’s left hand. To interact with the panel, he uses a laser beam emanating from his right hand.”); Ex. 1029, 551 (“ISAAC includes more complex functions in its two-dimensional control panels. Two-dimensional control panels are the virtual equivalent of conventional workstation pull down menus and dialog boxes.”); Ex. 1034 (depicting examples of icons in both a near and far interaction mode). Accordingly, a POSITA would have had a reasonable expectation of success in implementing a Ravasz-Tang virtual reality system.

### **C. Independent Claim 1**

1. **1[pre]: “A virtual reality environment selection interface comprising:”**

300. I have been asked to assume a scenario where the preamble is limiting.

As to that scenario, it is my opinion that Ravasz discloses it.

301. Ravasz's menus of selectable UI elements that launch applications (*selection interface*) in an artificial reality environment. *See* § XI.C.2-8.

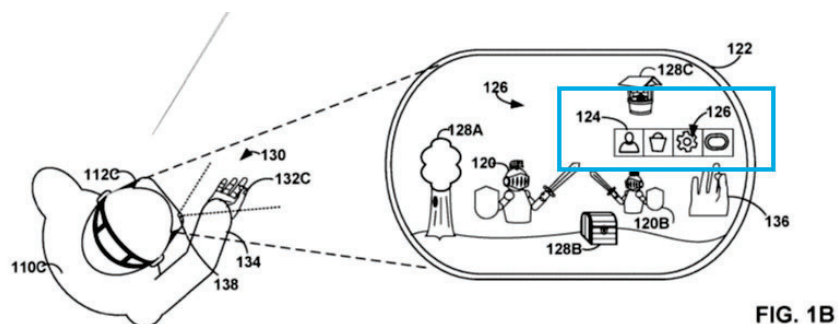
302. In my opinion, a POSITA would have recognized that Ravasz's virtual/artificial reality system (*see* Ex. 1007, [0001]) is a *virtual reality selection interface*, where "user interface elements" such as a "graphical user interface" are displayed as "a menu or sub-menu with which user 110 interacts to operate the artificial reality system, or individual user interface elements selectable and manipulatable by user 110, such as icon elements, toggle elements, drop-down elements, menu selection elements, two-dimensional or three-dimensional shapes, graphical input keys or keyboards, content display windows and the like" (*virtual reality interface*). *Id.*, [0026]. Further, as I detailed above, such application selection interfaces were well-known at the time of the '742 patent's priority date, such that a POSITA would have readily understood Ravasz's system to be an application selection interface. *See* §§ VI.C-D.

303. A POSITA would have understood Ravasz's "graphical user interface" to be a *virtual reality selection interface* because Ravasz discloses that "UI menu 124 and UI element 126 . . . presents one or more graphical user interface elements 124, 126 in response to detecting one or more particular gestures

by user 110, such as particular motions, configurations, positions, and/or orientations of the user's hands, fingers, thumbs or arms.” *Id.*, [0026]. Such “gestures” would enable *selection* within the “graphical user interface” (*selection ... interface*).

304. A POSITA would have understood these gestures to effect selection of the displayed user interface elements, including the menu elements Ravasz describes as “correspond[ing] to applications” (*id.*, [0089]), such that a user’s gesture operates to select among application-associated elements. Thus, a POSITA would have understood that Ravasz’s gesture-driven user interface presents and enables a selection of application-corresponding elements to be an interface for selecting applications (*application selection interface*).

305. As shown below in FIG. 1B, Ravasz’s graphical user interface (*application selection interface*) enables a user to make *selection[s]* by making gestures that interact with UI menu 124 and UI element 126.



Ex. 1007, FIG. 1B (excerpted and annotated); *see also id.*, [0032].

306. Ravasz explains that based on a “pre-defined gesture” of a user, “control unit 210” of the system “takes some action, such as ***selecting*** an option from an option set associated with a user interface element, translating the gesture into input (e.g., characters), launching an application or otherwise displaying content, and the like.” *Id.*, [0046].

307. Ravasz also describes user interface (UI) icon arrays from which a user is able to select various icons (*see, e.g.*, FIG. 7F below), including an array of “icons representing applications available or running in the artificial reality system. The images on the individual icons in icon array 720 can represent a current display of the corresponding application, or an image associated with the application” (***virtual reality environment selection interface***). *Id.*, [0089]. One example of such an application icon array is depicted below in FIG. 7F, along with ***selection*** of one of the applications icons (social icon) in FIG. 7E.

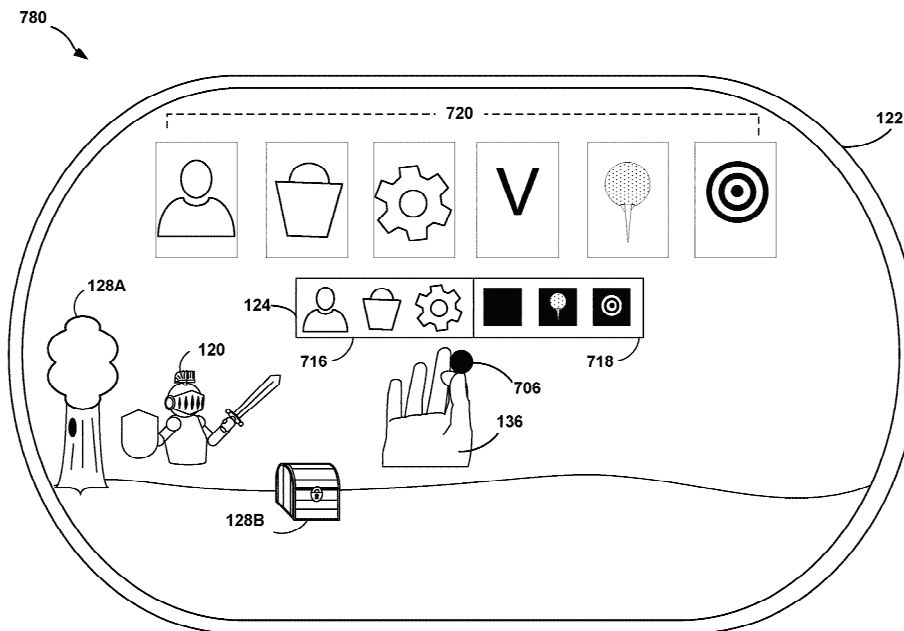


FIG. 7F

Ex. 1007, FIG. 7F.

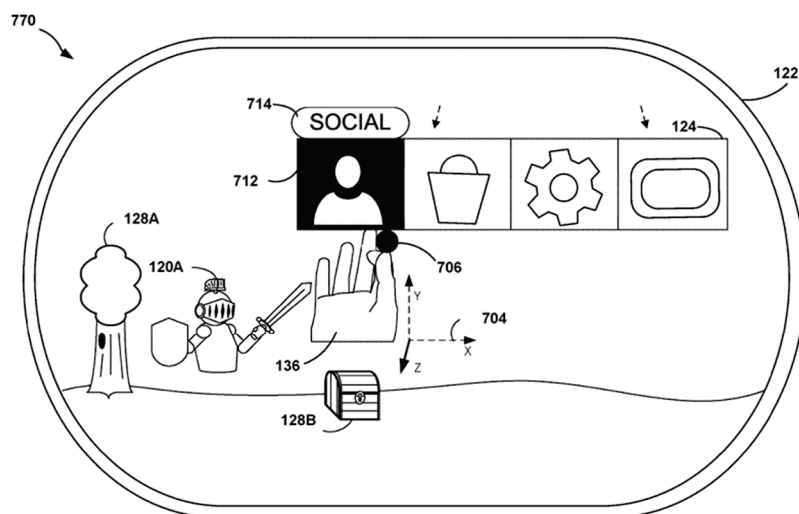


FIG. 7E

Ex. 1007, FIG. 7E.

308. Thus, it is my opinion that Ravasz discloses *a virtual reality environment selection interface*.

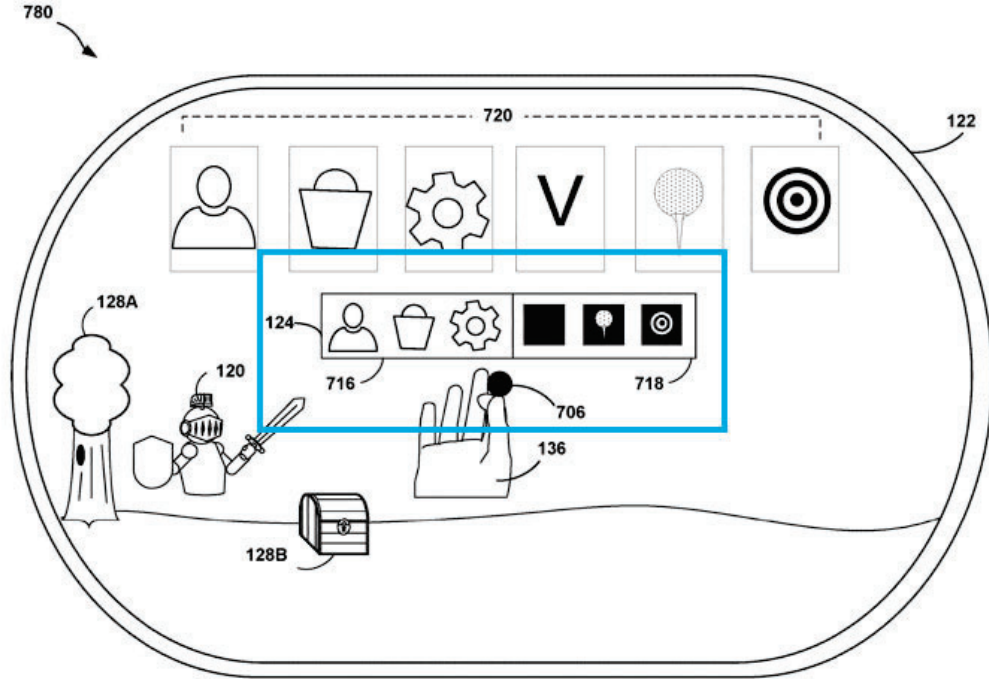
2. 1[a.i]: “a first software application icon”

309. In my opinion, Ravasz discloses this limitation.

310. Specifically, in my opinion, Ravasz discloses *a first software application icon* because Ravasz discloses a UI menu 124 comprising “UI elements 126 that are arrayed along a dimension of UI menu 124.” Ex. 1007, [0073]. A POSITA would have understood that these UI elements 126 are “arrayed along a dimension” of UI menu 124 such they are displayed as a set of multiple elements. *See id.*, FIGs. 7A-7F.

311. The UI menu elements “correspond to applications”, which include, for example, “favorite applications” or “applications currently running within the artificial reality system.” *Id.*, [0089].

312. Thus, it is my opinion that the UI menus element is a *first software application icon*. *See* Ex. 1007, [0073], [0089]-[0090]. This is also consistent with FIGs. 7A-7F, where each shows a grouping of at least three application icons, which is a *plurality* of different UI elements, in various UI menus, since Ravasz discloses that “the menu items of a UI menu **124** can correspond to applications”. *Id.*, [0089]. Below is FIG. 7F for example:



Ex. 1007, FIG. 7F (annotated).

313. In my opinion, a POSITA would have understood these arrayed elements in UI menu 124 to be application icons because Ravasz describes them as “icons representing applications available or running in the artificial reality system” and displays them as application icon arrays. *Id.*, [0089]; *see also* FIGs. 7A-7F.

314. Accordingly, it is my opinion that Ravasz discloses *a first software application icon*.

3. **1[a.ii]: “displayed in a virtual reality environment to a user using a virtual reality hardware device”**

315. In my opinion, Ravasz discloses this limitation.

316. Ravasz discloses that the UI element launching an application is *displayed in* an artificial reality environment (*a virtual reality environment*) *to a user* wearing a head mounted device, also referenced as HIVID (*using a virtual reality hardware device*).

317. A POSITA would have understood that Ravasz relates to a user's interaction with user interface elements in a virtual reality environment and, specifically, “graphical user interface elements and techniques for presenting and controlling the user interface elements within an *artificial reality environment*.” Ex. 1007, [0004]. Ravasz explains that “artificial reality is a form of reality that has been adjusted in some manner before presentation to a user, which may include, e.g., a *virtual reality* (VR), an augmented reality (AR), a mixed reality (MR), a hybrid reality, or some combination and/or derivatives thereof.” *Id.*, [0002].

318. Further, Ravasz explains that that the artificial reality system includes a head mounted display device HMD/HIVID (*virtual reality hardware device*) “configured to output artificial reality content” (*displayed in a virtual reality environment*). *Id.*, [0008]-[0009]. A POSITA would have further known that Ravasz's HMD/HIVID can “operate[] as a stand-alone, mobile artificial reality system” or “concurrently operate[] within artificial reality system.” *Id.*, [0023], [0040], [0043]. The HMD/HIVID “includes an electronic display and optical assembly for presenting artificial reality content 122 to user 110.” Ravasz, [0023];

[0044] (“HIVID 112 includes an interior-facing electronic display 203 configured to present artificial reality content to the user”); *see also* FIGs. 3 and 4 (“electronic display 203”).

319. A POSITA would have understood that Ravasz further teaches that the HMD/HIVID displays UI menu elements (e.g., software application icons) to the user. *Id.*, [0008]; *see also* FIGs. 7A-7F (depiction of HMD displaying UI menus). A POSITA would have understood that HMD/HIVID displays to display the application icons within the virtual reality environment because Ravasz describes the HMD/HIVID’s electronic display 203 as “configured to present artificial reality content to the user” (*id.*, [0044]) and describes the UI menu and its application-corresponding elements as part of that presented artificial reality content 122. *Id.*, [0026], [0089]. As such, a POSITA would have understood that the application icons of the UI menu are among the artificial reality content displayed to the user via the HMD/HIVID in the virtual reality environment.

320. Thus, it is my opinion that Ravasz discloses the limitation ***displayed in a virtual reality environment to a user using a virtual reality hardware device.***

4. **1[a.iii]: “wherein the first software application icon appears closer to a body part of the user”**

321. In my opinion, Ravasz in view of Tang renders obvious this limitation.

322. A POSITA would have understood Ravasz to describe the user making a pre-defined gesture to trigger the display of a UI application menu element (***first software application icon***). Ex. 1007, [0072], [0073].

323. The artificial reality system renders a “virtual hand” “representing the orientation of the user’s hand” or displays an image of the user’s hand in the virtual environment. *Id.*, [0068], [0030]. Specifically, the system “renders the portions of hand 132 of user 110 that are within field of view 130 as a virtual hand 136 within artificial reality content 122” such that “user 110 is able to view the portions of their hand 132 and/or arm 134 that are within field of view 130 as objects within artificial reality content 122.” *Id.*, [0028]; *see also* [0068], [0072], [0073] (“The artificial reality system can determine the position and orientation of the hand and can render a virtual hand 136 to represent the orientation of the user's hand and finger positioning.”). Additionally, the system can also simply display “a real-world image of hand 132 and/or arm 134 of user 110 within artificial reality content 122” instead of rendering a virtual copy of the hand. *Id.*, [0028].

324. The UI menu is then rendered “in proximity to the virtual hand”, thus ***appear[ing] closer to a body part of the user***, that has been positioned at the location of the user’s actual hand. *Id.*, [0072], [0073]; [0088] (“the artificial reality system can render the virtual hand ... in proximity to the UI menu 124 based on the current position of the user hand”); *see also* FIG. 7E.

325. For instance, the system “can detect the back-to-front motion” where the user has “moved their hand closer to themselves along the Z axis” and can translate the position of the UI menu such that the UI menu “appear[s] to be larger, and thus closer to the user” (*appear[ing] closer to a body part of the user*). Ex. 1007, [0087]; FIG. 7E.

326. To the extent that Ravasz does not explicitly disclose this limitation, it is my opinion that would have been obvious in view of Tang.

327. Tang discloses a virtual reality computing system that allows users to interact with virtual objects (similar to Ravasz’s UI elements) displayed both near to (near interaction mode) and at a distance from (far interaction mode) the user. Ex. 1005, [0016] (“facilitate[s] user interaction with a distant object in AR or V[R] by displaying ... an interface ... in a location that is proximal to the user”); *id.*, [0025] (user makes “predefined gesture” in far interaction mode, to “invoke[s] a near interaction mode and display[s] virtual interaction object 58 within the predetermined threshold distance 54 from the user”); *see also* § X.C.4.

328. In near interaction mode, virtual objects like “virtual buttons” or a “context menu” are displayed *close to a body part of a user*. *See* § X.C.4; Ex. 1005, [0021] (interactions within a “predetermined threshold distance” measured “with respect to various *parts of the user*” like “the *shoulder of the user*” or “from another *point on the body of the user*”); *id.*, [0028]-[0029] (context menu can be “displayed

as an affordance *near the user's hand*" i.e., "*in proximity to the user's hand*"). For virtual objects outside of a "predetermined threshold distance" from the user, Tang discloses that the user can "perform a predetermined gesture" (e.g., touch or pinch) to interact with a virtual object 48 in a "far interaction mode." *Id.*, [0021]-[0022]. This "predetermined threshold distance" is measured "with respect to various parts of the user," for instance, "with respect to the shoulder of the user" or "from another point on the body of the user" (*body part of the user*). *Id.*, [0021]. A user's interactions with virtual objects in the "far interaction mode" include "selection, movement, resizing, and display of a far context menu." *Id.*, [0022].

329. Upon the user making a "trigger input" (e.g., "predefined gesture") in far interaction mode, the system "invoke[s] a near interaction mode and display[s] virtual interaction object 58 within the predetermined threshold distance 54 from the user." *Id.*, [0025]. Thus, in near interaction mode, virtual interaction objects are displayed within a predetermined threshold distance measured from a body part of the user and, thus, is displayed *closer to a body part of the user*. Virtual interaction objects that are displayed closer to the user in near interaction mode can include "virtual button[s]" or a "context menu." *Id.*, [0028]; *see also* FIGs. 5C (virtual buttons) and FIG. 6 (virtual context menu). For example, a context menu can be "displayed as an affordance near the user's hand" for "improved readability ... and greater ability to make fine movements/selections with respect to a virtual

interaction object 58 (context menu 68) that is in proximity to the user's hand.” *Id.*, [0029].

330. A POSITA would have implemented Tang’s distance interaction mode system to display Ravasz’s UI menu elements (*software application icon[s]*) closer to (“within a predetermined distance of”) the user (e.g., the user’s hand) (*closer to a body part of a user*). Using Tang’s near distance interaction mode system would have enabled the user to better interact with the UI elements disclosed by Ravasz because of the challenges in interacting with the elements when they are distant from the user (e.g., decreased accuracy and increased arm fatigue). Thus, a POSITA would have been motivated to employ Tang’s distance interaction mode system to bring Ravasz’s UI menu closer to the user, such that the user could more easily select the software application icons from the UI menu, enhancing the user’s experience.

331. A POSITA would have had a reasonable expectation of success in implementing Tang’s distance interaction mode system with the UI elements in Ravasz’s virtual reality system because the modification would have been a simple change of programming. The modifications to Ravasz’s system would be a simple change to the programming of the HMD processor to include a “predetermined threshold distance” value in order to position the display of the UI menu within that threshold distance and thus, closer to the user. Given this, a POSITA would have had a reasonable expectation of success in implementing a Ravasz-Tang system.

332. A POSITA would have understood that because the virtual hand 136 is rendered at the position and orientation of the user's actual hand (*id.*, [0028], [0068]), or where the user's hand is displayed as a real-world image at its actual location (*id.*, [0030]) and the UI menu is rendered in proximity to that hand representation based upon the current position of the user's hand to be *closer to a body part*. *Id.*, [0072]-[0073], [0088]. As such, a POSITA would have understood that rendering the menu in proximity to the hand representation places the menu in proximity to the location of the user's actual hand, which is a *body part* of the user, such that *the first software application icon appears closer to a body part*.

333. Accordingly, Ravasz in view of Tang renders obvious the limitation *wherein the first software application icon appears closer to a body part of the user*.

5. 1[a.iv]: “[a body part of the user] that is tracked by a camera of the virtual reality hardware device to interact with the first software application icon”

334. In my opinion, Ravasz discloses this limitation.

335. In my opinion, the user's hand's *is tracked by image* capture devices 138 (*a camera*) of the HMD (*virtual reality hardware device* to select the UI menu element that launches applications (*interact with the first software application icon*)).

336. A POSITA would have understood that Ravasz's HMD/HIVID 112 includes "one or more image capture devices 138, e.g., cameras ... for capturing image data of the surrounding [] environment." Ex. 1007, [0023], [0045]; FIG. 1A. The gesture detector uses the images obtained by the image capture devices of the HMD to "identify the hand and/or arm of user 110, and track movements of the hand and/or arm relative to HIVID 112 to identify gestures performed by user 110." *Id.*, [0055].

337. Specifically, based on "captured image data," a POSITA would have understood that the gesture detector tracks movements like "changes to position and orientation, of the hand, digits, and/or arm" and "compare[s] motion vectors of the objects" to gestures catalogued in a "gesture library," allowing the HMD "to detect a gesture or combination of gestures performed" by the user. *Id.*, [0055], [0061].

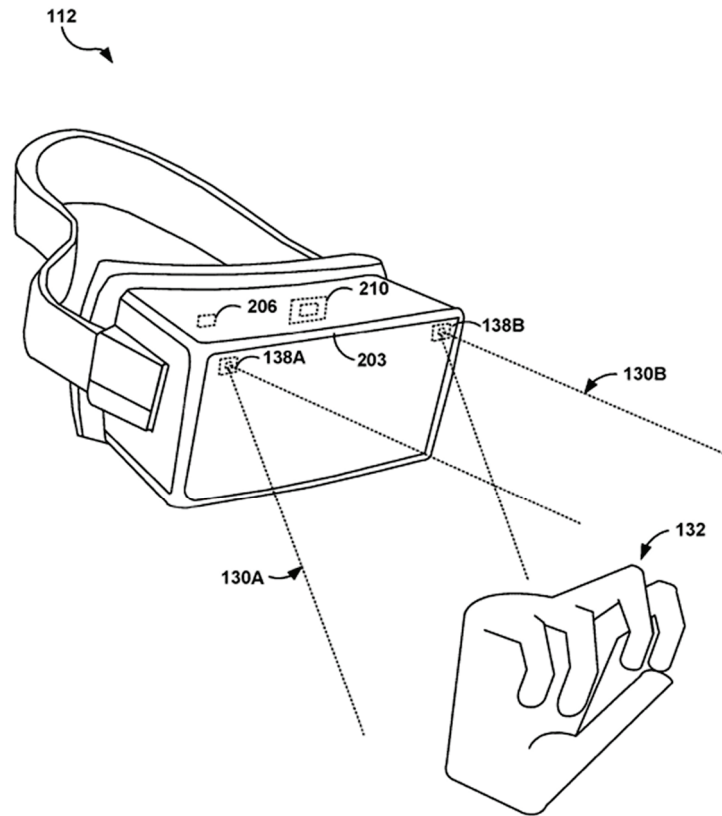


FIG. 2

Ex. 1007, FIG. 2.

338. Ravasz further explains that the gesture library includes a number of movements, including menu activation gestures and “selection gesture[s].” *Id.*, [0064]. To identify a “selection gesture,” the gesture detector “utilize[s] image data from image capture devices 138” (cameras) “to analyze configurations, positions, and/or orientations of a user’s hand.” *Id.* A selection gesture can be, for instance, “movement of a finger of the hand” or “movement of the hand in a direction that is

substantially normal to the plane of the UI menu” (*Id.*) in order to “select the menu element” (interact with the *first software application icon*). *Id.*, [0077].

339. As shown below, FIG. 7B depicts the selection of a UI menu item “upon the user performing a selection gesture 708,” such as “movement of a finger of the hand” “in a direction that is substantially normal to the plane of the UI menu.” *Id.*, [0076]. A POSITA would have understood FIG. 7B to show a virtual hand 136 angled in a direction that is substantially normal to the plane of the UI menu 124 so as to selected the highlighted menu item 708.

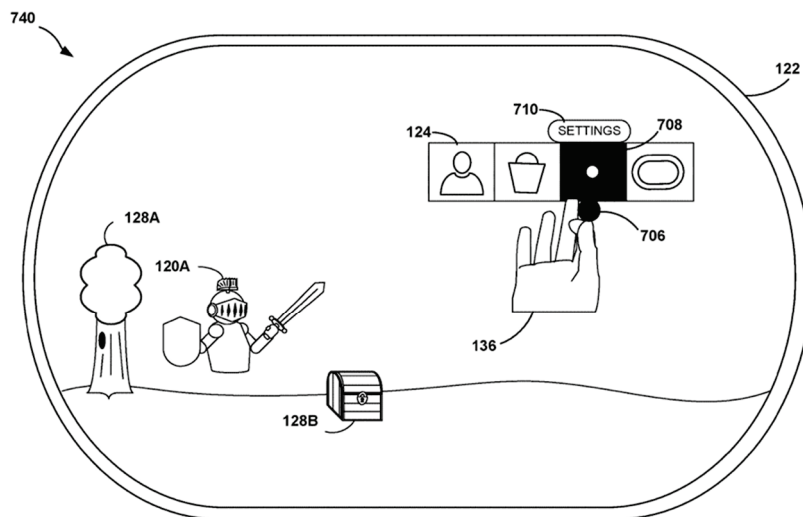


FIG. 7B

Ex. 1007, FIG. 7B.

340. Thus, it is my opinion that Ravasz discloses the limitation *[a body part of the user] that is tracked by a camera of the virtual reality hardware device to interact with the first software application icon.*

6. **1[a.v]: “[first software application icon appears closer] than another second software application icon that is displayed to the user when the user is using a physical controller in the virtual reality environment”**

341. In my opinion, Ravasz in view of Tang renders obvious this limitation.

342. Ravasz discloses an HIVID displaying both “a UI menu 124” comprised of UI icon elements (*first software application icon*) and a “UI icon array 720” comprised of UI icon elements (*second software application icon*). Ex. 1007, FIG. 7F. The icons in UI icon array 720 also correspond to software applications, that is, “a current display of the corresponding application, or an image associated with the application.” *Id.*, [0089]; *see also* FIGs. 7F, 7G. The individual UI menu 124 elements and UI icon array 720 elements are depicted below in FIGs. 7F and 7G.

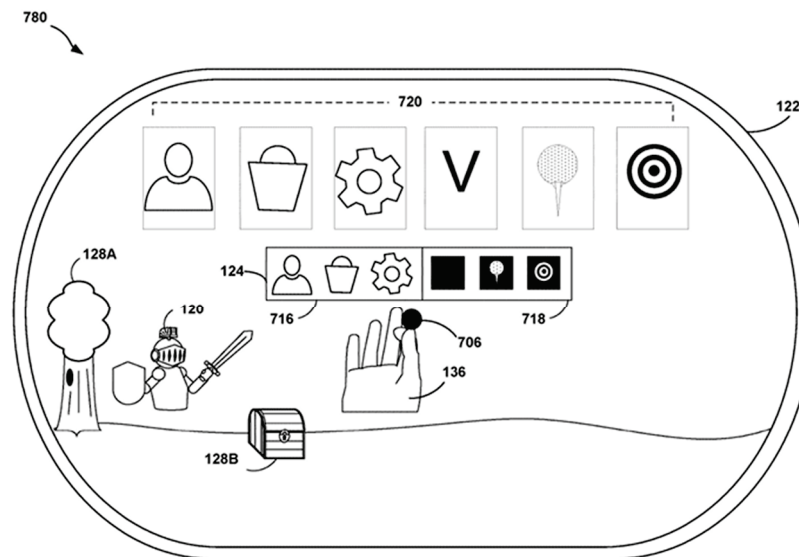


FIG. 7F

Ex. 1007, FIG. 7F.

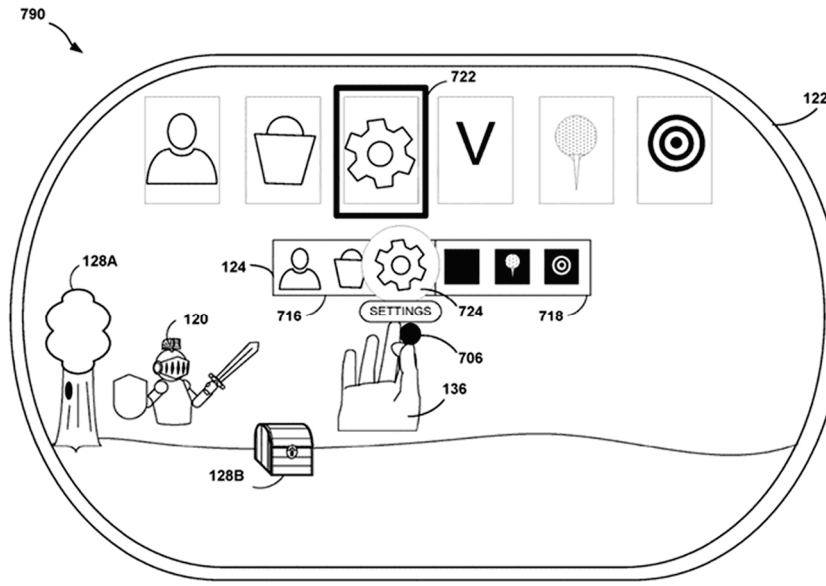


FIG. 7G

Ex. 1007, FIG. 7G.

343. The UI menu items 124 “are in proximity” to “virtual hand 136,” which is in the position of the user’s hand (*see* XI.C.3), such that the image of the UI menu icon “appear[s] larger” and thus, closer, to the user than those in the UI icon array. Ex. 1007, [0090]; *see* FIG. 7G (menu icon 724 enlarged to appear closer to the hand). As such, the UI menu element (***first software application icon***) appear closer to the user’s hand than UI icon array elements a (***second software application icon that is displayed to the user***).

344. As such, the UI menu elements (***first software application icon***) appear closer the user’s hand than UI icon array elements (***second software application icon that is displayed to the user***). A POSITA would have understood the icon array 720 to appear farther from the user than the UI menu 124 as Ravasz describes the hand-



Ex. 1007, FIG. 1B.

346. In my opinion, a POSITA would have understood that a user would have, for example, used “menu prompt” gestures to render a UI menu (*first software application icon*) and hand-held controllers to render a UI icon array (*second software application icon*) in the virtual reality environment. A POSITA would have understood that a user would have different physical means of interacting with virtual icons depending upon whether they are using their hands or a physical controller, such that depicting such icons differently based upon input mode would align with the different means of interacting.

347. To the extent that Ravasz does not explicitly disclose that the first software application icon *appears closer to a body part of the user...than another second software application icon*, in my opinion, it would be obvious in view of Tang.

348. Tang discloses a distance interaction mode system that a POSITA would have implemented with Ravasz’s UI menu to display a UI menu element (*first software application icon*) closer to the user’s hand (*closer to a body part of a user*) than the UI icon array to display another UI element (*another second software application icon*). See § X.C.4, X.C.6. Recognizing that virtual objects “beyond the reach of the user...may be difficult or tiresome for the user to control,” Tang taught a system that could recognize whether a virtual object is within or outside a

predetermined threshold distance from a user to trigger a near or far interaction mode. Ex. 1005, [0023].

349. As Tang explains, “a user interacting with a distant object may experience muscle fatigue if the interaction involves raised and/or extended hands and/or arms. Some types of interactions, such as...accessing a context menu, may even be impossible in situations where virtual content is displayed at a distance beyond the reach of the user.” *Id.*, [0016]. Using near and far interactions modes, “may facilitate ease of interaction between a user and a virtual object ... to make fine controls of the virtual object 48 and reduced muscle fatigue of the user.” *Id.*, [0037]. Further, using gestures when a context menu is in proximity to the user’s hand, “may provide greater intuitive and continuous interaction between the user and the virtual object.” *Id.*

350. A POSITA improving Ravasz’s AR system would have been motivated to implement Tang’s distance interaction mode system so that the user uses gestures to interact with the UI menu in near interaction mode. This would have improved user experience and as Tang recognized, gestures are difficult to use when the virtual object (or UI element in Ravasz’s system) is beyond the reach of the user. Accordingly, in near interaction mode, the user can use gestures when the virtual objects (such as the UI elements in the UI menu) is within a predetermined threshold distance of the user’s hand. In contrast, when Ravasz’s physical controllers are used

to interact with UI elements located further than a predetermined threshold distance (e.g., UI icon array, far context menu) the user may not be fatigued because the interaction does not “involve[] raised and/or extended hands and/or arms.” Ex. 1005, [0016]. Thus, in far interaction mode, the user can physical controllers to interact with UI elements located further than a predetermined threshold distance.

351. Implementing Tang’s distance interaction mode in Ravasz’s artificial reality system in such a way would have realized the benefits disclosed in Tang. Such implementation would have provided “greater ability to make fine movements/selections with respect to a virtual interaction object 58 (context menu 68) that is in proximity to the user’s hand.” Ex. 1005, [0029]. This would have also allowed the system to “respond to user interaction in an intuitive and user-friendly manner [to] provide an improved experience for the user.” *Id.*, [0002]; *see also* §§ XI.A-B.

352. Thus, it is my opinion that Ravasz in view of Tang renders obvious this limitation *[first software application icon appears closer] than another second software application icon that is displayed to the user when the user is using a physical controller in the virtual reality environment.*

**7. 1[b.i]: “the first software application icon operatively linked to launch a respective software application”**

353. In my opinion, Ravasz discloses this limitation.

354. As I explained above, Ravasz teaches *a first software icon* with which a user interacts. *See* § XI.C.2 (1[a.i]). In my opinion, Ravasz further explains that these menu icons “correspond to applications” (Ex. 1007, [0089]), meaning that they are *operatively linked*.

355. Ravasz teaches the mechanism by which a user navigates to and selects a particular icon. Ravasz discloses a “menu sliding gesture” — a motion of the hand — that causes the system to “translate the slidably engageable UI element to a second position relative to the menu interface.” *Id.*, [0007], [0010]. That gesture causes “a virtual hand [to] move[] in accordance with the user's hand to slide along a dimension of the UI menu 124.” *Id.*, [0033]. The menu item that is then in proximity to the slidably engageable element is highlighted “to indicate that the menu item... will be selected upon the user performing a selection gesture.” *Id.*, [0076]-[0077]; *see* FIGs. 7B, 7E.

356. Ravasz further explains that the selection gesture is operatively linked to launching the corresponding application. “[I]n response to gesture detector 424 detecting one of the pre-defined gestures, user interface engine 428 and/or application engine 440 may... launch applications.” *Id.*, [0063]; *see also id.*, [0046] (“[i]n response to identifying a pre-defined gesture, control unit 210 takes some action, such as... launching an application”); *id.*, [0056] (“certain gestures may be associated with other actions, such as... launching applications.”)

357. In my opinion, a POSITA would have understood these disclosures together to establish an operative link between a given application icon and the launching of its respective application. Because Ravasz assigns each menu icon to a specific application (*id.*, [0089]), and because a selection gesture directed at the highlighted icon causes the user interface engine and/or application engine to launch an application (*id.*, [0046], [0056], [0063]), a POSITA would have understood that selecting a particular icon launches the particular application is ***operatively linked to launch a respective software application.***

358. Thus, it is my opinion that Ravasz discloses ***the first software application icon operatively linked to launch a respective software application.***

8. **1[b.ii]: “when interacted with by a pushing, pulling, tapping, pressing or sliding action of the body part of the user directly on the first software application icon,”**

359. In my opinion, Ravasz alone or in view of Tang renders obvious this limitation.

360. First, in my opinion, Ravasz discloses that the user “perform[s] a selection gesture,” to select “a particular menu item of the UI menu” using movement of a finger or a hand. Ex. 1007, [0034], [0076] (where the UI menu item “selected upon the user performing a selection gesture,” “caus[ing] the artificial reality system to perform some action” like “an application to be instantiated”); *see also id.*, [0077].

361. A POSITA would have known that movement of the hand can be “in a direction that is substantially normal to the plane of the UI menu (e.g., between 0 and 30 degrees normal to the plane)”. *Id.*, [0076]; *see also* cl. 8. A POSITA would have understood movement of a finger and/or movement of the hand in a direction substantially normal to the plane of the UI menu to select (interact with) an application icon to be a ***push, press, pull, or tap*** on the icon rendered in the virtual reality environment. A POSITA would have understood that because a motion is directed substantially normal, i.e., perpendicular to, the plane in which the UI menu and its icons are rendered advances the finger or hand toward and against that rendered plane. This is the same physical motion by which a user ***pushes, presses, or taps*** a button or element lying in a plane. Thus, a POSITA would have understood a finger or hand movement toward and against the rendered plane of application icon, to select that icon, to be a ***push, press, or tap*** action directed at the icon itself in the virtual reality environment.

362. For instance, FIGs. 7A-7E depict a finger of the user’s hand ‘touching’ an application icon (***pushing, pulling, tapping, pressing action of the body part of the user directly on the application icon***) to select and/or launch that application. I have reproduced FIG. 7E below for reference:

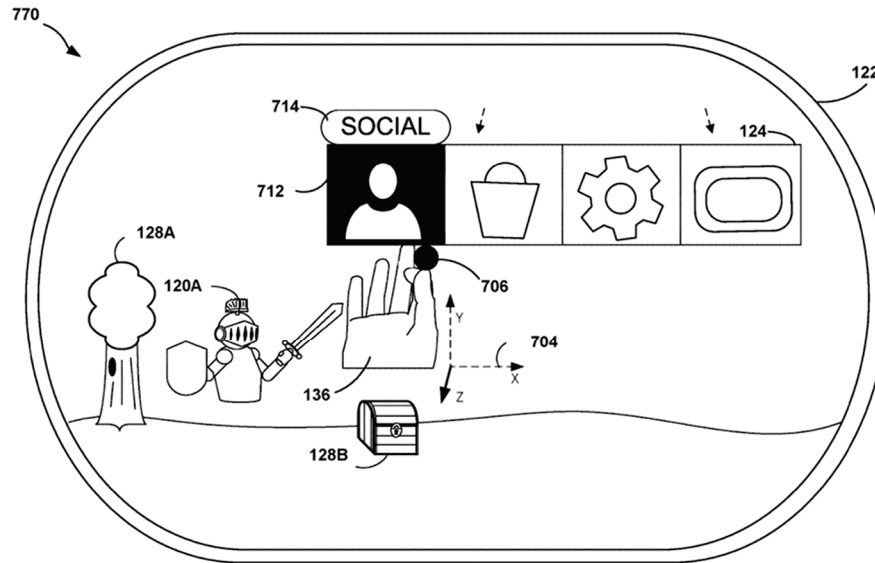


FIG. 7E

Ex. 1007, FIG. 7E.

363. To the extent that Ravasz does not explicitly disclose this limitation, it is my opinion that it would have been obvious in view of Tang.

364. Like Ravasz's gesture detector 424, Tang discloses a "gesture recognition module 24 [that] may be configured to identify poses and gestures expressed by the user by processing image data of the user collected by outward facing cameras 32 when these cameras capture images of the user's body or portions thereof, such as the user's hands." Ex. 1005, [0018]. The "predetermined gesture may be a gesture...such as a tap gesture." *Id.*, [0026]. "The plurality of gestures may further include a pressing motion by finger." *Id.*, [0028]. A POSITA would

have understood Tang's gesture recognition module to be comparable with Ravasz's gesture detector given the input and functional overlap.

365. A POSITA would have been motivated to implement Tang's tap or press gestures as one of Ravasz's selection gestures with a reasonable expectation of success because taps and presses directly on an element were well-known gestures for selection and execution of an action associated with that element. *See* §§ XI.A-B.

366. Thus, it is my opinion that Ravasz alone, or Ravasz in view of Tang, renders obvious *by a pushing, pulling, tapping, pressing or sliding action of the body part of the user directly on the application icon.*

9. 1[b.iii]: “wherein the first software application icon and the second software application icon are operatively linked to launch the same respective software application.”

367. In my opinion, Ravasz discloses this limitation.

368. The UI elements of Ravasz's UI menu and UI icon array are *the first software application icon and the second software application icon*, respectively, *operatively linked to launch the same respective software application.* *See* § X.C.9.

369. Ravasz teaches that “in response to gesture detector 424 detecting one of the pre-defined gestures,” such as a “selection gesture” on a UI element in a UI menu, “user interface engine 428 and/or application engine 440 may...*launch applications.*” Ex. 1007, [0063]; *see also* [0047] (“In response to identifying a pre-

defined gesture, control unit 210 takes some action, such as...***launching an application***”); [0056] (“[C]ertain gestures may be associated with other actions, such as...***launching applications.***”). Ravasz further discloses that menu items can “correspond to applications” and that detecting a selection gesture may “cause an application to be instantiated, or can cause a currently running application to be brought into the foreground.” Ex. 1007, [0089], [0076]. A POSITA would have understood from these disclosures that selecting an application icon in Ravasz's interface is operatively linked to the launching of the corresponding application, whether by instantiating the application, or by bringing an already-running application into the foreground.

370. Ravasz illustrates in Figure 7F (shown below), “an example HIVID display 780 illustrating a UI menu 124 and UI icon array 720 in accordance with aspects of the disclosure....The images on the individual icons in icon array 720 can represent a current display of the corresponding application, or an image associated with the application.” Ex. 1007, [0089], FIG. 7F. A POSITA would have understood that the icons in UI menu 124 and UI icon array 720 are two software application icons (***a first and second software application icon***) that are ***operatively linked to launch the same application***, because their icon images are the same.

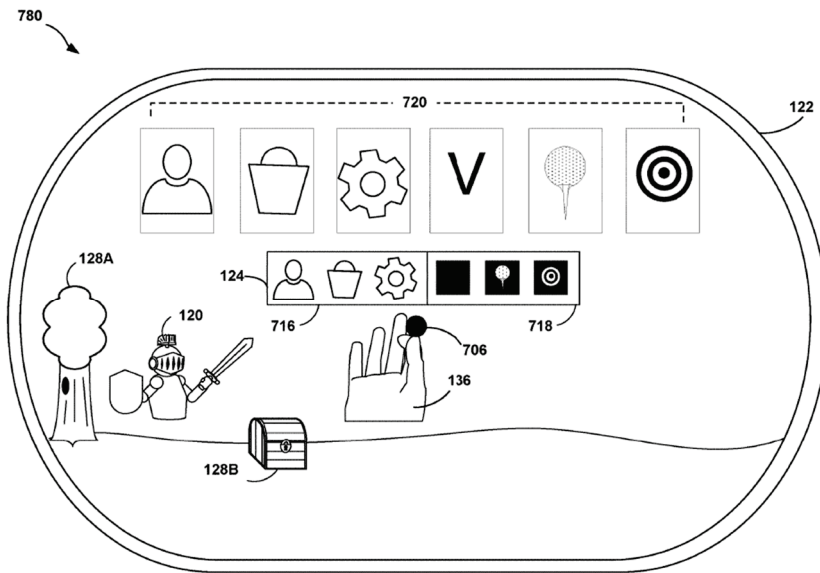


FIG. 7F

Ex. 1007, FIG. 7F.

In my opinion, a POSITA would have understood that because Ravasz teaches that the image on an icon “represent[s]...the corresponding application” or is “an image associated with the application” (*id.*, [0089]), the icon image is tied to the application it represents. As such, the two icons would bear the same image. A POSITA would have understood that both icons are operatively linked to the same application, such that a selection gesture on either one would launch the same respective application.

371. Thus, in my opinion, Ravasz discloses the limitation *wherein the first software application icon and the second software application icon are operatively linked to launch the same respective software application.*

**D. Dependent Claims 2-7:**

1. **Claim 2: “The virtual reality environment selection interface of claim 1, wherein the first software application icon is displayed as a 3-dimensional button that launches the respective software application when pressed by the user's hand or finger.”**

372. In my opinion, Ravasz in view of Tang renders obvious this limitation.

373. In my opinion, the combination of the UI element in the UI menu (*the software application icon*) *that launches* an application when the selection gesture is a press (*a respective software application when pressed*) *by the user's hand or finger*. See §§ XI.C.7-8.

374. Ravasz discloses that the graphical user interface, like a menu “with which the user interacts to operate the ... individual graphical user interface elements selectable and manipulatable by a user” includes elements such as “icon elements” and “three-dimensional shapes.” Ex. 1007, [0026]. Ravasz explains that “[t]he graphical user interface elements may, for example, be a graphical user interface, such as a menu or sub-menu with which the user interacts to operate the artificial reality system, or individual graphical user interface elements selectable and manipulatable by a user, such as...three-dimensional shapes.” *Id.*, [0006]. A POSITA would have understood from this disclosure that Ravasz’s application icons can be displayed as three-dimensional elements within the artificial reality environment. Ravasz further describes a UI menu element, which is *software application icon* with “three-dimensional” highlighting such that the image is

“brought forward, thereby making the image appear larger to the user” (*3-dimensional button*). *Id.*, [0090].

375. A POSITA would have understood Ravasz’s FIG. 7G, which I have reproduced below, to depict *at least one software application icon that is displayed as a 3-dimensional button*. *Id.*, [0090] (“In this example, a three-dimensional highlighting is used, where the menu item in proximity to the slidably engageable UI element 706 can be brought forward, thereby making the image appear larger to the user.”).

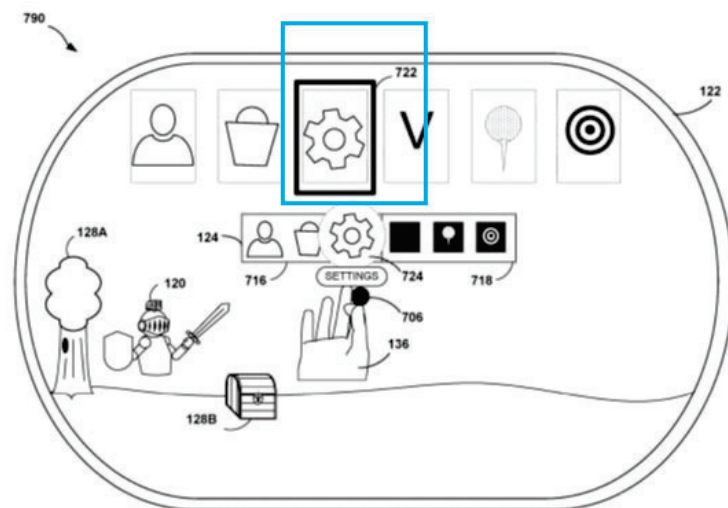


FIG. 7G

Ex. 1007, FIG. 7G (annotated).

376. A POSITA would have understood FIG. 7G to show the traditional settings icon in 722 to have been brought forward, thereby made to appear larger, to the user in relation to the below traditional settings icon 724. Indeed, a POSITA

would have been aware of the relevant examples I provided in the Technology Overview above, including Mark Mine’s rendering of 3D buttons in control panels, and the MRTK support of 3D buttons and offsets, e.g., to use when a user makes the button the focus of an interaction such as taught by Ravasz. *See* § VI.C (Interaction and Selection Movements).

377. As I described above in 1[b.ii] (*see* § XI.C.8), the user interacts with the software application icon to select and launch the application when ***pressed by the user’s hand or finger***. A POSITA would have understood a software application icon interacted with through press is a virtual “button.” Virtual “buttons” well-known in the art as demonstrated by Tang. Ex. 1005, [0028] (describing “virtual interaction objects” as “virtual buttons”. A POSITA would have understood that pressing such a virtual button via hand or finger in the manner Ravasz discloses would launch the respective software application, consistent with how the selection gesture causes an application to be launched. Ex. 1007, [0046], [0063].

378. As such, it is my opinion Ravasz in view of Tang renders obvious ***wherein the first software application icon is displayed as a 3-dimensional button that launches the respective software application when pressed by the user’s hand or finger***.

2. **Claim 3/4: “The virtual reality environment selection interface of claim [2/1], further comprising up and down arrows displayed as buttons adjacent a grouping**

**of a plurality of one or both of software application and virtual reality platform system setting icons that includes the first software application icon, wherein the up and down arrows are operatively linked to scrolling the plurality of one or both of software application and virtual reality platform system setting icons in the grouping when directly interacted with by a user's hand or finger.”**

379. In my opinion, Ravasz in view of Tang renders obvious this limitation.

380. In my opinion, a POSITA would have implemented Tang’s scrolling functionality to navigate Ravasz’s UI menu. Ex. 1005, [0029], FIG. 6; Ravasz further teaches rendering on Tang’s buttons 64 for scrolling “arrows [that]...indicate the direction the user’s index figure...should be moved.” Ex. 1007, [0069]; *see also* § X.D.2.

381. In near interaction mode, virtual objects like “virtual buttons” or a “context menu” are displayed *close to a body part of a user*. *See* § X.C.4; Ex. 1005, [0021] (interactions within a “predetermined threshold distance” measured “with respect to various *parts of the user*” like “the *shoulder of the user*” or “from another *point on the body of the user*”); *id.*, [0028]-[0029] (context menu can be “displayed as an affordance *near the user's hand*” i.e., “*in proximity to the user's hand*”).

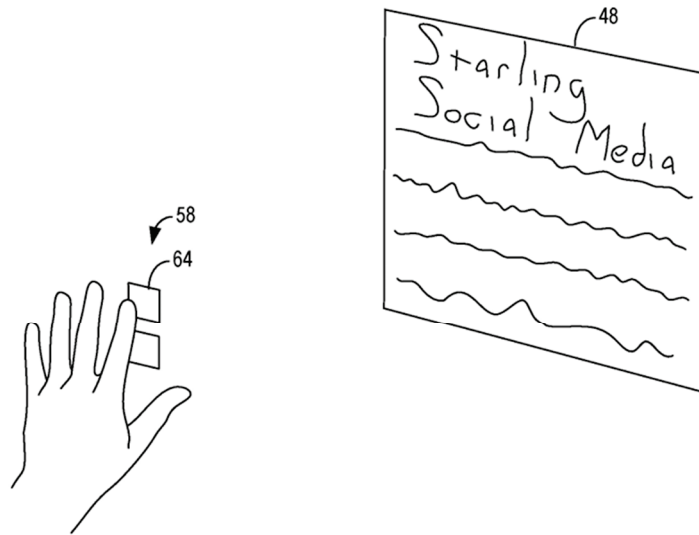


FIG. 6

Ex. 1005, FIG. 6.

382. Ravasz discloses that user interface elements like “arrows” can be rendered “to indicate that the user’s index finger and thumb should be moved” as a menu prompt. Ex. 1007, [0069]. A POSITA would have understood this to mean that Ravasz renders arrow-shaped user interface elements within the artificial reality environment in connection with menu navigation. Further, a POSITA would have understood this to mean that the rendering of arrow UI elements are part of the menu-navigation scheme.

383. Ravasz also discloses that UI menu items can be “oriented vertically” and respond to “substantially vertical motion of the hand”. *Id.*, [0083].

384. For instance, when the UI menu is “configured in a vertical position” “vertical motion of [the user’s] hand” can cause the “virtual hand to move along the vertical dimension of the UI menu.” *Id.*, [0091]. Specifically, menu sliding gesture 608 “can be [a] substantially vertical motion of the hand” when menu items are “oriented vertically.” *Id.*, [0083]. A POSITA would have understood that this vertical menu-sliding functionality advances the displayed menu items along the vertical dimension of UI menu 124, such that it moves the user’s position through the set of application icons in the vertical direction.

385. A POSITA would have further understood that the up and down arrow buttons would be displayed adjacent to the vertically-oriented UI menu. This would mean that they are spatially next to the application icons along the vertical dimension so that the user can see and reach the arrows in relation to the icons that they control. Ravasz confirms that the menu sliding gesture is made “proximate” to the menu items (*adjacent to the plurality of software application icons*). *Id.*, [0034]. In my opinion, a POSITA would have understood that UI arrow elements placed proximate (*adjacent*) to the UI menu would have also allowed a user to move vertically, i.e., scroll, along the software application icon menu items “configured in a vertical position” and would have been motivated to use virtual arrows to do so.

A POSITA would have further understood such arrow buttons to be *operatively linked to scrolling* because Ravasz maps its selection gestures to system actions

(*id.*, [0063]; *see* § XI.C.5 (1[a.iv])), where the up arrow reflects the advancement of menu items in one vertical direction and the down arrow in the other. As such, interacting with a given arrow causes the system to scroll the application icons in the corresponding direction. Indeed, before 2022 this had become the de facto standard for scrolling user interface elements. In the Technology Overview section above I reproduce FIG. 5 from the 1997 paper by Mark Mine, Ex. 1029 (“ISAAC: A Meta-CAD System for Virtual Environments”), which shows exactly this, as I indicate in the annotated version of the figure below.

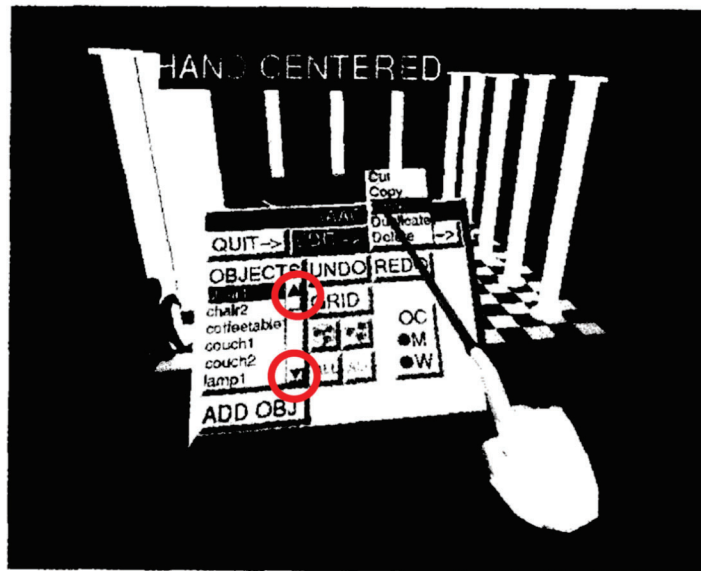


**Figure 5** Two-dimensional control panel

Ex. 1029 (“ISAAC: A Meta-CAD System for Virtual Environments”), FIG. 5 (annotation added).

386. In my opinion, a POSITA would have been motivated to implement Tang’s scrolling functionality to navigate Ravasz’s UI menu with a reasonable

expectation of success because it was a well-known UI function to navigate long list that would have been intuitive to users. *See* §§ XI.A-B.

387. Thus, it is my opinion that Ravasz in view of Tang renders obvious *further comprising up and down arrows displayed as buttons adjacent a grouping of a plurality of one or both of software application and virtual reality platform system setting icons that includes the first software application icon, wherein the up and down arrows are operatively linked to scrolling the plurality of one or both of software application and virtual reality platform system setting icons in the grouping when directly interacted with by a user's hand or finger.*

3. **Claim 5: “The virtual reality environment selection interface of claim 4, wherein the plurality of one or both of software application and virtual reality platform system setting icons in the grouping are displayed within an apparent distance of a user's arm length to the user.”**

388. In my opinion, Ravasz in view of Tang renders obvious this limitation.

389. Ravasz's elements in the UI menu (*the plurality of one or both of software application and virtual reality platform setting icons in the grouping*) are displayed within Tang's predetermined threshold distance 54. *See* § XI.D.3; Tang discloses the predetermined threshold distance “in a range of 460 mm to 580 mm” or the “average distance from the shoulder of an average user to the grip center of a hand” (*within an apparent distance of a user's arm length to the user*). Ex. 1005, [0031]; *see also* § X.D.3.

390. Thus, in my opinion, Ravasz in view of Tang renders obvious the limitation *wherein the plurality of one or both of software application and virtual reality platform system setting icons in the grouping are displayed within an apparent distance of a user's arm length to the user.*

4. **Claim 6/7: “The virtual reality environment selection interface of claim [1/2], wherein the first software application icon is displayed within an apparent distance of a user's arm length to the user.”**

391. In my opinion, Ravasz in view of Tang renders obvious this limitation.

392. Ravasz’s application-launching element in the UI menu (*first software application icon*) *is displayed within* Tang’s predetermined threshold distance 54. See § XI.C.4. Tang discloses the predetermined threshold distance “in a range of 460 mm to 580 mm” or the “average distance from the shoulder of an average user to the grip center of a hand” (*within an apparent distance of a user’s arm length to the user*). Ex. 1005, [0031]; *see also* § X.D.3.

393. Thus, in my opinion, Ravasz in view of Tang renders obvious the limitation *wherein the first software application icon is displayed within an apparent distance of a user's arm length to the user.*

#### **E. Independent Claim 8:**

1. **8[pre]: “A virtual reality environment selection interface comprising:”**

394. In my opinion, Ravasz discloses this limitation for substantially the same reasons as I explained above in § XI.C.1 (Ground 2, Limitation 1[pre]).

395. Ravasz discloses menus of selectable UI elements that launch applications (*selection interface*) in an artificial reality environment (*virtual reality environment*). *Id.* In my opinion, these menus present the user with selectable options for interacting with the artificial reality environment and the applications available within it, and thus constitute an interface for selecting within that environment.

396. Thus, in my opinion, Ravasz discloses the limitation *a virtual reality environment selection interface*.

## 2. 8[a.i]: “a first software application icon”

397. In my opinion, Ravasz discloses this limitation for substantially the same reasons as I described above in § XI.C.2 (Ground 2, Limitation 1[a.i]).

398. Ravasz discloses a UI element in a UI menu that can launch an application (*first software application icon*). *Id.* As explained above, a POSITA would have understood this UI element to be a software application icon because it is a graphical menu element that, when selected, launches its corresponding application.

399. Thus, in my opinion, Ravasz discloses the limitation *a first software application icon*.

3. **8[a.ii]: “a first virtual reality platform system setting icon”**

400. In my opinion, Ravasz discloses this limitation.

401. In my opinion, the settings element in the Ravasz’s UI menu is *a first virtual reality platform system setting icon*. Ravasz discloses that a user interacts with “a graphical user interface, such as a menu or sub-menu...to operate the artificial reality system” itself, or selectable and modifiable “individual user interface elements ... such as [application] icon elements.” Ex. 1007, [0026]. Thus, the user has the option to control or operate the VR system (*virtual reality platform system*) or software applications within the VR environment. *Id.*

402. Ravasz further discloses “configurable” settings, which are *virtual reality platform system settings*. For instance, “the artificial reality system can be configurable (for example , by the user) to determine a configuration of the left hand or the right hand.” Ex. 1007, [0067]. Such a configuration represents a modification of a system setting (e.g., left or right-handedness of the system). The user can also configure the HMD itself when gesture detector 424 detects a pre-defined gesture, such that the “user interface engine 428 dynamically generates a user interface ... allowing the user 110 to ... configur[e] HIVID 112” (Ex. 1007, [0063]), which is a further alteration of the VR system settings. The “user interface engine 428 and/or application engine 440” can themselves “modify configurable settings” upon detection of particular pre-defined gestures by the user. Ex. 1007, [0063].

403. A POSITA would have understood a “configurable” setting to be a system setting because configuring the HMD/HIVID 112, for instance, would encompass altering/operating the VR system settings. Ravasz depicts “example HIVID displays illustrating positioning and interacting with UI menus,” in FIGs. 7A-7G, including, system settings icons. Ex. 1007, [0019]. For instance, in FIG. 7B, Ravasz depicts menu item 708 labeled as a “Settings” icon. Ex. 1007, FIG. 7B, [0076]; *see also*, FIG. 7C (menu item illustrated using a traditional settings icon); FIG. 7G (same).

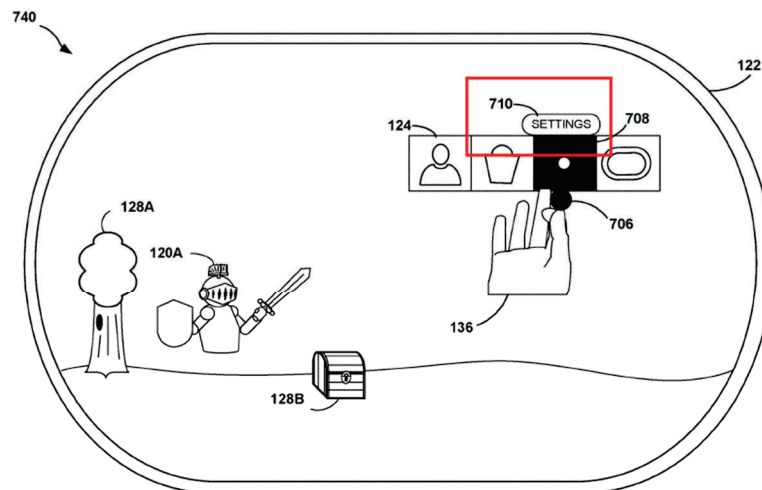


FIG. 7B

Ex. 1007, FIG. 7B (annotated). This is also seen, as shown in FIGs. 7C and 7G below, where menu item 708 is illustrated using a traditional settings icon. *Id.*, [0076].

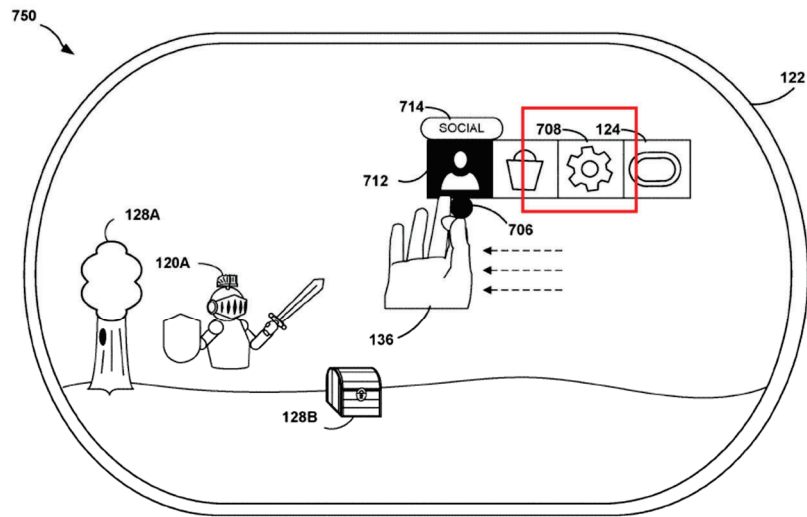


FIG. 7C

Ex. 1007, FIG. 7C (annotated).

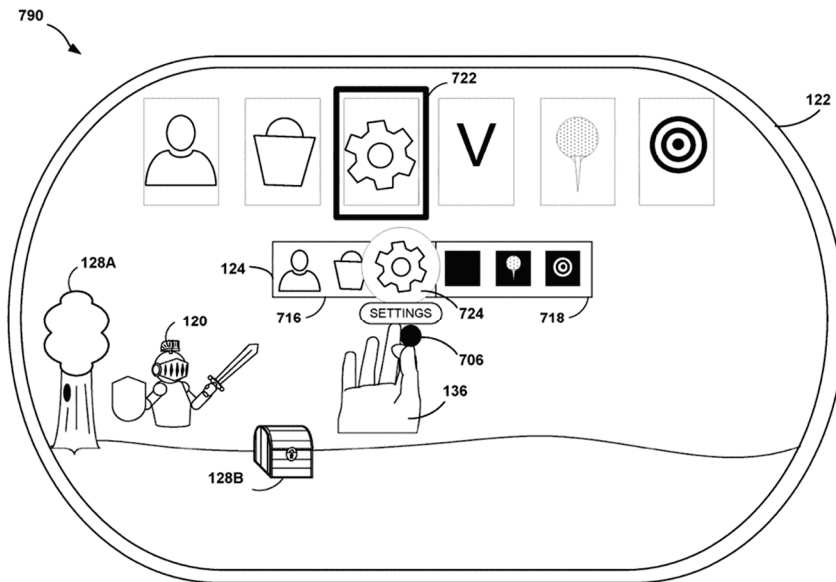


FIG. 7G

Ex. 1007, FIG. 7G.

404. Thus, in my opinion, Ravasz discloses *a first virtual reality platform system setting icon*.

4. **8[a.iii]: “displayed together in a virtual reality environment to a user using a virtual reality hardware device”**

405. In my opinion, Ravasz discloses this limitation for substantially the same reasons as I discussed above in §§ XI.C.3 (Ground 1, Limitation 1[a.ii]).

406. The application-launching element and configurable-settings element are displayed in the UI menu, and therefore *displayed together* because they appear together as a group. The UI menu is *displayed in* an artificial reality environment (*virtual reality environment*) to a user using HMD 112 (*virtual reality hardware device*). See § XI.C.3 (Ground 1, Limitation 1[a.ii]).

407. Thus, Ravasz discloses the limitation *displayed together in a virtual reality environment to a user using a virtual reality hardware device*.

5. **8[a.iv]: “wherein the first software application icon and the first virtual reality platform system setting icon appear closer to a body part of the user that is tracked by a camera of the virtual reality hardware device to interact with the first software application icon and the first virtual reality platform system setting icon than a second software application icon and second virtual reality platform system setting icon”**

408. In my opinion, Ravasz in view of Tang discloses this limitation for substantially the same reasons as I discussed above in § XI.C.4 (Ground 2, Limitation 1[a.iii]) and § XI.C.5 (Ground 2, Limitation 1[a.iv]).

409. In the combination, the application-launching element (*first software application icon*) and configurable-settings element (*first virtual reality platform system setting icon*) in the UI menu in near interaction mode are displayed within a predetermined threshold distance (*appear closer*) from the user, including the user's hand (*to a body part of the user*). See § XI.C.4. The user's hand (*a body part of the user*) is tracked by image capture device 138 (*a camera*) in HMD 112 (*of the virtual reality hardware device*) to recognize gestures (*to interact*) associated with the application-launching element (*first software application icon*) and configurable-settings element (*first virtual reality platform system setting icon*). See § XI.C.5. In my opinion, a POSITA would have understood that this hand-tracking is what enables the user to interact with the near-interaction icons because image capture device 138 tracks the hand's position such that the system can detect when the hand reaches and engages an icon within the threshold distance.

410. Thus, in my opinion, Ravasz in view of Tang renders obvious the limitation *wherein the first software application icon and the first virtual reality platform system setting icon appear closer to a body part of the user that is tracked by a camera of the virtual hardware device to interact with the first software application icon and the first virtual reality platform system setting icon than a second software application icon and second virtual reality platform system setting icon.*

6. **8[a.v]: “than a second software application icon and a second virtual reality platform system setting icon that is displayed to the user when the user is using a physical controller in the virtual reality environment”**

411. In my opinion, Ravasz in view of Tang renders obvious this limitation.

412. As I explained above, application-launching and configurable-settings UI element in the UI menu in near interaction mode (the combination I discussed in §§ XI.E.2-3) is displayed within a predetermined threshold distance *than* the application-launching UI element in the UI icon array (*a second software application icon*) *that is displayed to the user when the user* is using a user-input device (*physical controller*) *in the virtual reality environment*. See §§ XI.C.6 (Ground 2, Limitation 1[a.v]), XI.E.5 (Ground 1, Limitation 8[a.v]).

413. In the combination, a UI element in the UI icon array modifies the system settings (*second virtual reality platform system setting icon*). Ex. 1007, [0063] (“[I]n response to gesture detector **424** detecting one of the pre-defined gestures, user interface engine **428** and/or application engine **440** may ... modify configurable settings”), FIG. 7G.

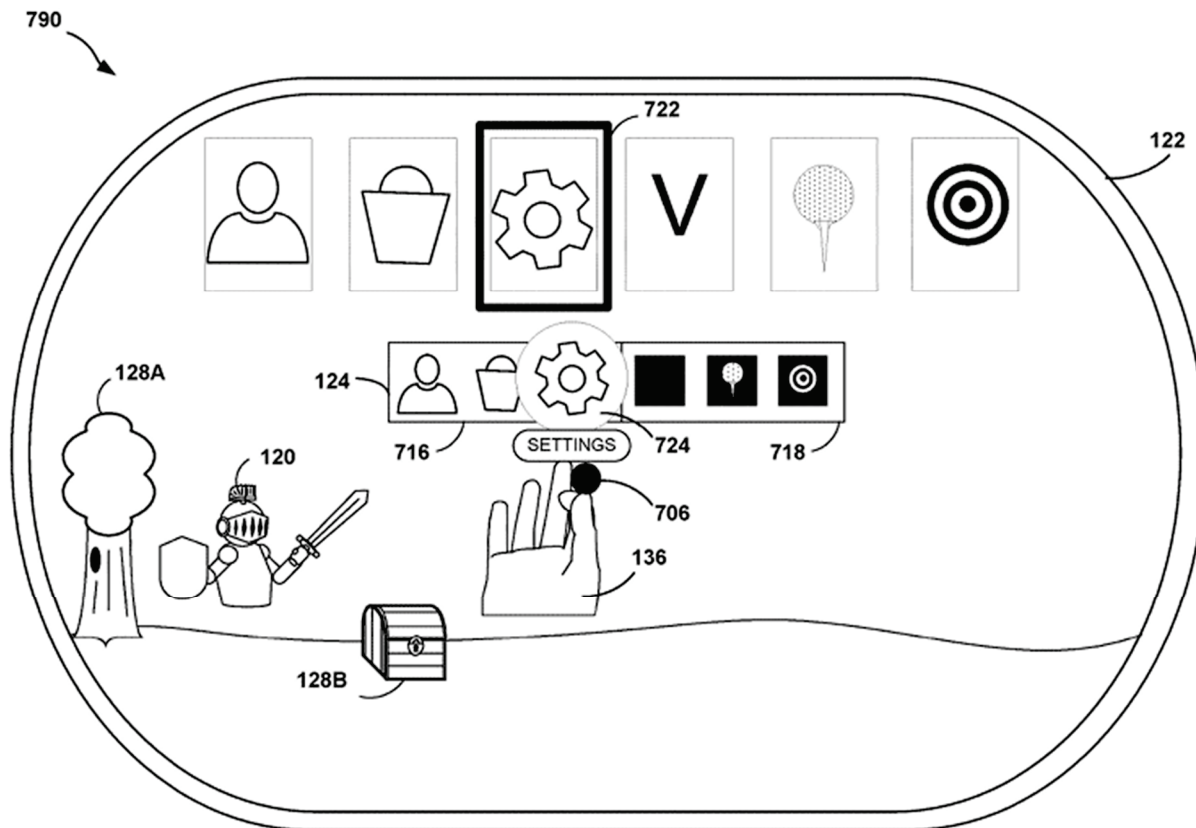


FIG. 7G

Ex. 1007, FIG. 7G.

414. Thus, in my opinion, Ravasz in view of Tang renders obvious the limitation “*than a second software application icon and a second virtual reality platform system setting icon that is displayed to the user when the user is using a physical controller in the virtual reality environment*”.

7. 8[b.i]: “the first virtual reality platform system setting icon being operatively linked to activate a setting”

415. In my opinion, Ravasz discloses this limitation.

416. Ravasz’s configurable-settings element in the UI menu (*first virtual reality platform system setting icon*) is operatively linked to activate a setting. *Id.*

417. Ravasz discloses that the “user interface engine 428 and/or application engine 440” have an ability to “modify configurable settings, [and] start or stop processes or perform other actions.” Ex. 1007, [0063]. Therefore, Ravasz’s system has “settings” and “processes” (*setting*) that can be started or stopped. Ex. 1007, [0063]. A POSITA would have understood that a setting or a process is “started,” is one that is *activated* when engaged. A setting that can be started, stopped, or modified is one whose state changes in response to a user action; a POSITA would have understood “activating” a setting to encompass causing exactly that change of state. Ravasz discloses that “in response to gesture detector 424 detecting one of the pre-defined gestures” on, for instance, a user interface element (*virtual reality platform system setting icon*), “user interface engine 428 and/or application engine 440 may...modify configurable settings” (of which there is one *first virtual reality platform system setting icon*). Ex. 1007, [0063]; *see also* § X.E.3; *see also* Ex. 1007, [0047] (“In response to identifying a pre-defined gesture, control unit 210 takes some action, such as...modify[ing] configurable settings.”). A POSITA would also have understood modifying a configurable setting encompasses “activating” it. In my opinion, this is because the gesture directed at the settings icon is what causes the setting to be modified.

418. As I explained above, interacting with a system setting icon to *activate* it would have been obvious to a POSITA. *See* § XI.E.3.

419. Thus, in my opinion, Ravasz discloses the limitation *the first virtual reality platform system setting icon being operatively linked to activate a setting*.

8. **8[b.ii]: “when interacted with by a pushing, pulling, tapping, pressing or sliding action of the body part of the user directly on the first virtual reality platform system setting icon; and”**

420. In my opinion, Ravasz alone or in view of Tang renders obvious this limitation for substantially the same reasons as I discussed above in § XI.C.8 (Ground 2, Limitation 1[b.ii]).

421. An action is performed when the user taps or presses the configurable-setting element using the user’s hand. *Id.* Ravasz teaches that “[d]etection of the selection gesture may cause the artificial reality system to perform some action.” Ex. 1007, [0076]. Notably, “in response to gesture detector 424 detecting one of the pre-defined gestures,...modify configurable settings.” *Id.*, [0063]. In my opinion, it would have been obvious to a POSITA that this pre-defined gesture could be tap or press of the virtual object representing the configurable settings to activate a setting, particularly since taps and presses were already being used in the combination to interact with other icons including launching applications. *See* § XI.C.8. In my opinion, a POSITA would have had been motivated to use the same tap or press gesture for the settings icon that is already used for the application icons

in the same menu because doing so provides a single, consistent interaction model across all icons in the menu, and applies a gesture the combination already employs to a closely analogous element to yield the predictable result of activating the setting. A POSITA would therefore have had a reasonable expectation of success because such a combination was well-known and within their skillset.

422. Thus, in my opinion, Ravasz alone or in view of Tang renders obvious the limitation “*when interacted with by a pushing, pulling, tapping, pressing or sliding action of the body part of the user directly on the first virtual reality platform system setting icon; and*”.

9. **8[c]: “the first software application icon being operatively linked to launch a software application when interacted with by a pushing, pulling, tapping, pressing or sliding action of the body part of the user directly on the first software application icon.”**

423. In my opinion, Ravasz in view of Tang renders obvious this limitation for substantially the same reasons as I discussed in §§ XI.C.7-8 (Ground 2, Limitations 1[b.i]-1[b.ii]) and X.E.2 (Ground 2, Limitations 8[a.i]).

424. As I explained previously, Ravasz’s application-launching element will launch an application when the user taps or presses the user’s hand directly on the element (*operatively linked to launch a software application when interacted with a...tapping [or] pressing...action of the body part of the user directly on the first software application icon*). See § XI.C.7-8. In my opinion, the gesture directed at

the application icon is what causes the corresponding application to launch, such that the icon is operatively linked to launching that application.

425. Thus, in my opinion, Ravasz in view of Tang renders obvious the limitation *first software application icon being operatively linked to launch a software application when interacted with by a pushing, pulling, tapping, pressing or sliding action of the body part of the user directly on the first software application icon.*

**F. Dependent Claims 9-11:**

1. **Claim 9: “The virtual reality environment selection interface of claim 8, wherein the first virtual reality platform system setting icon is displayed as a 3-dimensional button that activates the setting when pressed by the user's hand or finger and the first software application icon is displayed as a 3-dimensional button that launches the software application when pressed by the user's hand or finger.”**

426. In my opinion, Ravasz in view of Tang renders obvious this limitation.

427. As I discussed, the combination discloses an application-launching element that *is displayed as a 3-dimensional button that launches a software application when pressed by the user's hand or finger.* See § XI.D.1. It would have also been obvious to render the element that modifies the settings (*the first virtual reality platform system setting icon...that activates the setting when pressed by the user's hand or finger*) as a 3-dimensional button. Ex. 1005, [0028], FIGs. 5A, 5B, 5E; Ex. 1007, [0026] (“UI element 126 may be a...three-dimensional

shape.”). In my opinion, a POSITA would have understood the benefits of rendering all icons in the same UI menu in three-dimensional form because it would be more aesthetically pleasing and therefore enhance the user experience. A POSITA would also have understood that presenting the setting icon and the application icon in the same three-dimensional button form provides a uniform appearance and a single, predictable interaction model across the menu, such that a user who has learned to press one icon understands how to operate the others and that applying the three-dimensional button rendering already used for the application-launching element (*see* § X.D.1) to the analogous setting icon is nothing more than the use of a known technique. A POSITA would have had a reasonable expectation of success and would have faced no technical obstacle in implementing it.

428. Thus, in my opinion, Ravasz in view of Tang renders obvious the limitation *wherein the first virtual reality platform system setting icon is displayed as a 3-dimensional button that activates the setting when pressed by the user's hand or finger and the first software application icon is displayed as a 3-dimensional button that launches the software application when pressed by the user's hand or finger.*

2. **Claim 10/11:** “The virtual reality environment selection interface of claim [9/8], wherein the first grouping of the plurality of icons are displayed within an apparent distance of a user's arm length to the user.”

429. In my opinion, Ravasz in view of Tang renders obvious this limitation for substantially the same reasons as I discussed in § XI.D.3 (Ground 2, Claim 5).

430. As I discussed previously, the elements in the UI menu in near interaction mode (*first grouping of the plurality of icons are displayed*) within a predetermined threshold distance 54 which “may be in a range of 460 mm to 580 mm,” representing an “average distance from the shoulder of an average user to the grip center of a hand” (*an apparent distance of a user’s arm length to the user*). Ex. 1005, [0031]; see § XI.D.3. Because Ravasz expressly ties the 460–580 mm range to the average distance from an average user's shoulder to the grip center of their hand, a POSITA would have understood that icons displayed within this threshold are displayed within an apparent distance of the user's arm length. A POSITA would have understood that in the near interaction mode discussed above, the first grouping of icons (including the first software application icon and the first virtual reality platform system setting icon) is displayed within this threshold distance 54, and therefore within the apparent arm-length distance.

431. Thus, in my opinion, Ravasz in view of Tang renders obvious the limitation *wherein the first grouping of the plurality of icons are displayed within an apparent distance of a user's arm length to the user*.

**XII. GROUND 3: RAVASZ WITH TANG AND MINE RENDERS  
OBVIOUS CLAIMS 12-20**

**A. A POSITA Would Have Been Motivated to Combine**

432. In my opinion, a POSITA would have been motivated to modify Ravasz-Tang method for providing an interactive interface in a virtual reality environment to incorporate Mine’s method for detecting a controller for several compelling technical and practical reasons, including combining known prior art elements according to known methods to achieve predictable results, and addressing well-understood ergonomic and interaction friction points in virtual reality systems.

433. As an initial matter, in my opinion, all three references are directed to interactive interfaces in a virtual reality environment. Ex. 1005, [0016] (“The inventors have recognized a challenge associated with user manipulation of virtual objects in a virtual reality (VR) or an augmented reality (AR) environment.”); Ex. 1006, [0003], [0008] (“it is an object of the present invention to provide a technique to allow controlling an electronic apparatus in accordance with a control method desired by the user.”); Ex. 1047, [0002], [0007]; Ex. 1007, [0004] (“In general, this disclosure describes artificial reality systems and, more specifically, graphical user interface elements and techniques for presenting and controlling the user interface elements within an artificial reality environment.”); *see also* § VIII (Overview of the Prior Art). Because of this shared focus, a POSITA implementing the virtual reality interactive interface in Ravasz-Tang would naturally look at other virtual reality

systems that focus on interactive interfaces like that in Mine. Because each reference is in the same technological field and addresses the common goal of optimizing user interaction within synthetic environments, a POSITA seeking to improve input flexibility and reduce user fatigue in Ravasz-Tang would naturally look to contemporaneous prior art in the same field, such as Mine.

434. In addition, the references specifically address the problems identified in the other respective references. Tang explains that its depiction of objects near and far addresses the fact that users experience issues with reach and fatigue. Ex. 1005, [0016] (“fine control of parts or points on distant objects may be challenging for a user...[a]lso, a user interacting with a distant object may experience muscle fatigue if the interaction involves raised and/or extended hands and/or arms.”). Mine identifies a similar concern, regarding the need for a user so as to keep their hand at a certain height to be included in the image capturing range in gesture modes. Ex. 1006, [0052]-[0053]; Ex. 1047, [0041]-[0042]. A POSITA implementing Ravasz-Tang’s interface would implicate the concerns and solutions detailed in Mine. Ex. 1007, [0007]. Mine’s controller detection method would allow the interface to determine and automatically invoke a far detection mode if the user has become fatigued and taken the opportunity to rest their hands and use a different input method.

435. Next, the references all include complementary components. As I explained in the Technology Overview above, head-mounted displays incorporating outward-facing cameras, motion tracking, and gesture-recognition capabilities were mature and well-understood components long before the priority date. *See* § VI.A (Technology Underlying Virtual Reality). Ravasz discloses “artificial reality systems...that generate and render graphical user interface elements for display to a user in response to pre-defined gestures by the user, such as particular motions, configurations, positions, and/or orientations of the user’s hands, fingers, thumbs or arms, or a combination of pre-defined gestures.” Ex. 1007, [0005]. Tang also discloses virtual objects that may be displayed to the user, and allows those objects to be displayed at varying distances relative to the user, incorporating a distance component to Ravasz. Ex. 1005, [0016]. Mine similarly discloses computer graphical elements that may be displayed to the user, and allows those elements to be interacted with, with either the user’s hand or a controller, merely adding functionality that Ravasz already contemplates. Ex. 1006, [0044]-[0051]; Ex. 1047, [0033]-[0040].

436. Finally, a POSITA would understand that if a user made a choice to interact using a controller, i.e. they picked up and held a controller, the system could automatically transition to a pointing means of interaction, for example using a virtual laser beam metaphor as taught by Mark Mine in 1996 (Ex. 1030) as discussed

in the Technology Overview above. A POSITA would understand that doing so could realize the benefits articulated by Mark Mine. For example, the virtual laser beam metaphor transforms the task from 3D positioning to pointing in 2D making it easier to use and more precise, and it can reduce fatigue. Further, a POSITA would understand that attempting to use one's hands to directly interact with virtual interaction objects that are near or beyond a user's reach would require the user to move their body towards the objects, which is not always desirable from an effort standpoint, and it can be unsafe. Conversely, a POSITA would understand that attempting to use a controller to directly interact with virtual interaction objects that are *within* the user's reach could be cumbersome, as they would no longer have the affordance of individual fingers to interact more precisely with the virtual interaction objects—they would be using their clenched hand around the controller body, which would be relatively large and cumbersome, therefore relatively imprecise.

437. Thus, to a POSITA, integrating Mine's controller-detection logic (Ex. 1006; Ex. 1047) into Ravasz-Tang would be nothing more than the predictable combination of complementary, well-known input structures to enhance overall system usability.

**B. A POSITA Would Have Had a Reasonable Expectation of Success**

438. In my opinion, a POSITA would have had a reasonable expectation of success in modifying Ravasz-Tang's method for providing an interactive interface

in a virtual reality environment to incorporate Mine's method for detecting a controller. Such a combination relies on standard software control logic and general components operating in their expected and designed manner.

439. First, all three references use similar components in virtual reality devices, making the combination of the disclosures more straight-forward. Ravasz discloses image capture devices 238, gesture detector 324, and motion sensors 206 to detect gestures. Ex. 1007, [0008], [0045]. Tang discloses inward and outward-facing cameras (30/32), gesture recognition modules 24, and inertial measurement units 36. Ex. 1005, [0020], [0017], [0019]. Mine discloses an imaging unit 202, control unit 211, and attitude sensor 204 including an inertial measurement unit. Ex. 1006, [0029], [0033], [0045]-[0046]; Ex. 1047, [0018], [0022], [0034]-[0035]. Therefore, a POSITA would know that combining these references would have been a simple modification of similar components.

440. Second, a POSITA would have been aware of multiple ways to implement Mine's method of detecting controller contact, and controller use in general. For example, a POSITA would understand that the control unit could use the imaging unit to visually recognize when a hand is holding a controller, and the controller's tracking information (e.g., from the attitude sensor and/or inertial measurement unit) to determine whether the controller is generally in motion or is remaining still. A POSITA would also be aware of capacitive and other electrical

means for determining whether a user's hand is in contact with the surface of a controller, such as the means discussed in the Technology Overview above.

441. Third, all of the references disclose a controller or user-input device, such that implementing Mine's method of detecting use of controllers with Ravasz-Tang would have been straight-forward for a POSITA. Ex. 1007, [0039] ("Artificial reality system 20 uses data received from...controllers 114 to capture 3D information within the real world environment, such as motion by users 110"); Ex. 1005, [0049] ("When included, input subsystem 310 may comprise or interface with one or more user-input devices such as a...game controller."). Therefore, a POSITA would have known that the benefits of Mine's controller detection method could have been integrated into Ravasz-Tang's system.

**C. Independent Claim 12:**

1. **12[pre]: "A method for providing an interactive control interface in a virtual reality environment comprising:"**

442. I have been asked to assume a scenario where the preamble is limiting. As to that scenario, it is my opinion that Ravasz discloses the preamble.

443. Ravasz discloses a method for providing menus of selectable UI elements that launch applications and modify configurable settings (*method for providing an interactive control interface*) in an artificial reality environment (*in a virtual reality environment*). *Id.*

444. Ravasz discloses “techniques for presenting and controlling the user interface elements within an artificial reality environment” (*method for providing an interactive control interface in a virtual reality environment*). Ex. 1007, [0004]. Ravasz further discloses “user interface elements specifically designed for user interaction and manipulation within an artificial reality environment.” *Id.*, [0022]. In particular, Ravasz discloses “methods for activating menu prompts and menus” (user interface (UI) elements) and “for determining positioning and user interaction with menus.” *Id.*, [0065]. A POSITA would understand that these methods would amount to user interaction that would give the user control in a virtual reality environment.

445. Therefore, it is my opinion that Ravasz discloses *a method for providing an interactive control interface in a virtual reality environment*.

2. **12[a]: “detecting that a user using a virtual reality environment via a virtual reality hardware device is not using or has discontinued use of a physical device controller used to interact with the virtual reality environment;”**

446. In my opinion, Ravasz alone or in view of Mine renders obvious this limitation. Here, the user is using an artificial reality environment (*a virtual reality environment*) displayed through HMD 112 (*via a virtual reality hardware device*). See § XI.C.3.

447. Ravasz discloses that the user can interact with virtual UI elements using a controller 114 (*physical device controller used to interact with the virtual reality environment*) held by the user. *See* Ex. 1007, [0040]. “Controllers 114 may be in communication with HIVID 112B using near-field communication of short-range wireless communication such as Bluetooth, using wired communication links, or using other types of communication links.” *Id.* A POSITA would have understood that a user *is not using or has discontinued use of* the controller 114 if there is no signal received by HMD 112 from controller 114.

448. To the extent that Ravasz does not explicitly disclose detecting that a user *is not using or has discontinued use of* controller 114, in my opinion, it would have been obvious in view of Mine.

449. Mine discloses an “information processing system 1 [that] includes an HMD 100, an image processing device 110, and a controller 120” for interacting with computer graphics (CG) in a virtual reality environment. Ex. 1006, [0003], [0023], [0024] (“A composite image composing a captured image, which the HMD 100 captures the range in front of the user, and such content as computer graphics (CG) in a form in accordance with the attitude of the HMD 100, is displayed on the HMD 100.”); Ex. 1047, [0002], [0012], [0013]. The user interacts with the computer graphics using the controller, which is “holdable by hand or wearable on the hand of the user” and operable by “physical contact” (*physical device controller*). Ex. 1006,

[0027], [0028]; Ex. 1047, [0016], [0017]. Mine discloses that the controller 120 “includes a button enclosing an optical trackpad (‘OTP’) and other physical control components that a user could engage with. Ex. 1006, [0026]-[0028]; Ex. 1047, [0015]-[0017].

450. To interact with CG elements, the user will take some action to engage with the controller 120. These interaction methods include the user causing “the HMD 100 to display a menu, including a pointer, by a lengthy pressing of the button of the OTP” or can “select[ing] [] [an] item” “by pushing the button of the OTP down.” Ex. 1006, [0027]; Ex. 1047, [0016].

451. Mine also considers when and how the user interacts with the controller 120. Specifically, Mine discloses a method for determining “whether [or not] the hand of the user is in contact with the OTP of the controller 120,” that is, whether the user is making “physical contact” with the controller (*method of detecting that a user...is not using or has discontinued use of a physical device controller*). Ex. 1006, [0028], [0072]; Ex. 1047, [0017], [0061]; *see also* Ex. 1006, [0078] (“The state of the hand of the user (whether or not the hand of the user is in contact with the OTP ...) tends to indicate the intention of the user on how the user wants to control the HMD 100.”); Ex. 1047, [0067]. Therefore, whether or not the user’s hand is in contact with the controller is critical in determining how the user wants to operate the HMD 100. In Figure 6, Mine outlines the mode selection processing, in which

a control unit 211 determines whether the user is in one of three modes, including two hand control modes (ray control mode, tracking control mode), and a physical controller mode (OTP control mode). Ex. 1006, FIG. 6; Ex. 1047, FIG. 6. During this processing, “[i]f it is determined that the hand of the user is not in contact with the OTP, processing advances” to determine which of either hand-controlled modes are being used (i.e., ray control mode or tracking control mode). Ex. 1006, [0072]-[0073]; Ex. 1047, [0061]-[0062]. If a user is not using a controller, the user is opting to use the hand-controlled modes. Because the controller unit 211 determines that the hand of the user is not in contact with the OTP on the controller, the controller unit 211 is *detecting that a user is...not using or has discontinued use of a physical device controller*.

452. A POSITA would have been motivated to modify Ravasz’s interface method to include Mine’s controller detection method because it would have improved user interaction with the system. Ravasz’s system receives user inputs from controllers 114A and 114B, as well as user hand gestures. Ex. 1007, [0040]. Therefore, Ravasz discloses multiple methods for the user to provide inputs to the system. Because Ravasz’s artificial reality system receives multiple modes of user inputs from both gestures and controllers (*see* §§ XI.E.6, XI.E.9), a POSITA would have incorporated a method to determine which mode was being used. This would

be accomplished by determining when a user had discontinued use of the controllers, one type of input, to switch to a hand gesture mode, the other type of input.

453. A POSITA would have also understood that such a detection method could be more accurate. Although Ravasz inherently teaches that a user *is not using or has discontinued use of* controller 114 if there is no signal from the link, detecting whether there is physical contact on the controller would be more accurate. For example, a physical controller could still be connected to the HMD 112 by Bluetooth or through a wired link, but the user could have switched to hand gestures.

454. A POSITA would have understood that incorporating a method to detect when a user has discontinued use of the physical controllers to switch to a VR hand control mode (hand gestures) would have benefited a system that allowed for multiple user input methods. For example, issues with the system could arise if a user has stopped using a controller and began using their hands for control. In this case, efficiently detecting the switch to a hand gesture mode would prevent errant control inputs from the physical device controller, thereby making selection more precise and improving the user's experience.

455. A POSITA would have had a reasonable expectation of success in making this combination because both Ravasz and Mine disclose physical controllers as user input methods for their artificial and virtual reality systems. Ex. 1007, [0040] ("HIVID 112B may receive user inputs from controllers 114 held by

user 110B.”); Ex. 1006, [0023] (“The information processing system 1 includes an HMD 100, an image processing device 110, and a controller 120.”), [0026] (“The controller 120 is a device to perform various controls of the HMD 100.”); Ex. 1047, [0012], [0015].

456. Incorporating a method to determine whether the user was in physical contact with Ravasz’s controllers to cleanly select/switch control modes could have been as simple as using software to determine whether the system thought the controller was asleep or otherwise not in use, or could have involved some hardware and software additions. Either approach would have been well within the skill set of a person of ordinary skill in the art before 2020.

457. Further, a POSITA would have been aware of multiple ways to implement Mine’s method of detecting controller contact, and controller use in general. For example, a POSITA would understand that Mine’s control unit could use the imaging unit to visually recognize when a hand is holding a controller, and the controller’s tracking information (e.g., from the attitude sensor and/or inertial measurement unit) to determine whether the controller is generally in motion or is remaining still. Further, a POSITA would also be aware of capacitive and other electrical means for determining whether a user’s hand is in contact with the surface of a controller, such as the means discussed in the Technology Overview above.

458. Thus, in my opinion, Ravasz alone or in view of Mine renders obvious *detecting that a user using a virtual reality environment via a virtual reality hardware device is not using or has discontinued use of a physical device controller used to interact with the virtual reality environment.*

3. 12[b]: “displaying to the user a body interactive icon of a software application and a virtual reality platform system setting after said detecting, wherein the body interactive icon is displayed to appear closer to a body part of the user that is tracked by a camera to interact with the body interactive icon than a physical controller icon of a software application and virtual reality platform system setting displayed to the user when the user was using the physical device controller in the virtual reality environment, wherein the body interactive icon and the physical controller icon both are linked to launch the same software application or virtual reality platform setting;”

459. In my opinion, Ravasz in view of Tang renders obvious this limitation.

460. As I discussed, the HMD displays to a user UI elements (also called menu items) in a UI menu including an application-launching and configurable-settings elements (the combination I discussed in §§ XI.E.2-4) (*displaying to the user ... a software application and a virtual reality platform setting*). The HMD would be *displaying ... a body interactive icon* so that the user can interact with these elements using gestures.

461. Further, in the Ravasz-Tang combination, the UI menu displayed in near interaction mode is within a predetermined threshold distance to the user’s hand

that is tracked by image capture devices 138 (the combination I discussed in § XI.E.5) (*at least one body interactive icon is displayed to appear closer to a body part of the user that is tracked by a camera*). Also in the Ravasz-Tang combination, the user, in near interaction mode, uses their hand to interact with the UI menu using pre-defined gestures including movements that are normal to the UI menu such as tapping and pressing (the combination I discussed in § XI.E.8) (*to interact with the first body interactive icon*).

462. Alternatively, in the far interaction mode, the UI icon display is displayed further than the predetermined threshold distance (*than...a software application and virtual reality platform system setting displayed to the user*) when the user is using controller 114 in the artificial reality environment (the combination discussed in §§ XI.E.6-7) (*when the user was using the physical device controller in the virtual reality environment*). The HMD would be displaying a *physical controller icon* that the user can interact with these elements using a controller. *See* § XI.E.6.

463. In my opinion after combining Ravasz-Tang with Mine, Ravasz's HMD would display the UI menu in Tang's near interaction mode after determining that the user's hand of is not in contact with the controller as taught by Mine (*after said detecting*) so that the system can switch to gestures in near interaction mode. *See* § XII.C.2. A POSITA would recognize that transitioning the menu layout from

a far/remote distance (second grouping used during controller input) to a near/touchable distance (first grouping used during hand tracking) directly accommodates the change in range.

464. Thus, in my opinion, the Ravasz in view of Tang renders obvious *displaying to the user a body interactive icon of a software application and a virtual reality platform system setting after said detecting, wherein the body interactive icon is displayed to appear closer to a body part of the user that is tracked by a camera to interact with the body interactive icon than a physical controller icon of a software application and virtual reality platform system setting displayed to the user when the user was using the physical device controller in the virtual reality environment, wherein the body interactive icon and the physical controller icon both are linked to launch the same software application or virtual reality platform setting.*

4. **12[c]: “receiving a control input selecting the body interactive icon from the user that appears as a direct touching body interaction from the user to the body interactive icon;”**

465. In my opinion, Ravasz discloses this limitation.

466. Ravasz discloses a system that “receive[s] user inputs in the form of gestures by [sic] hands 132A, 132B of user 110A” (*receiving a control input*). Ex. 1007, [0040]; *see also* FIG. 1B, [0035] (“technique [that] may provide the user with



*interactive icon*), this is an input to the system because the user is signaling action for the system to take.

468. Further, the “UI element 26” (*body interactive icon*) is one of a first grouping of icons because “UI menu 124” “can include one or more UI elements 126,” as depicted in FIG. 7A. Ex. 1007, [0073], FIG. 7A; *see also* § XI.C.8-9.

469. Ravasz also teaches that the “selection gesture can be a movement of the hand in a direction that is substantially normal to the plane of the UI menu.” Ex. 1007, [0076]. Movement that is substantially normal to the plane of the UI menu would appear as movement very near to the surface of the UI menu as displayed. A POSITA would understand that such a movement *appears as a direct touching body interaction from the user to the* UI element because it is used to simulate pushing, pulling, tapping, or pressing on the UI element in the UI menu. A POSITA would have also understood movement of a finger and/or movement of the hand in a direction substantially normal to the plane of the UI menu to select (*interact with*) an body interactive icon to be a push, press, pull, or tap on the icon rendered in the virtual reality environment. *See* § XI.C.8. A POSITA would have understood this because a motion directed substantially normal (i.e., perpendicular) to the plane in which the icon is rendered advances the finger or hand toward and against that rendered plane, which is the same physical motion by which a user pushes or taps a button lying in a plane, such that the user’s selection gesture appears as a direct

touching interaction with the icon. For instance, FIGs. 7A-7E depict a finger of the user's hand 'touching' a body interactive icon (pushing, pulling, tapping, pressing action of the body part of the user directly on the body interactive icon) to select and/or launch that application. Ex.1007, FIGs. 7A-7E; *see* § XI.C.8.

470. Thus, in my opinion, Ravasz discloses *receiving a control input selecting the body interactive icon from the user that appears as a direct touching body interaction from the user to the body interactive icon.*

5. 12[d]: “launching, in response to receiving the control input, a virtual reality platform system setting that is linked to the body interactive icon if the body interactive icon represents a software application; and”

471. In my opinion, Ravasz discloses this limitation for substantially the same reasons I discussed in §§ XI.C.7-8 (Ground 2, Limitation 1[b.i]-1[b.ii]).

472. As I discussed, Ravasz discloses that if the UI element is associated with a software application (*if the body interactive icon represents a software application*), the system will *launch* the application associated with element (*a respective software application that is linked to the body interactive icon*). This launching occurs *in response to receiving* the user input in the form of a selection gesture (*the control input*), which could be in the form of a pushing, pulling, tapping, pressing, or sliding action of the user. *Id.*; *see also* Ex. 1007, FIG. 7E.

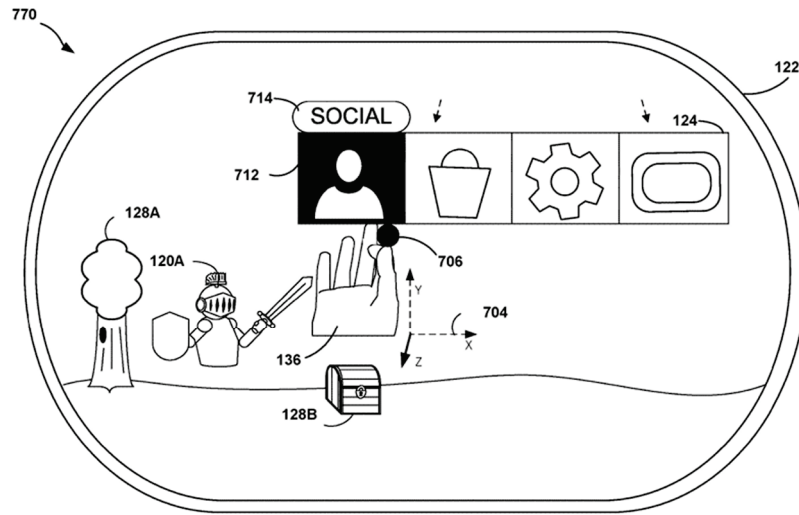


FIG. 7E

Ex. 1007, FIG. 7E.

473. Thus, in my opinion, Ravasz discloses *launching, in response to receiving the control input, a virtual reality platform system setting that is linked to the body interactive icon if the body interactive icon represents a software application; and.*

6. 12[e]: “activating, in response to receiving the control input, a virtual reality platform system setting that is linked to the body interactive icon if the body interactive icon represents a virtual reality platform system setting.”

474. In my opinion, Ravasz discloses this limitation for substantially the same reasons I discussed in §§ XI.E.7-8 (Ground 2, Limitation 8[b.i]-1[b.ii]).

475. As I discussed, Ravasz discloses that if the UI element is associated with settings to configure the artificial reality environment (*if the icon represents a*

*virtual reality platform system setting*), modifying (*activating*) the configurable settings associated with the menu item that the user has chosen to interact with (*a virtual reality platform system setting that is linked to the chose icon*). This activation occurs *in response to receiving* the user input in the form of a selection gesture (*the control input*), which could be in the form of a pushing, pulling, tapping, pressing, or sliding action of the user. *Id.*; see also Ex. 1007, FIG. 7G.

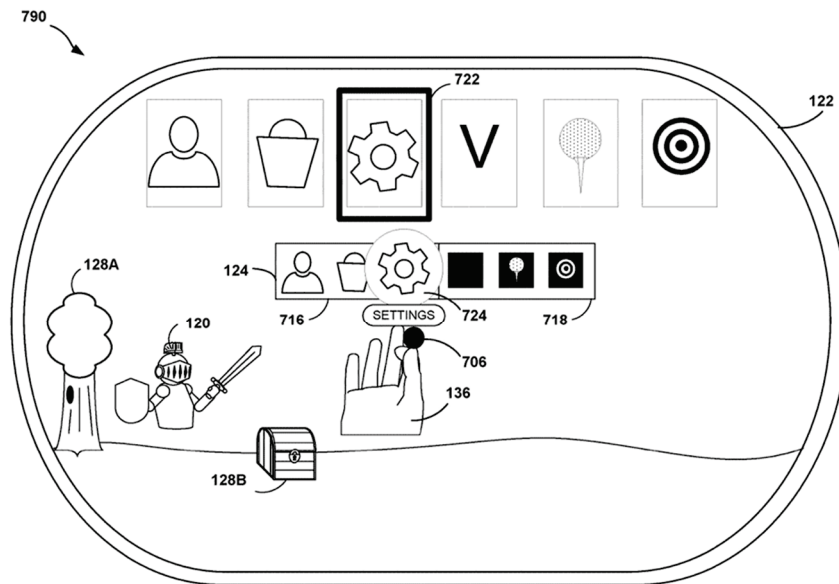


FIG. 7G

Ex. 1007, FIG. 7G.

476. Thus, in my opinion, Ravasz discloses *activating, in response to receiving the control input, a virtual reality platform system setting that is linked to the body interactive icon if the body interactive icon represents a virtual reality platform system setting.*

**D. Dependent Claims 13-20:**

1. **Claim 13: “The method of claim 12, wherein the body interactive icon is displayed as a 3-dimensional button that (i) activates a virtual reality platform system setting when pressed by the user’s hand or finger if the body interactive icon represents a virtual reality platform system setting and (ii) launches a software application when pressed by the user’s hand or finger if the body interactive icon represents a software application.”**

477. In my opinion, Ravasz in view of Tang renders obvious this limitation.

478. As I discussed, Ravasz discloses pre-defined gestures performed directly on the UI element. These gestures either modify configurable settings or launch an application (*body interactive icon... that (i) activates a virtual reality platform system setting...and (ii) launches a software application*). See §§ XII.C.5-6.

479. In the Ravasz-Tang combination, the icon would have been displayed as a three-dimensional shape such as a button. See § XI.F.1; see also Ex. 1007, [0026] (“UI element 126 may be a...three-dimensional shape that is manipulatable by a user”); Ex. 1005, [0028] (“The plurality of virtual interaction objects 58 may include...at least one virtual button 64.”).

480. Further, to the extent that Ravasz does not explicitly teach this limitation, this would have been obvious in my opinion to a POSITA in view of Tang. See § XI.E.8-9; see also Ex. 1005, [0035] (“The plurality of gestures may

include a pressing motion by a finger.”). A POSITA would understand that a gesture that includes a pressing motion by a finger could be used to interact with the UI element in Ravasz, such that the finger could be pressed on the UI element.

481. Thus, in my opinion, Ravasz in view of Tang renders obvious *wherein the body interactive icon is displayed as a 3-dimensional button that (i) activates a virtual reality platform system setting when pressed by the user’s hand or finger if the body interactive icon represents a virtual reality platform system setting and (ii) launches a software application when pressed by the user’s hand or finger if the body interactive icon represents a software application.*

2. **Claim 14: “The method of claim 13, further comprising up and down arrows displayed as buttons adjacent a plurality of body interactive icons that include the body interactive icon, wherein the up and down arrows are operatively linked to scrolling the plurality of body interactive icons when directly interacted with by a user’s hand or finger.”**

482. In my opinion, Ravasz in view of Tang renders obvious this limitation for substantially the same reasons I discussed in § XI.D.2 (Ground 2, Claim 3).

483. In my opinion, a POSITA would have implemented Tang’s scrolling functionality to navigate Ravasz’s UI menu. Ex. 1005, [0029] (“In the example of FIG. 6, two virtual buttons 64 are shown that may be a scrolling mechanism for the virtual content.”), FIG. 6. Ravasz further teaches rendering on Tang’s buttons 64 for scrolling “arrows [that]...indicate the direction the user’s index figure...should be moved.” Ex. 1007, [0069]. In my opinion, combining Tang’s directional scroll

buttons with Ravasz's arrow indicators would have been a routine combination of well-known graphical interface navigation controls to achieve predictable list scrolling that a POSITA would have been very familiar with.

484. Thus, in my opinion, Ravasz in view of Tang renders obvious *further comprising up and down arrows displayed as buttons adjacent a plurality of body interactive icons that include the body interactive icon, wherein the up and down arrows are operatively linked to scrolling the plurality of body interactive icons when directly interacted with by a user's hand or finger.*

3. **Claim 15/19/20: "The method of claim [14/12/13], further comprising determining an apparent distance relative to the user that the body interactive icon should be displayed to be within a touching distance of the user."**

485. In my opinion, Ravasz in view of Tang renders obvious this limitation.  
*See* § XI.D.3.

486. In the Ravasz-Tang combination, the system determines whether the menu items in the UI menu are within a predetermined threshold distance from the user's hand (*determining an apparent distance relative to the user*). *See* § XI.D.3. The predetermined threshold distance is "in a range of 460 mm to 580 mm," representing an "average distance from the shoulder of an average user to the grip center of a hand," which a POSITA would have understood to be the average wingspan of the average user. Therefore, the Ravasz-Tang combination system

determines whether the menu items are within the wingspan of the user (that *the body interactive icon should be displayed to be within a touching distance of the user*). Ex. 1005, [0031]; *see also* § XI.D.3.

487. As I previously explained, Ravasz discloses a *plurality of one or both of software application and virtual reality platform system setting icons in the grouping are displayed within an apparent distance of a user's arm length to the user*. *See* § XI.D.3. Further, Ravasz in view of Tang renders obvious gesture-interaction elements in the UI menu displayed in near interaction mode that are within a predetermined threshold distance to the user's hand (*body interactive icons*). *See* § XII.C.3. In my opinion, a POSITA would have understood that if the icons are displayed within arm's length to the user, they are *within touching distance of the user*.

488. Thus, in my opinion, Ravasz in view of Tang renders obvious *further comprising determining an apparent distance relative to the user that the body interactive icon should be displayed to be within a touching distance of the user*.

**4. Claim 16: “The method of claim 15, wherein the apparent distance is determined based on an arm's length of a user.”**

489. In my opinion, Ravasz in view of Tang renders obvious this limitation for substantially the same reasons I discussed in § XI.D.3 (Ground 2, Claim 5). Because the predetermined threshold distance represents the “average distance from

the shoulder of an average user to the grip center of a hand,” Ex.1005, [0031], a POSITA would have understood that length to be based on an arm’s length of a user.

490. Thus, in my opinion, Ravasz in view of Tang renders obvious *wherein the apparent distance is determined based on an arm’s length of a user.*

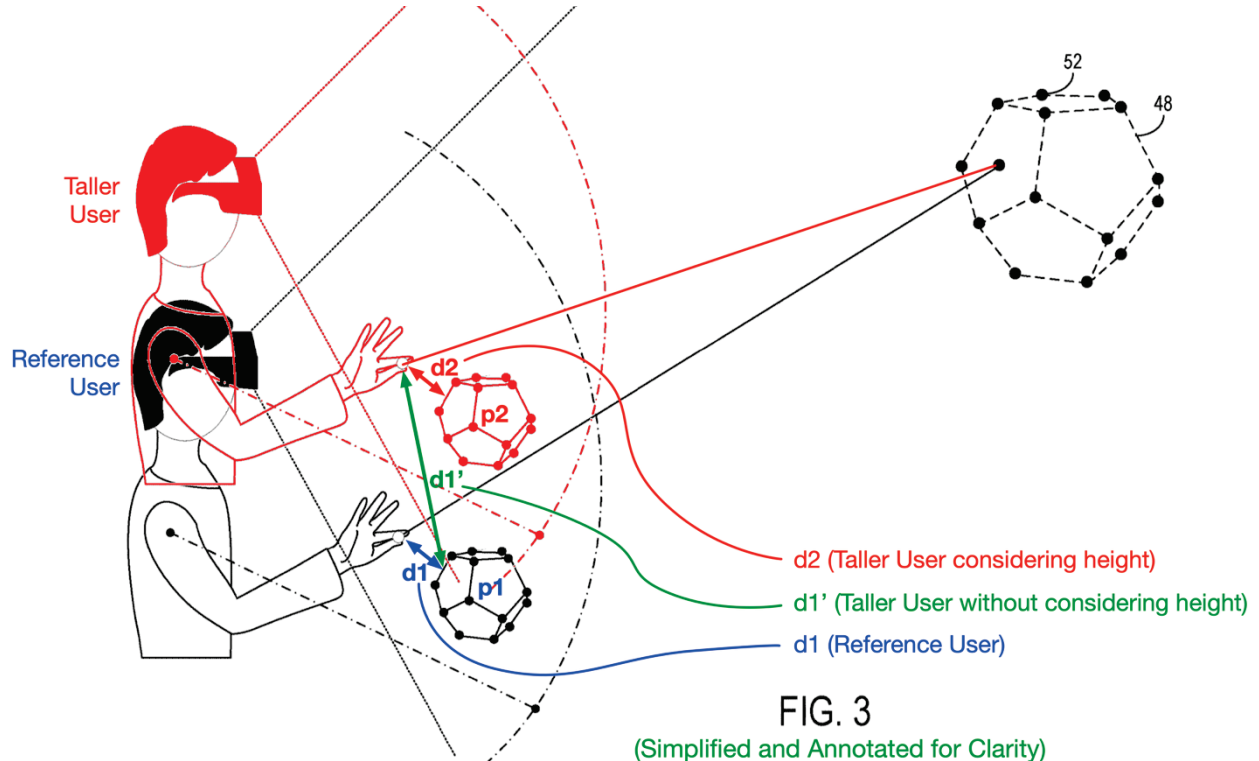
**5. Claim 17: “The method of claim 15, wherein the apparent distance is determined based on a height of the user.”**

491. In my opinion, Ravasz in view of Tang renders obvious this limitation.

492. As I indicated above for 12[b], it is my opinion that after combining Ravasz-Tang with Mine, Ravasz’s HMD would display the UI menu in Tang’s near interaction mode after determining that the user’s hand is not in contact with the controller as taught by Mine (*after said detecting*) so that the system can switch to gestures in the near interaction mode. *See* § XII.C.3. Further, in the Ravasz-Tang combination, the UI menu displayed in the near interaction mode is within a predetermined threshold distance to the user’s hand that is tracked by image capture devices 138 (*first software application icon and the first virtual reality platform system setting icon are displayed to appear closer to a body part of the user that is tracked by a camera*). *See* § XI.E.5. Also, in the Ravasz-Tang combination, the user, in near interaction mode, uses their hand to interact with the UI menu using pre-defined gestures including movements that are normal to the UI menu such as

tapping and pressing (*to interact with the first software icon and the first virtual reality platform*). See § XI.E.8.

493. A POSITA would understand that to allow a person to use their hand to interact with the UI menu using such pre-defined gestures one would have to render the UI menu such that it is within a predetermined threshold distance to the user's hand. A POSITA would further understand that, compared to a reference user—a user of typical height, the UI menu would have to be rendered in a difference position for a taller user, so that the predetermined distance to the user's hand was maintained. To illustrate this point, I created a simplified and annotated version of Tang's FIG. 3 (Ex. 1005), which I have included below.



Ex. 1005, FIG. 3 (Simplified and Annotated for Clarity).

In the original FIG. 3 from Ex. 1005, the UI menu would be at position p1 (blue) for the Reference User, which would be distance d1 (blue) from the Reference User's hand. In this configuration, the UI menu would be within the predetermined distance to the user's hand. If one rendered the UI menu in the same position p1 (blue) for a Taller User (red), as was done for the Reference User, the distance from the UI menu to the taller user's hand would then be d1' (green). As is evident from my simplified and annotated figure above, the distance d1' (green) would be greater than the originally intended predetermined distance d1 (blue) to the user's hand, such that the user might no longer be able to use their hand to interact with the UI menu using pre-defined gestures. To render the UI menu such that it was within the originally intended predetermined distance d1 (blue) to the user's hand, so the user could use their hand to interact with the UI menu using pre-defined gestures, it would instead need to be rendered at position p2 (red), which would result in it being distance d2 (red) from the Taller User's hand, where d2 (red) would then be equal to d1 (blue), such that the user would be able to use their hand to interact with the UI menu using pre-defined gestures. As such, a POSITA would have understood that rendering the virtual interaction object such that *the apparent distance is determined based on a height of the user* would result in the virtual interaction object *displayed within a touching distance of the user* (claim 15).

494. Thus, in my opinion, Ravasz in view of Tang renders obvious *wherein the apparent distance is determined based on a height of the user.*

6. **Claim 18:** “The method of claim 15, wherein the apparent distance is determined based on a predetermined value representing average arms’ length for a predetermined group of persons.

495. In my opinion, Ravasz in view of Tang renders obvious this limitation.

496. As I discussed, Ravasz discloses determining an *apparent distance* relative to the user. *See* § XI.D.3.

497. The predetermined threshold distance (*apparent distance*) is “in a range of 460 mm to 580 mm,” (*determined based on a predetermined value*) *representing* an “average distance from the shoulder...to the grip center of a hand” (*average arms’ length*) of “an average user.” Ex. 1005, [0031]; *see also* § XI.D.3.

498. Thus, in my opinion, Ravasz in view of Tang renders obvious *wherein the apparent distance is determined based on a predetermined value representing average arms’ length for a predetermined group of persons.*

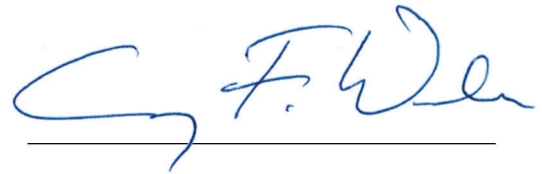
### **XIII. CONCLUSION**

499. For all the reasons stated above, it is my opinion that the challenged claims of the ’742 patent are unpatentable.

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This declaration and my opinions are made to the best of my knowledge and understanding, and based on the material available to me at the time of signing this declaration. All statements made herein of my own knowledge are true, and all statements made on information and belief are believed to be true. Further, I am aware that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001. I declare under penalty of perjury that the foregoing is true and correct.

Executed this 25 day of August 2026 in Longwood, Florida.



Gregory Welch

### APPENDIX A: MATERIALS CONSIDERED

| Exhibit No. | Description                                                                                                                       |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------|
| 1001        | U.S. Patent No. 11,656,742 to Fieldman (“the ’742 Patent”)                                                                        |
| 1002        | File History of U.S. Patent No. 11,656,742                                                                                        |
| 1005        | U.S. Patent Application Publication No. 2020/0225830 to Tang et al. (“Tang”)                                                      |
| 1006        | U.S. Patent Application Publication No. 2025/0013302 to Mine et al. (“Mine”)                                                      |
| 1007        | U.S. Patent Application Publication No. 2020/0387228 to Ravasz et al. (“Ravasz”)                                                  |
| 1008        | RESERVED                                                                                                                          |
| 1009        | Mark R. Mine, Virtual Environment Interaction Techniques, UNC Chapel Hill Computer Science Technical Report TR95-018, May 5, 1995 |
| 1010        | ASME, The Link Flight Trainer, June 10, 2000                                                                                      |
| 1011        | Royal Air Force Museum, Flight Simulation and Synthetic Trainers                                                                  |
| 1012        | Irving C. Statler, NASA, Characteristics of Flight Simulator Visual Systems, April 1981                                           |
| 1013        | Dean Kocian, A Visually-Coupled Airborne System Simulator, 1977                                                                   |
| 1014        | Aurale R. DeRuyck, An Electromagnetic Position Sensor, 1973                                                                       |
| 1015        | Sutherland, A Head-Mounted Three Dimensional Display, 1968                                                                        |

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| Exhibit No. | Description                                                                                                                                                                      |
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| 1017        | General Electric, Modifications to Interim Visual Spaceflight Simulator, 1966                                                                                                    |
| 1018        | Parisi, Learning Virtual Reality, November, 2015                                                                                                                                 |
| 1019        | U.S. Patent No. 2,955,156 to Heilig ("Heilig")                                                                                                                                   |
| 1020        | TechCrunch, HoloLens Hands-On: How We Built An App for Microsoft's Augmented Reality Headset, May 1, 2015                                                                        |
| 1021        | Paul James, RoadtoVR, Watch Halo Played on Microsoft HoloLens in Augmented Reality, December 7, 2015                                                                             |
| 1022        | Hayden Dingman, Five Years of VR: A Look at the Greatest Moments from Oculus Rift to Quest 2, March 29, 2021                                                                     |
| 1023        | Brian Crecente, Oculus Rift S, Oculus Quest Hit May 21, Pre-Orders Open, April 30, 2019                                                                                          |
| 1024        | Oculus Quest Basics Tutorial, <a href="https://www.youtube.com/watch?v=pVFcsedWsKE">https://www.youtube.com/watch?v=pVFcsedWsKE</a> , May 20, 2019 (last accessed Aug. 18, 2026) |
| 1025        | Jason Jerald, The VR Book: Human-Centered Design for Virtual Reality, 2016                                                                                                       |
| 1026        | NSA, Virtual Reality, 1992                                                                                                                                                       |
| 1027        | Billinghurst, A Survey of Augmented Reality, March, 2015                                                                                                                         |
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| <b>Exhibit No.</b> | <b>Description</b>                                                                                                                       |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------|
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| 1030               | Mark R. Mine, Working in a Virtual World: Interaction Techniques Used in the Chapel Hill Immersive Modeling Program, 1996                |
| 1031               | Ben Schneiderman, Designing Menu Selection Systems, 1986                                                                                 |
| 1032               | Github, MixedRealityToolkit-Unity, August 21, 2019                                                                                       |
| 1033               | Github, MixedRealityToolkit-Unity, README.md                                                                                             |
| 1034               | Github, MixedRealityToolkit-Unity, README_Button.md                                                                                      |
| 1035               | Github, MixedRealityToolkit-Unity, Pointers                                                                                              |
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| Exhibit No. | Description                                                                                                                                                                              |
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| 1046        | Ben Lang, Oculus Quest Hand-tracking Starts Rolling Out This Week, Developer SDK Next Week, RoadtoVR, December 2019                                                                      |
| 1047        | JP Patent Application No. 2022-049042 Certified Translation                                                                                                                              |
| 1049        | U.S. Patent No. 11,531,448 to Fieldman (“the ’448 Patent”)                                                                                                                               |
| 1050        | File History of U.S. Patent No. 11,531,448                                                                                                                                               |
| 1051        | Hyunyoung Song et al., Grips and Gestures on a Multi-Touch Pen, CHI 2011. May 7-12, 2011, Vancouver, BC, Canada                                                                          |
| 1052        | Munehiko Sato et al., Touché: Enhancing Touch Interaction on Humans, Screens, Liquids, and Everyday Objects, CHI 2012, May 5-10, 2012, Austin, Texas, USA                                |
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| 1054        | James P. Williams and Greg Welch, The Pressure Sensitive Touch-pad, Purdue University, E.E.T. 454 Project Report, April 30, 1985                                                         |
| 1055        | Greg Welch and James P. Williams, The Easy Chair, May 5, 1986                                                                                                                            |
| 1056        | Chris Kohler, Review: Oculus Touch, WIRED, Dec. 5, 2016                                                                                                                                  |

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| Exhibit No. | Description                                                                                                                                                      |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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