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Filed on behalf of Meta Platforms, Inc.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

META PLATFORMS, INC.,
Petitioner

v.

MULLEN INDUSTRIES, LLC,
Patent Owner

Case No. IPR2025-00702
U.S. Patent No. 10,967,270

**Petition for *Inter Partes* Review of
U.S. Patent No. 10,967,270**

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I. INTRODUCTION

Meta Platforms, Inc. (“Petitioner”) respectfully requests *inter partes* review of claims 4, 5, 16, 17, and 19 of U.S. Patent No. 10,967,270 (EX1001, “the ’270 Patent”).

Virtual reality systems have been available for decades. *See generally* EX1015. These systems allowed users to explore virtual worlds, and as technology advanced generally, so did the immersive experience of these systems. By the 2000s, with the advance of location-based computing, virtual systems could track the location and movement of objects and users. This tracking was implemented, in part, by setting reference locations and object directions.

The ’270 Patent describes a gaming system that tracks a user’s movement and physical location for a virtual game character on a virtual gamefield. During a lengthy prosecution, the Examiner rejected the claims finding all the limitations known in the art. The Examiner only allowed the claims after they were amended to recite that the *directional reference is operable to be updated during said gameplay*. But even this feature was already known. For example, Cheok¹ discloses a Human Pacman game that would reinitialize the inertial sensors and references angles during play.

¹ *See supra*, Section IV.A.

Accordingly, Petitioner respectfully requests the Board institute review and find all challenged claims of the '270 Patent unpatentable.

II. IDENTIFICATION OF CHALLENGES

Ground	Claims	Statute	Prior Art ²
1	4, 5, 16, 17, 19	pre-AIA 35 U.S.C. § 103	Cheok (EX1006), Nakamura (EX1007), Foxlin077 (EX1008)
2	4, 5, 17		Nakamura, Benini (EX1009)
3	16 and 19		Nakamura, Benini, Foxlin068 (EX1010)

The challenged claims are not entitled to an effective filing date earlier than September 1, 2004.³ *See infra*, Sec. III.A.1.

III. BACKGROUND

A. '270 Patent

The '270 Patent describes well-known systems that employ wireless communication devices with locating and directional devices to allow multi-user gameplay in a virtual world. The '270 Patent describes a multiplayer virtual PACMAN game as an example of such a reality-based video game, where one player may “[c]ontrol...PACMAN...by changing the location of the wireless [device]” and “[a] different player could use a different game system...to control a ghost in the

² Each is §§ 102(a), (b), and/or (e) prior art.

³ Petitioner does not concede this priority date.

same game.” *Id.*, 3:48-55. Each “user may look down at a display screen, see his/her character, and run around his/her physical environment in order to similarly run his/her virtual character through a virtual maze.” *Id.*, 3:57-60.

The ’270 Patent describes that “[l]ocation information may be utilized, for example, to determine a virtual character’s location (e.g., a particular first-person perspective) in the virtual realm.” *Id.*, 3:16-19. Various “locating devices” and “directional devices” enable the collection of a user’s location information during gameplay. *Id.*, 3:43-4:35.

B. Priority No Earlier Than September 1, 2004

The ’270 Patent is not entitled to a priority date earlier than September 1, 2004, the filing date of the first utility application to which the ’270 patent claims priority. EX1001, 1. The challenged claims⁴ are not supported by Provisional Application 60/499,810, filed September 2, 2003 (“the ’810 provisional”) or Provisional Application 60/603,481, filed August 20, 2004 (“the ’481 provisional”). *See generally* EX1036; *see also generally* EX1037; Welch ¶83.

To claim priority to either provisional filing date, “each application in the chain leading back to the earlier application must comply with the written

⁴ Independent claim 4 and dependent claims 5, 16, 17, and 19 are challenged.

description requirement of 35 U.S.C. § 112.” *Zenon Envtl., Inc. v. U.S. Filter Corp.*, 506 F.3d 1370, 1378 (Fed. Cir. 2007). To satisfy this requirement, “the specification of the **provisional** 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 . . . to enable an ordinarily skilled artisan to practice the invention **claimed** in the **non-provisional** application.” *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (emphasis original). Moreover, the provisional application “must describe the later claimed invention in sufficient detail that one skilled in the art can clearly conclude that the inventor invented the claimed invention as of the filing date sought.” *Tech. Licensing Corp. v. Videotek, Inc.*, 545 F.3d 1316, 1331 (Fed. Cir. 2008).

Neither provisional complies with the written description requirement for claim 4, which recites, in part, “to receive...a second manual input for setting a directional reference for a direction of gameplay for a virtual character of a location-based game.” EX1001, 24:41-53; *see generally* EX1036; *see also generally* EX1037; Welch ¶83. The ’810 provisional does not provide written description support for “a second manual input” or using such “for setting a directional reference for a direction of gameplay for a virtual character of a location-based game.” *See generally* EX1036; Welch ¶83. The ’481 provisional concerns a flexible keyboard

and monitor and has no written description support for claim 4 including the foregoing recited element. *See generally* EX1037; Welch ¶83.

Accordingly, the challenged claims⁵ of '270 Patent are not entitled to claim benefit of priority to either provisional application. *See generally* EX1036; *see also generally* EX1037.

C. Prosecution History

The Examiner rejected the original claims of the '270 Patent in a series of non-final rejections spanning more than a decade—from 2007 until 2019. *See generally* EX1002. Issued claims 4 and claim 5 (corresponding to prosecution claims 23 and 24, respectively) appeared in the original claims but initially only recited limitations concerning the manual input of a *directional reference*. *Id.*, 718. On March 20, 2019, PO amended claim 4 to additionally recite a manual input for setting an *origin location setting*. *Id.*, 278-79 (adding origin location setting limitations). Despite substantively amending independent claim 4, the Examiner continued to reject claims 4 and 5. Welch ¶86.

But on September 10, 2019, the Examiner finally gave in and allowed the claims after PO amended claim 4 to further recite *said directional reference is*

⁵ Claims 5, 16, 17, and 19 depend on claim 4.

operable to be updated during said gameplay. *Id.*, 244. The Examiner stated that while the relied-upon prior art teaches that the direction of a camera changes with a movement of a character, there is no disclosure to updating or resetting the direction of the camera during gameplay. *Id.*, 229. PO then requested continued examination and submitted additional claims, including issued claims 16 (corresponding to prosecution claim 34), 17 (corresponding to prosecution claim 35), and 19 (corresponding to prosecution claim 37). *Id.*, 68-69. These additional claims were allowed on August 18, 2020, and the '270 Patent issued on April 6, 2021. *Id.*, 43-49; EX1001, 1; Welch ¶86.

IV. THE PRIOR ART

None of the prior art was cited during prosecution of the '270 patent nor is any prior art cumulative to the prior art cited during prosecution.

A. Cheok (EX1006)

1. Overview

Cheok is presented as a primary reference.

Cheok discloses a “Human Pacman” AR and VR gaming system. *Compare* EX1006, 106-108, *with* EX1001, 3:12-5:15; Welch ¶96. As shown below in Figures 5 and 6, Cheok’s Human Pacman game closely resembles the original Pacman set in an outdoor area for gameplay. *Id.*, 110-11; Welch ¶96.

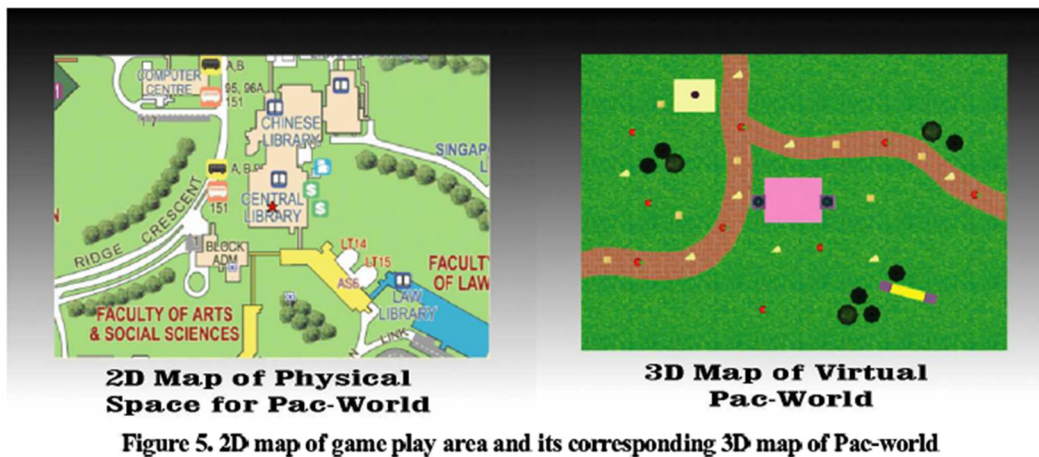


Figure 6. Correspondence between the physical world and the virtual Pac-world

Cheok's Human Pacman comprises an “interactive ubiquitous and mobile entertainment system that is built upon position and perspective sensing via Global Positioning System and inertia sensors; and tangible human-computer interfacing with the use of Bluetooth and capacitive sensors.” *Id.*, 106. Cheok's system features “Pacmen and Ghosts” as “real human players in the real world experiencing mixed computer graphics fantasy-reality provided by using wearable computers that are

equipped with GPS and inertia sensors for players' position and perspective tracking.” *Id.*, 106. An example of a user's wearable computer is shown in Figure 4 below. *Id.*, 110.



Figure 4. Detail configuration of wearable computer

Id., FIG. 4. The wearable computer also incorporates a HMD which enables users to switch between AR and VR modes. *Id.* Figure 11 below shows an example of the two modes available to users. Welch ¶97.



Figure 11: HMD display and the corresponding label under VR mode when Pacman gains power

Id., FIG. 11.

Cheek further discloses that “[v]irtual cookies and actual tangible physical objects with Bluetooth devices and capacitive sensors are incorporated into the game play to provide novel experiences of seamless transitions between real and virtual worlds.” EX1006, 106. For example, Pacmen players collect virtual cookies and collect ingredients that are Bluetooth embedded objects. *Id.*, 106, 109. As shown in Figure 9 below, when a player collects a cookie, the cookie disappears from the virtual world in real-time. *Id.*, 112; Welch ¶98.

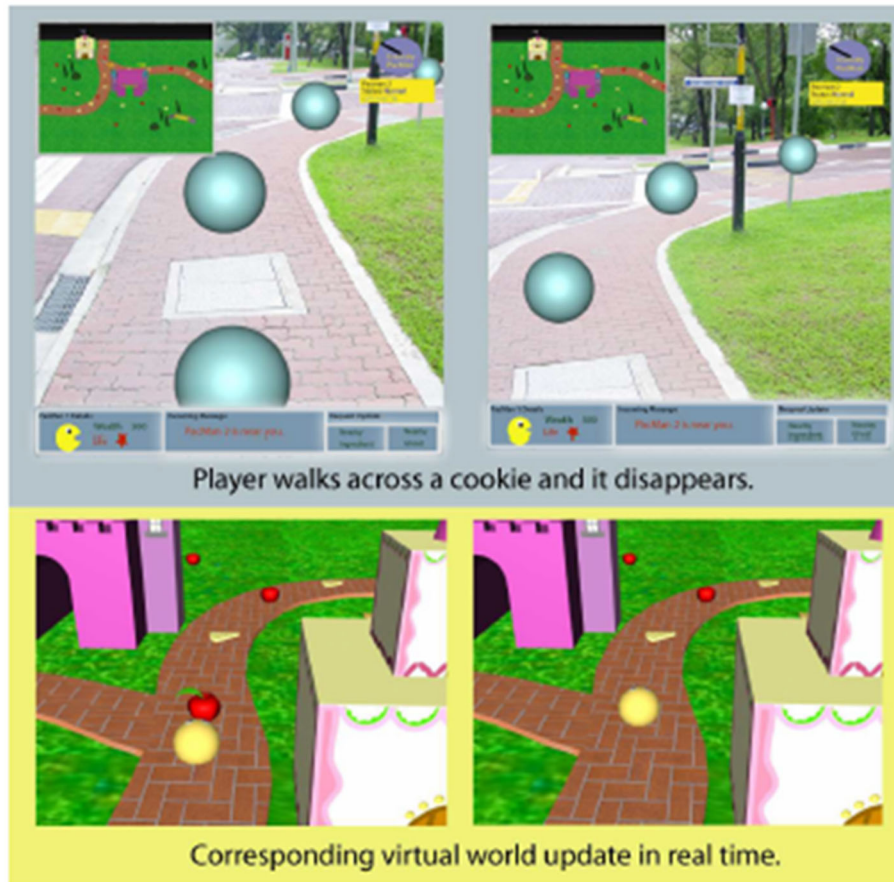


Figure 9: Pacman collecting cookies

Id., FIG. 9.

While Cheok's Human Pacman largely resembles original Pacman, it also introduces a third type of player—Helpers, as shown in Figure 8 below, who participate in the game remotely via a computer terminal and exclusively use the VR mode to help Pacmen and Ghosts with identifying enemy mobile units and hidden ingredients. EX1006, 106, 111; Welch ¶¶99.



Figure 8. Close collaboration between the outdoor Pacman and her Helper

EX1006, FIG. 8.

The above-described Human Pacman system “features a centralized architecture that is made up of four main entities, namely the central server, wearable computers, Sony VAIO laptops, and Bluetooth embedded objects,” as shown in Figure 3 below. *Id.*, 109. Cheek discloses that “[t]he Wireless Lan serves as a communication highway between the wearable computers, the helper computers (Sony VAIOs laptops), and the server desktop computer.” *Id.* “The underlying program is built on a client/server model with wearable computers and helper laptops as clients, and the desktop computer as a central server.” *Id.*, 109-10. “The server

maintains up-to-the minute players' information (location, status etc.), and presides over any communication between Bluetooth objects and the wearable computers.”

Id., 110; Welch ¶100.

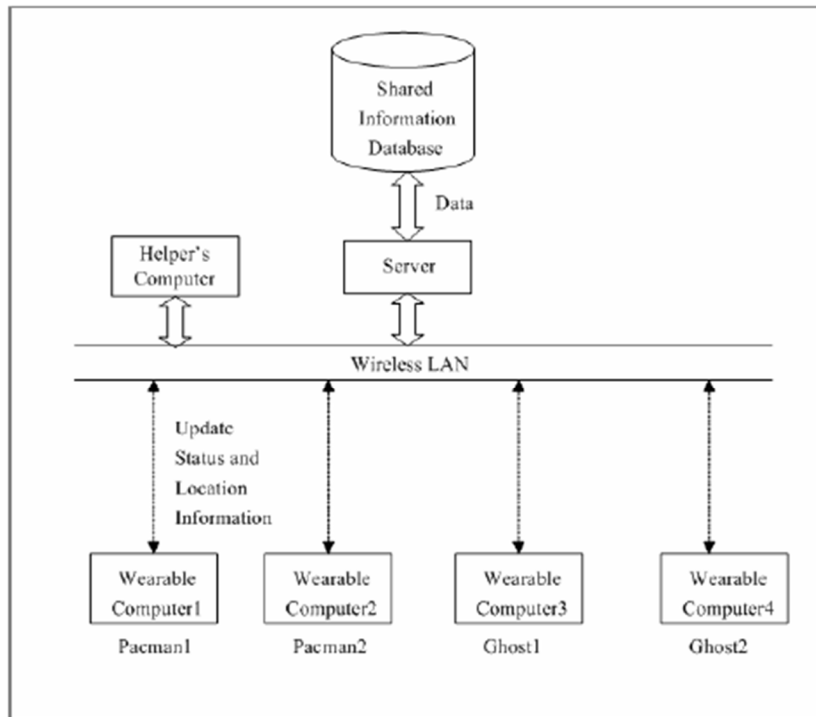


Figure 3. Complete system overview of Human Pacman

Id., FIG. 3.

Like the '270 Patent, Cheok teaches a gaming system comprising a wireless-enabled wearable computer device that incorporates a HMD, disclosing a *system* comprising a wireless communication *device* with a *display* that has a *graphical user interface*, as recited in independent claim 4. Secs. III.B-C., Welch ¶101. Also like the '270 patent, Cheok discloses an *origin location setting* and a *direction of gameplay*, as recited in independent claim 4. Cheok explains that its wearable

computer device has GPS and inertial sensors, in which a user's location is tracked in the real world and their corresponding virtual character (e.g., a Pacman or Ghost) is shown in corresponding positions in the virtual world displayed on the user's HMD. EX1006, 108-09. Notably, Cheok recognizes that there are vast sensor tracking issues that its paper does not address and would lead one to look to other sources that have addressed these issues. *Id.*, 108, 115. Welch ¶102.

2. Cheok is Prior Art

Cheok is a printed publication that was publicly available on May 22, 2003 when it was disseminated to attendees of the NetGames 2003 Conference participants. *See* Claypool ¶¶6-10; Delman ¶11. Also, Cheok was publicly available on January 6, 2004 through the ACM digital library. Delman ¶¶5-10.

Cheok originated at the NetGames 2003 conference (the "NetGames '03 Conference") where Cheok's subject matter was presented on May 22-23, 2003. Claypool ¶¶6-7. Each conference made available and disseminated to all attendees of NetGames Conferences peer-reviewed research papers... that have been accepted for publication at the NetGames Conference. Claypool ¶4. Cheok's paper was submitted and accepted. Thus, the NetGames'03 Conference disseminated Cheok to all attendees. Delman ¶10, Claypool ¶7. *See Mass. Inst. of Tech. v. AB Fortia*, 774 F.2d 1104 (Fed. Cir. 1985) (holding that an orally presented paper that was

distributed only six times at conference was a printed publication); *see also* Claypool ¶¶6-10 (“The NetGames ’03 Conference Proceedings, including Human Pacman, was disseminated to conference attendees on the first day of the NetGames ’03 Conference (May 22, 2003). I received a printed copy of the NetGames’03 Conference Proceedings, including Human Pacman, when I attended the conference on May 22, 2003”); Delman ¶11 (“The conference started on May 22, 2003, and the paper would have been available to the conference attendees on this date.”). Moreover, the ACM Digital Library published Cheok online on January 6, 2004 in a searchable database (e.g., by keywords) and it is still accessible today. Delman ¶¶10. It is in the regular business practice of ACM to publish articles accepted to its conference proceedings, journals, and full-text publications. Delman ¶5-6. Cheok is prior art because publication through dissemination and publication online occurred before September 1, 2004. Delman ¶10 (“The conference started May 2003, and the paper would have been available to the conference attendees on this date.”)

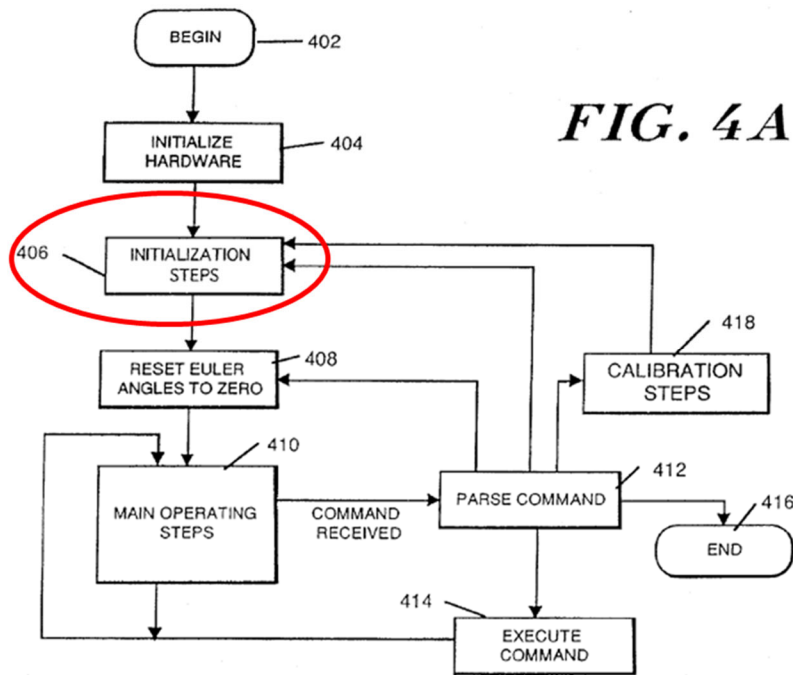
B. Foxlin077 (EX1008)

Foxlin077 is a U.S. patent issued on July 8, 1997, and is prior art under §102(a), (b), and (e). Foxlin077 discloses an inertial sensor for use in VR and AR applications, like Cheok. EX1008, Abstract, 1:16-22, 5:7-9, 6:20-22; Welch ¶109.

Foxlin077 is presented as a secondary reference in combination with Cheok. Welch ¶109.

Foxlin077's inertial sensor addresses drift issues and “track[s] the orientation of a body to which it is mounted, without interaction with radiation, energy, signals, or physical connections from any other apparatus.” EX1008, 1:63-66; Welch ¶110. Specifically, Foxlin077 recognizes “[a] difficulty with using gyroscopes for head-orientation tracking is drift,” which “arises from integrating over time, a signal that is noisy, or has a bias.” EX1008, 2:56-58; Welch ¶110. Foxlin077 resolves this with a “drift compensator” component that automatically corrects drift. EX1008, 6:27-32, 9:1-23; Welch ¶110.

Drift compensation requires using parameters measured during an initialization process, as shown in red in Figure 4A below. EX1008, 11:1-7; *see also id.*, 9:61-67; Welch ¶111.



EX1008, FIG. 4A (annotated). The initialization steps “establish the rest position, from which orientation is measured and measure biases for the rate sensors,” after which “the main operating steps 410 are performed.” *Id.*, 9:67-10:7. “Initialization must be conducted with the sensor assembly held stationary in a known reference orientation.” *Id.*, 10:29-31. A “user is instructed 432 to place the sensor assembly in such a position by a message delivered to the apparatus input/output devices or implicitly by the fact of starting the tracker.” *Id.*, 10:31-35. After initialization, the operating steps are repeated until a command is received, where a command may be user-generated and includes operations such as a reinitialization process. *Id.*, 10:9-11, 10:17-20; Welch ¶111.

Like the '270 Patent, Foxlin077 discloses *a second manual input for setting a directional reference for a direction of gameplay...based on the direction of said device*, as recited in independent claim 4, because a user is prompted by a message to manually place the inertial sensor assembly in a known reference orientation in order to establish the rest position from which orientation is measured. Secs. III.C-D; Welch ¶112.

Also like the '270 Patent, Foxlin077 discloses that the *directional reference is updated during said gameplay*, as recited in independent claim 4, and *reset during play of said location-based game*, as recited in dependent claim 5, because Foxlin077 discloses that the same initialization process can be performed in the middle of the main operating steps in response to a manual reinitialization command. Secs. III.C-D; Welch ¶113.

C. Nakamura (EX1007)

Nakamura is Japanese patent application published on March 21, 2001 and is prior art under §102(a), (b), and (e). EX1007 is a true and correct translation of Nakamura. *See generally* EX1038. Nakamura is presented as a primary reference and also secondary reference in combination with Cheok. Welch ¶104.

Generally, Nakamura discloses “a system for controlling a computer based on location information,” which involves a virtual role-playing game with virtual

characters on a virtual playfield with virtual locations. EX1007, ¶[0001]. As such, “new scenes or worlds automatically open depending on certain conditions.” EX1007, ¶[0005]. For example, “by utilizing current location information, which can be obtained through technologies such as GPS, a new virtual world is opened.” *Id.* A user walks, runs, or bicycles through the real world, and the user’s current location in the real world is reflected in the virtual world, allowing the role-playing game to progress. *Id.*, ¶[0014]. This enhances the game playing environment by combining real location information with conventional gaming methods. *Id.*, Abstract. Welch ¶105.

Nakamura implements its system on a mobile terminal equipped with a GPS unit for acquiring the user’s current location. *Id.*, ¶¶[0016], [0019]. The mobile terminal “connect[s] to a server system 20 that provides the role-playing game through the general internet 1 as the computer network.” *Id.*, ¶[0018]. Nakamura further explains that “[i]n the role-playing game executed by the game system 10, a position icon (such as an illustration resembling a human figure) displayed on the screen moves in response to the movements of the user holding terminal 6.” *Id.*, ¶[0031]. This display of virtual position allows the user to feel as if they are “entering and moving through the virtual world of the role-playing game screen.” *Id.* The virtual world also allows for the display of “event icons representing other

users who are accessing the same role-playing game,” as well as “communication (chat) through the screen” with the other users of the role-playing game. *Id.*, ¶[0029]. Welch ¶106.

Like the '270 Patent, Nakamura teaches a gaming system comprising a mobile terminal with a display with a GUI, on which the user may manually arrange a movable position icon in order to set a desired initial position for gameplay, discloses a *system* comprising a wireless communication *device* with a *display* that has a *graphical user interface* to receive a *first manual input for setting a origin location setting for a location reference for gameplay*, as recited in independent claim 4. Secs. III.C-D; Welch ¶107. Nakamura further discloses that the mobile terminal has a GPS unit, and tracks a user’s location in the real world, based on the initial position set by the user, and their corresponding position icon (a human figure illustration) is shown in corresponding positions in the virtual world displayed on a mobile terminal. EX1007, ¶¶[0005], [0009], [0015]-[0016], [0019], [0025], [0034]-[0036]; Welch ¶107.

D. Benini (EX1009)

1. Overview

Benini discloses wireless portable devices for exploring virtual environments. EX1009, 1-4. Benini is presented as a secondary reference in combination with Nakamura. Welch ¶115.

Benini discloses a “hardware/software system for PDA-based interaction with IVEs [(immersive virtual environments)] realized in the field of Virtual Heritage (VH): Virtual Reality applied to Cultural Heritage.” EX1009, 2. Benini aims to “reconstruct[] cultural heritage objects and environments” in an immersive virtual reality environment. *Id.*, 1. For example, “Virtual Heritage” applications may allow scholars to explore an archaeological site or the general public to explore a virtual museum. *Id.*, 2. Benini discloses the use of “standard, consumer-market wearable interactive terminals, such as palmtop computers (Pocket PC and PDAs), as the preferred interfacing device with IVEs...in the field of Cultural Heritage.” *Id.* As shown below in Figure 3, the system consists of portable terminals for interfacing with the virtual environment (e.g., a virtual theatre) over a wireless network, along with client-server software that runs on the terminals (client) and virtual reality engine (server). *Id.*, 4. Welch ¶116.

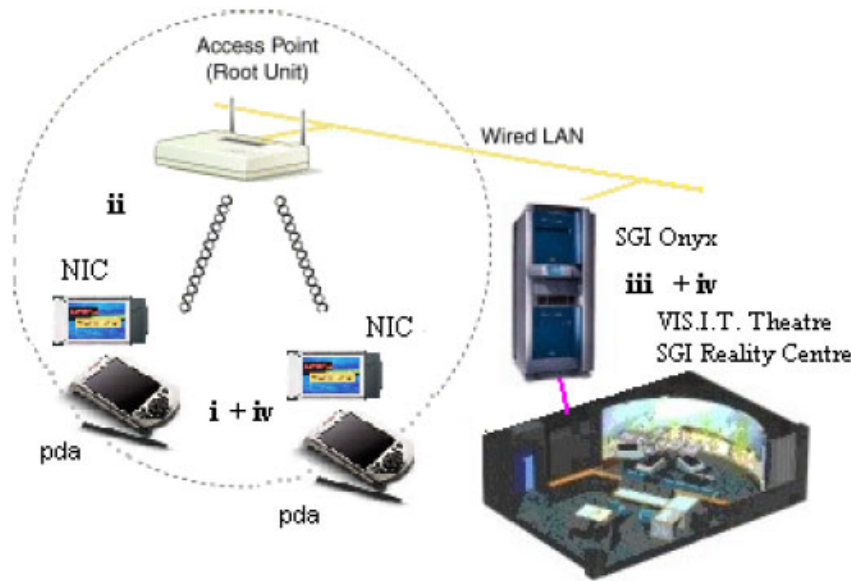


**Figure 3: Components of the interactive system:
portable terminals(i), wireless network(ii), virtual
theater (iii), client-server software (iv).**

EX1009, FIG. 3.

Benini additionally explains how the portable palmtop computers/PDAs can be used to support the basic interaction tasks in the field of 3D user interfaces—navigation, selection/manipulation, and system controls. *Id.*, 2-3. For example, a PDA may incorporate a “‘2D map’ in which the users visualize their position and orientation in the virtual world,” to allow users to see “which regions can be reached by their current position.” *Id.*, 3. Benini explains “[t]he UI features a two-dimensional map abstraction of the VR world, augmented with various navigation controls,” including “eight arrows to more intuitively navigate in the environment.”

Id., 3. The 2D map reproduces a view of the virtual environment, “enabl[ing] the user to visualize his/her position in the virtual world with a red rectangle and the direction of observation with a green rectangle.” *Id.*, 4. “[F]our arrows realizes the metaphor of moving forward, backward, left and right the avatar in the VE as if it is walking into it; and four arrows are used to turn around and to look up and down.” *Id.*, 4. Figure 2 below shows an example PDA with arrows (in green) for visualizing position and direction in the virtual environment. Welch ¶117.



Figure 2: The User Interface developed for interacting via PDA with the Nu.M.E. VE

EX1009, FIG. 2 (annotated). The user interface arrows can be used to “change [the] camera’s position and orientation (interacting with the 2D map or with the arrows),”

thereby changing the view in the virtual environment. *Id.*, 5. When “requesting to change [a] camera’s position and orientation” according to interaction with the map/arrows, the portable terminal (client) has to send to the server (virtual reality engine) “a 6-dimensional vector that includes world coordinates (x, y, z) and the three angles: heading—the rotation about the Z axis—pitch—the rotation about the X axis—and roll—the rotation about the Y axis.” *Id.* This allows the server “to increment [the] current camera’s position and orientation” to show a new view in the virtual environment. *Id.* Welch ¶117.

Like the ’270 Patent, Benini discloses *a second manual input for setting a directional reference*, as recited in independent claim 4, because the portable terminal has directional arrows that allow a user to manually change the position and orientation of a virtual world on the display. Secs. III.C-D; Welch ¶188. Also like the ’270 Patent, Benini discloses that the *directional reference is updated during said gameplay*, as recited in independent claim 4, and *reset during play of said location-based game*, as recited in dependent claim 5, because the directional arrows can be used while actively exploring a virtual environment. *Id.*; EX1009, 3-5. Welch ¶118.

2. Benini is Prior Art

Benini originated at the EUROMEDIA'2002 Conference (the "EUROMEDIA Conference") where Benini's subject matter was presented on April 15-17, 2002. Geril ¶¶7, 11-13 ("Benini... was published in the Conference Proceedings Book," where "the Conference Proceeding Book was shipped... for distribution to attendees at the start of the conference"). The Conference, "as part of its ordinary course of business," created and organized an event in which "papers peer-reviewed by an intentional program committee that were subsequently accepted,.. were collected together for the conference's proceedings." *Id.*, ¶5-6. Benini submitted a paper that was peer-reviewed and accepted for publication. *Id.*, ¶12. At the EUROMEDIA Conference, Benini's paper was disseminated to all conference attendees on April 15, 2002. *See Mass. Inst. of Tech.*, 774 F.2d at 1104 (holding that an orally presented paper that was distributed only six times at conference was a printed publication); *see also* Geril ¶¶4, 7, 10--13 ("It was the regular business practice to... make available, and public the proceedings of the... Conferences," "Benini was published in the Conference Proceedings Book for the EUROMEDIA'2002 Conference and distributed to all attendees of the EUROMEDIA'2002 Conference, no later than April 15, 2002, according to the process described above."). Moreover, Benini was published in the Conference

Proceedings Book for the EUROMEDIA'2002 Conference and was available to the general public for order and purchase in the SCS Publications Catalogue and on the SCS Europe Bvba website after the conference. Geril ¶14. Benini is prior art as of April 15, 2002.

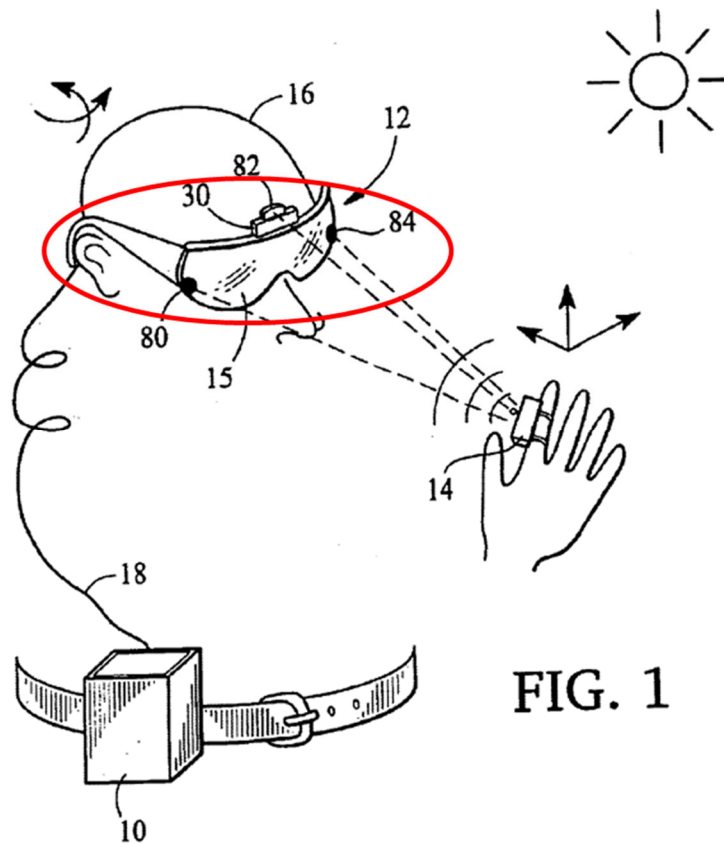
E. Foxlin068 (EX1010)

Foxlin068 is a U.S. patent application publication published on February 28, 2002 and is prior art §102(a), (b), and (e). Foxlin068 is presented as a secondary reference in combination with Nakamura and Benini.

Foxlin068 relates to a wireless location tracking technologies for use in virtual reality games. Specifically, Foxlin068 discloses using a *head-mounted display*, as recited in claim 16, to perform such wireless tracking. Foxlin068's "invention may combine a sourceless head orientation tracker 30 with a head-worn tracking device 12 that tracks a hand-mounted 3D beacon 14 relative to the head 16." EX1010, 5:5-8. Foxlin068's "new tracking technique is essentially 'sourceless' in that it can be used anywhere with no set-up of a source, yet it enables a much wider range of virtual environment-style navigation and interaction techniques than does a simple head-orientation tracker, including manual interaction with virtual objects." *Id.*, Abstract. For example, Foxlin068's tracking device may be used in virtual environments such as virtual reality games. *Id.*, 13:28-32, 14:5-42. Foxlin068

explains that the tracking device may incorporate an “inertial orientation tracker” and “position tracker” to perform wireless tracking. *Id.*, 5:45-50. Foxlin068 is presented as a secondary reference in combination with Nakamura. Welch ¶120.

Foxlin068’s “fully integrated wearable VR system” is shown in Figure 1 below. The system has “three parts (a wearable computer 10, a headset 15 with an integrated tracking system, and a hand-mounted beacon 14) and one cable connection 18.” EX1010, 5:14-18. Foxlin068 explains that the headset component (in red) may be a HMD. *Id.*, 5:45-62, 6:30-38, 6:61-63. Welch ¶121.



Id., FIG. 1 (annotated).

Like the '270 patent, Foxlin068 discloses a *head-mounted display*, as recited in claim 16, because the headset of the tracking device may take the form of a HMD. Secs. III.C-D. Welch ¶122.

V. LEVEL OF ORDINARY SKILL

A person of ordinary skill in the art (“POSITA”) in 2004 would have had at least a bachelor’s degree in electrical engineering, computer science, or a similar field, with at least two years of relevant experience working with VR and AR systems. Additional experience could substitute for less education, and additional education could likewise substitute for less experience. Welch ¶91; *see also id.* ¶¶88-90.

This Petition does 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 at the relevant time. *Id.* ¶92.

VI. CLAIM CONSTRUCTION

The Board construes the claims “using the same claim construction standard that would be used” in district courts. 37 C.F.R. §42.100(b). This Petition

establishes the prior art meets each of the claim limitation under any reasonable construction.⁶ Thus, no express construction is required.

**VII. GROUND 1: CHEOK IN VIEW OF NAKAMURA AND FOXLIN⁰⁷⁷
RENDERS OBVIOUS CLAIMS 4, 5, 16, 17, AND 19**

A. Motivation to Combine

1. Cheok and Nakamura

A POSITA would have been motivated to implement the Cheok Human Pacman based on Nakamura's teachings, for example, to implement the details of an initialization process to set an initial location. Welch ¶124; Sec. VII.C.3.b. Cheok discloses the system tracks real-time player location with respect to an initialization point but does not disclose the specific processes to set an initial location reference. EX1006, 106-108, 110. A POSITA would have thus been motivated to rely on the teachings of other references discussing these processes, including Nakamura's initialization step, in which a user manually inputs an initialization point. Welch ¶124. A POSITA would have also been motivated to implement the teachings of Nakamura's initialization feature in Cheok's system because it would have helped establish the real and virtual world correspondence. *Id.* A POSITA would have been

⁶ Petitioner reserves the right to argue alternative constructions in other proceedings, including indefiniteness.

motivated to include the manual process disclosed in Nakamura because it would have given the user further flexibility to create a more immersive experience in Cheok. *Id*; *see also, supra*, Section VII.C.3.b.

2. Cheok and Foxlin077

A POSITA would have also been motivated to implement the Cheok Human Pacman system based on Foxlin077's teachings, for example, to implement an inertial sensor initialization/reinitialization process for improved accuracy and reduced drift. Welch ¶126; Sec. VII.C.4.b. Cheok suggests that its wearable computer's sensors, including the inertial sensor, are subject to an initialization process, but does not disclose any specific initialization processes. EX1006, 108-09. A POSITA would have thus been motivated to rely on Foxlin077's initialization/reinitialization process, in which a user manually sets an orientation in response to a prompt. Welch ¶126. Indeed, a POSITA would have been motivated to consult Foxlin077 for these inertial sensor features because the InertiaCube2 inertial sensor described in Cheok is the same sensor as in Foxlin077. *Id.*; Sec. VII.C.3.b; EX1006, 109, 116; EX1013, 2; *see also* Welch ¶125.

A POSITA would have also been motivated to implement the Cheok system based on Foxlin077's initialization/reinitialization teachings because Cheok states that its sensors may be subject to tracking issues not addressed by the scope of the

Cheok paper. EX1006, 108, 115. Foxlin077 explains how to handle one common issue with inertial sensors—drift—with a drift compensation component that requires an inertial sensor initialization/reinitialization process. Welch ¶126. A POSITA would have also recognized that Foxlin077’s initialization/reinitialization process would have improved user experience when interacting with the real environment. *Id.*

See also, supra, Section VII.C.4.b (further motivation for Foxlin077).

B. Reasonable Expectation of Success

1. Cheok and Nakamura

A POSITA would have had a reasonable expectation of success in combining the teachings of Cheok and Nakamura. Welch ¶127. A POSITA would have used the software algorithms of Nakamura’s initialization process for setting an origin location to implement Cheok’s Human Pacman system. *Id.* Such a combination would have involved implementing the Cheok system in a manner that Cheok suggests is feasible—implementing the real-time tracking system such that it operates with respect to an initialization point. *Id.*

A POSITA would have also had the skill to implement and reasonable expectation of success in achieving such a combination, because it would have involved a combination of known technologies (e.g., known system of real-time

tracking with respect to an initialization point) according to known methods (e.g., known methods of initialization using a movable icon prompt) to yield the predictable result of a system in which a manual input for origin of gameplay is provided in response to a prompt. Welch ¶¶125, 127.

See also, supra, Section VII.C.3.c.

2. Cheok and Foxlin077

A POSITA would have had a reasonable expectation of success in combining the teachings of Cheok and Foxlin077. *Id.* ¶128. Specifically, a POSITA would have been able to implement Foxlin077's inertial sensor initialization/reinitialization process for the InertiaCube2 inertial sensor in Cheok's Human Pacman system which shared the same inertial sensor. *Id.* ¶128. Such a combination would have involved implementing the Cheok system in a manner that Cheok suggests is feasible—implementing the real-time tracking system such that an inertial sensor initialization process is performed—particularly since the Foxlin077 algorithms were intended to be used by same inertial sensor. *Id.*

See also, supra, Section VII.C.4.c

C. Independent Claim 4⁷

1. Preamble

To the extent limiting, Cheok discloses the preamble. Welch ¶¶129-130. As discussed in Section V.A, Cheok discloses a “Human Pacman” gaming *system* that brings existing iterations of Pacman into an augmented and virtual reality environment, allowing for human players representing Pacmen and Ghosts to engage in a physical role-playing game in a wide outdoor physical area. *See* Sec. IV.A; EX1006, 1. Human Pacman supports both AR and VR modes, with Pacman and Ghosts equipped with wearable computers and HMDs to switch between the two modes. *Id.* The wearable computers are also equipped with GPS and inertial sensors to track players’ position and orientation. *Id.* Unlike original Pacman, Human Pacman also introduces a third type of player—Helpers, who participate in the game remotely via a computer terminal and exclusively use the VR mode to help Pacmen and Ghosts with identifying enemy mobile units and hidden ingredients. *Id.* Human Pacman features a central architecture consisting of a central server, wearable computers, helper laptops, and Bluetooth embedded objects, with Wireless Lan enabling communication between the entities. *Id.*

⁷ Appendix A contains the claim language for all challenged claims.

2. 4[a]

Cheok discloses this limitation. Welch ¶¶131-138.

First, Cheok discloses *a device having a display*. Welch ¶132. Cheok discloses that each human player (Pacman or Ghost) wears a “wearable computer” *device* that enables “position and perspective tracking” to track movement through the real world. EX1006, 106, 107-109. As shown in red in Figure 4 below, each wearable computer has a Cy-Visor Head Mounted Display (*a device having a display*). *Id.*, 110. Figure 8 shows the game player donning the wearable computer installed on a vest and HMD on the player’s head. *Id.*, 111-12; Welch ¶133.



Figure 4. Detail configuration of wearable computer



Figure 8. Close collaboration between the outdoor Pacman and her Helper

Id., FIG. 4 (annotated), FIG. 8; Welch ¶133.

Second, Cheok discloses *wherein a graphical user interface is provided on said display*. As shown in Figure 7, a Pacman or Ghost player can see through the

HMD a view of the virtual world (i.e., the Pac-World view in the upper left corner), and a view of the real world overlaid with virtual cookies. EX1006, 111. Welch ¶134.

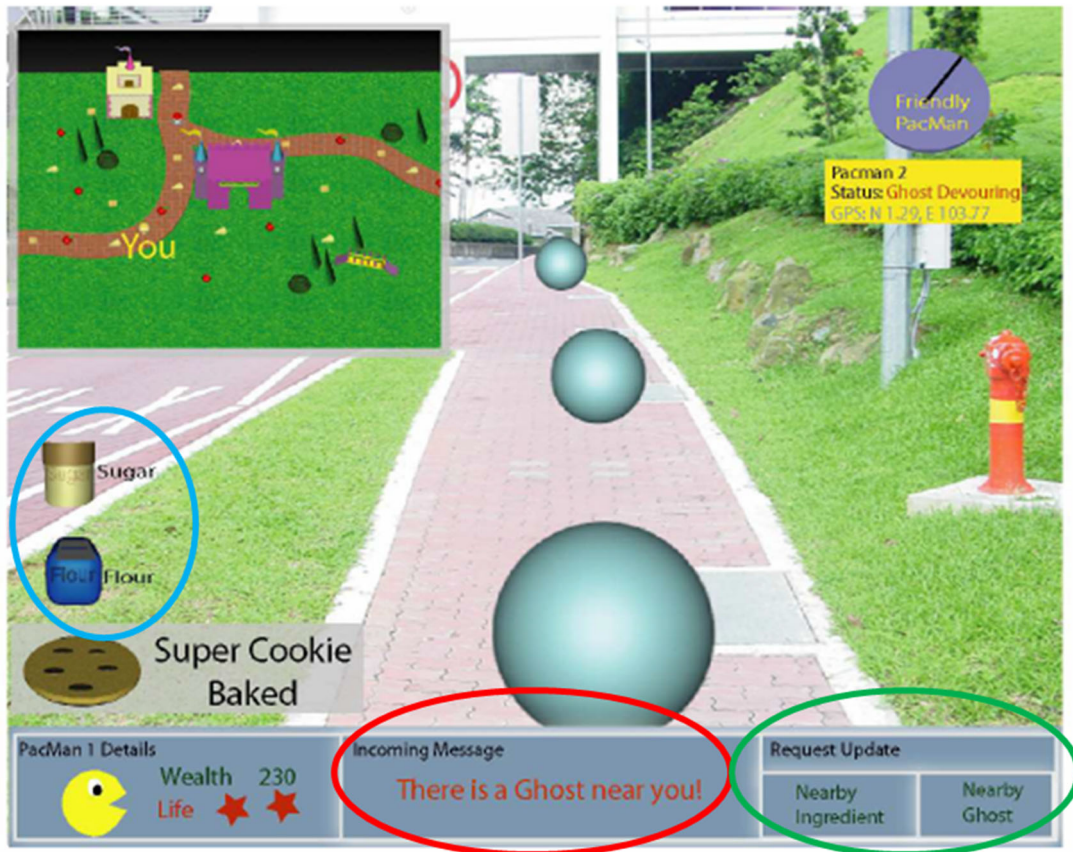


Figure 7. First person view as presented in HMD display of Pacman

EX1006, FIG. 7 (annotated). The HMD shows various graphical features in addition to the visual representation of the virtual and real worlds. For example, as shown above in red, the display includes a panel showing incoming “alert message[s]” (e.g., alerting to nearby Ghosts, nearby ingredients, or new special powers). *Id.*, 109, 114;

see also Welch ¶135. As shown in green, the display also includes clickable buttons that allow a Pacman user to request updates from Helpers on nearby ingredients or nearby Ghosts. EX1006, 114, 115. Cheek also discloses that ingredients (blue in Figure 7 above) may be clicked on to be exchanged/dumped. EX1006, 115. The wearable computer user interacts with the display (e.g., by clicking) by using the Twiddler2 component which consists of a handheld keyboard and mouse. *Id.*, 110, 115. Accordingly, a POSITA would have understood that the HMD provides a GUI (*wherein a graphical user interface is provided on said display*) because it provides a visual interface allowing Pacman or Ghost users to use their wearable computers to interact with other users, Helpers, or the environment through buttons and clickable icons. Welch ¶¶136-138. Indeed, a POSITA would have understood that such a GUI that receives manual input through buttons and clickable icons would have been configured to receive manual inputs as recited in limitations 4[a.1] and 4[a.2] below. *Id.* ¶138; Secs. VII.C.3-4.

3. 4[a.1]

Cheek in view of Nakamura renders obvious this limitation. Welch ¶¶139-144.

Cheek discloses *a[n] origin location setting for a location reference for gameplay*. Cheek's wearable computer (*device*) incorporates a dead-reckoning

module and GPS, among other sensors, to enable location tracking of users. EX1006, 106, 108, 110; Welch ¶140. The dead-reckoning module and GPS track the device's position (*location*) in real time by measuring displacement and direction with respect to an "initialization point" (*origin location setting*). Ex1006, 108; Welch ¶141. Cheok discloses that by calculating the location with respect to an initialization point, the "real-time position of each mobile user" is communicated to the server and other players. Welch ¶142. This real-time tracking of a player's movement in the physical world is "reflected...in real time" in the corresponding virtual character's movement in the virtual Pac-World. EX1006, 112. Thus, a POSITA would have understood that the Human Pacman system tracks location data for each user with respect to an initialization point (*origin location setting*), where the initial location data provides a location reference for the virtual character's gameplay (*a location reference for gameplay*). Welch ¶143.

Cheok does not explicitly disclose that the initialization point is set by having the GUI of the device's display receive *a first manual input*, but a POSITA would have been motivated and found it obvious to implement this feature in view of Nakamura. *Id.* ¶144.

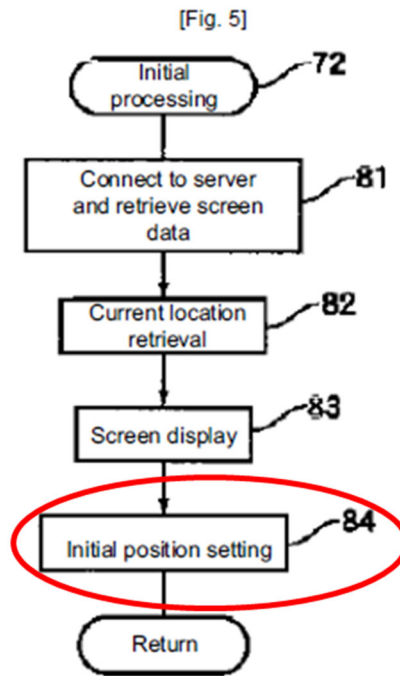
a. Nakamura

Like Cheok, Nakamura relates to a wireless location-based gaming system for interacting with a virtual space. *Id.* ¶145. Nakamura discloses a system for providing a role-playing game in a virtual world. EX1007, ¶¶[0005], [0018]. In the role-playing game, a user moves “through the real world, and the user’s current location in the real world is reflected in the virtual world, allowing the role-playing game to progress.” *Id.*, ¶[0015]. Further, a GPS receiver may be used as the positioning system to track the location of a user’s device (e.g., a mobile phone or some computer-readable recording medium) and that communication with the server system may occur wirelessly. *Id.*, ¶[0016]. Nakamura also discloses that the role-playing game may be played by multiple “users who are accessing the same role-playing game” (*id.*, ¶[0029]), and that users may compete with each other (*id.*, ¶[0009]). Thus, Nakamura is similar to Cheok, which as discussed for Section V.A and claim 4’s preamble, discloses an interactive multi-person gaming system in a virtual environment where users role play as Pacmen, Ghosts, or Helpers and locations are tracked in real-time and communicated wirelessly. Secs. IV.A, VII.C.1. A POSITA would have therefore been motivated to consider the teachings of Nakamura when implementing Cheok’s Human Pacman system. Welch ¶145.

Nakamura additionally discloses a feature for manually setting on a display interface a user's current location in the real world as a predetermined initial position in the virtual world. *Id.* ¶147. Nakamura explains that “new scenes or worlds automatically open depending on certain conditions.” EX1007, ¶[0005]; Welch ¶146. For example, “by utilizing current location information, which can be obtained through technologies such as GPS, a new virtual world is opened.” *Id.* Nakamura explains that this system for displaying virtual worlds may be provided on a mobile terminal equipped with a GPS unit to track the user's current location. *Id.*, ¶¶[0016], [0019]. Nakamura further explains that “initial settings [can] be configured to reflect movements in the real world within the virtual world.” *Id.*, ¶[0009]. Nakamura discloses that “it is desirable to perform an initial setup that defines the correspondence between the current location and the virtual position, as well as the ratio for converting actual displacement into virtual displacement, prior to starting the role-playing game.” *Id.*, ¶[0025]. The “function 33 for performing the initial setup is provided as one of the features of the display control unit 30, and the settings defined there are stored in a memory such as ROM or RAM.” *Id.*; Welch ¶147.

As part of this initial setup, “it is desirable to set the current location in the real world as a predetermined position (the initial value of the virtual position) within the first virtual world.” EX1007, ¶[0009]; Welch ¶147. The initial position may

represent “the starting point of the game or, if the game was interrupted, the point where it was paused.” EX1007, ¶[0009]. While it is possible “to use the parameters that are set by default” (*id.*, ¶[0025]), it is also possible to manually set (*first manual input*) the initial position setting (*origin location setting*). For example, as shown in red in Figure 5 below, “[i]n step 84, the function 32 for displaying the virtual position and virtual displacement displays the position icon 113 corresponding to the current location at the initial position 112 of the screen 111.” *Id.*, ¶[0035]. Welch ¶148.



EX1007, FIG. 5 (annotated). After the position icon is initially displayed on the screen, the “position icon 113, or position display icon, can be arranged according

to the user's preference.” *Id.*, ¶[0035]. Once the user has chosen a suitable initial position, the user performs an operation on the display to trigger an “initial setting function” that “set[s] that current location as the initial position” parameter. *Id.*, ¶[0036]; Welch ¶148.

b. Combination

A POSITA would have been motivated to rely on Nakamura’s initialization features to implement Cheok’s Human Pacman system. Welch ¶149. As discussed above, Cheok discloses that when tracking real-time position of a player, the system determines location with respect to an initialization point. However, Cheok does not disclose the specific processes for an initialization step to set an initial location reference. A POSITA would have thus found it beneficial to implement Cheok based on Nakamura’s teachings of an initialization step wherein a player uses the display interface to manually input an initialization point. *Id.*

As further discussed above, Nakamura also discloses that its initialization function is desirable because it allows for the alignment of real and virtual worlds—that is, the initial location setting provides a *location reference for gameplay* that helps establish the real and virtual world correspondence. EX1007, ¶[0025]. Thus, a POSITA would have recognized that Nakamura’s initialization function would be a natural fit with Cheok’s system, which also relies on a real and virtual world

correspondence during gameplay. Welch ¶150. Consistent with the above and in such a combined system, for example, the GUI of the wearable computer's HMD would have been configured to receive manual input for setting an initial position that serves as a location reference for further gameplay (*a first manual input for setting a origin location setting for a location reference for gameplay*). *Id.*; see also Sec. VII.A.

c. Reasonable Expectation of Success

A POSITA would have also had a reasonable expectation of success combining the teachings of Cheok and Nakamura. Welch ¶150. As discussed above, both references are in the same field of art. Furthermore, a POSITA would have understood that implementing the combination would have involved implementing the Cheok system in a manner that Cheok suggests is feasible—implementing the real-time tracking system such that it operates with respect to an initialization point. *Id.* A POSITA would have also had the skill to implement and reasonable expectation of success in achieving such a combination, because it would have involved a combination of known technologies (e.g., known system of real-time tracking with respect to an initialization point of Cheok) according to known methods (e.g., known methods of initialization of Nakamura) to yield the predictable result of a system with a graphical interface that receives a manual input for origin

location to serve as a location reference for gameplay. Welch ¶¶151-152; *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007); *see also* Sec. VII.B.

4. 4[a.2]:

Cheok in view of Foxlin077 renders obvious this limitation. Welch ¶¶153-157.

Cheok discloses *a direction of gameplay for a virtual character of a location-based game provided on said device based on the direction of said device*. Cheok discloses that its dead-reckoning module includes component parts such as a dead-reckoning device, GPS, digital compass, and inertial sensors to enable tracking of users. EX1006, 106, 108, 110; Welch ¶154. The inertial sensor and digital compass of the dead-reckoning module are used to determine the direction the user (and the user's wearable computer (*device*)) is facing on the physical playfield (*the direction of said device*). EX1006, 108 (“The DRM measures the displacement of the user from an initialization point by **measuring the direction (with data obtained from the compass)**...[W]hen GPS position data is available, it can be used to **correct...direction calculations....**”), 109 (“By placing the [InertiaCube2] sensor on the cap of each player, her **head movement and orientation is tracked** to high accuracy.”). Cheok explains that “the point-of-view of each mobile player is sent to the computer of a helper through the server, and the corresponding view in the virtual

PacWorld can be displayed.” *Id.*, 109; Welch ¶155. In other words, the direction/orientation of a user’s Ghost or Pacman virtual character (*a direction of gameplay for a virtual character of a location-based game provided on said device*) is established based on the direction the user (with a wearable computer) is facing on the physical field (*based on the direction of said device*). Welch ¶156.

While Cheok does not explicitly disclose a second manual input for setting a directional reference for a direction of gameplay for a virtual character of a location-based game provided on said device based on the direction of said device and said location-based game is provided on said device with respect to said directional reference and said directional reference is operable to be updated during said gameplay, a POSITA would have been motivated and found it obvious to implement the underlined features in view of Foxlin077. Welch ¶157.

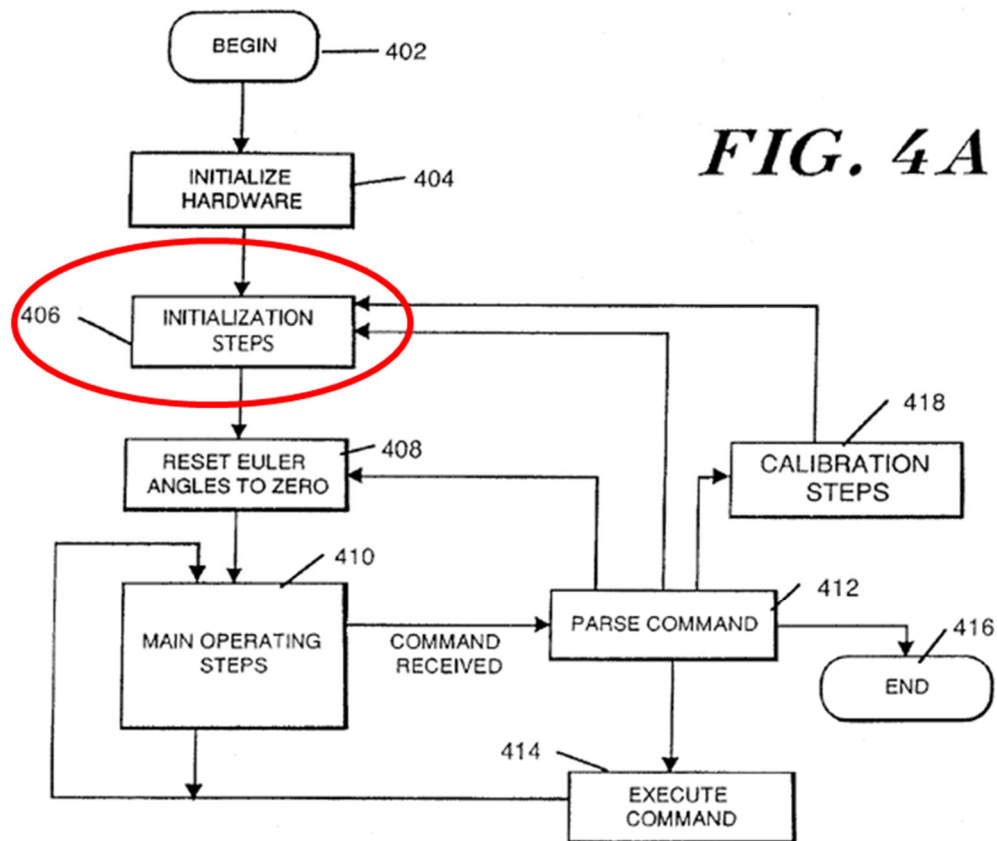
a. Foxlin077

Like Cheok, Foxlin077 relates to motion tracking in VR and AR applications. Welch ¶158. Foxlin077 discloses an “inertial angular orientation tracking apparatus” (EX1008, 6:20-22) which may be used, for example, in applications in which “it is important to track the motions of parts of a human body,’ such as “virtual reality (‘VR’) applications” and “for other head-mounted display (‘HMD’) applications” (*id.*, 1:16-22). For example, Foxlin077 explains that the inertial sensor

may be incorporated in “an apparatus for simulating a virtual environment that is displayed to a user.” *Id.*, 5:7-9. The apparatus “can be used with opaque virtual environments, where the entire environment is presented to a display,” as well as “in a see-through environment, where the user has visual access to the real environment, but in addition, a virtual environment is superimposed on the real environment,” i.e., an AR environment. *Id.*, 22:1-18; Sec. III.A. Foxlin077 explains that its inertial sensor is a “self contained sensor apparatus [that] generates a signal that corresponds to at least two of the three orientational aspects of yaw, pitch and roll of a human-scale body, relative to an external reference frame.” EX1008, Abstract. Foxlin077’s inertial sensor “track[s] the orientation of a body to which it is mounted, without interaction with radiation, energy, signals, or physical connections from any other apparatus.” *Id.*, 1:63-66. Thus, Foxlin077 relates to similar concepts as Cheok, which as discussed further above, discloses a virtual environment gaming system, compatible with both VR and AR modes, in which inertial sensors are incorporated into users’ wearable computer devices in order to facilitate orientation/direction tracking. EX1006, 108-10. Indeed, a POSITA would have understood that the inertial sensor described in Foxlin077 (EX1006, 109) is the same as the InertiaCube2 inertial sensor described in Cheok, since the InertiaCube2 manual cited in Cheok (*id.*, 116) identifies that the product is covered by the Foxlin077 patent (EX1013, 2).

A POSITA would have therefore been motivated to consider the teachings of Foxlin077 when implementing Cheok's Human Pacman system. Welch ¶158.

Foxlin077 further discloses that its inertial sensor is designed to address drift issues. *Id.* ¶159. In particular, Foxlin077 explains that “[a] difficulty with using gyroscopes for head-orientation tracking is drift,” which “arises from integrating over time, a signal that is noisy, or has a bias.” EX1008, 2:56-58. Foxlin077 explains that “[d]rift would make the virtual world appear to gradually rotate about the user's head even when the user is not moving.” *Id.*, 2:58-60. Foxlin077 discloses that its inertial angular orientation tracking apparatus incorporates a “drift compensator” component that attempts to automatically correct drift. *Id.*, 6:27-32, 9:1-23. Drift compensation requires using parameters measured during an initialization process, as shown in red in Figure 4A below. *Id.*, 11:1-7 (“Compensation [for errors] is made using parameters measured during the calibration 418 and initialization 406 steps.”); *see also id.*, 9:61-67. Welch ¶159.

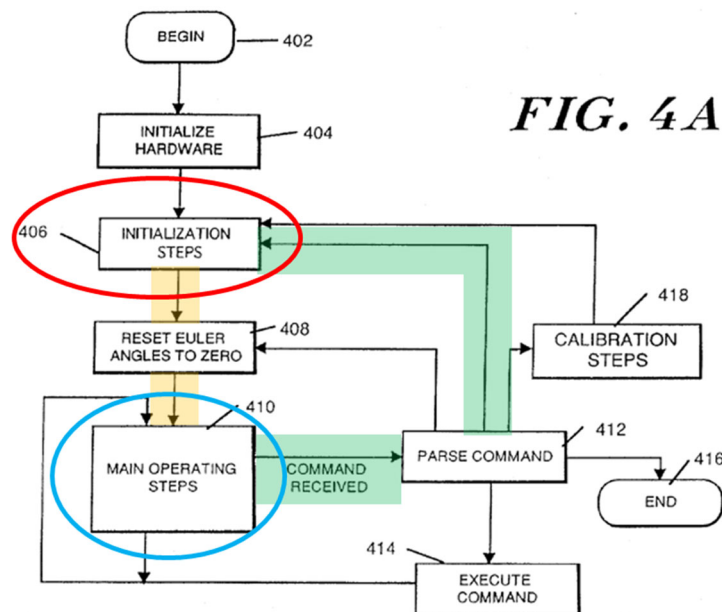


EX1008, FIG. 4A (annotated). The initialization steps “establish the rest position, from which orientation is measured and measure biases for the rate sensors,” after which “the main operating steps 410 are performed.” *Id.*, 9:67-10:7. Foxlin077 explains that “[i]nitialization must be conducted with the sensor assembly held stationary in a known reference orientation.” *Id.*, 10:29-31. Foxlin077 explains that a “user is instructed 432 to place the sensor assembly in such a position by a message

delivered to the apparatus input/output devices or implicitly by the fact of starting the tracker.” *Id.*, 10:31-35; Welch ¶160.

A POSITA would have understood that in such a process, the user is establishing a reference orientation (*a directional reference for a direction of gameplay*) by providing a manual orientation (e.g., by holding the sensor assembly stationary in a certain direction) (*a second manual input for setting a directional reference*) in response to a message delivered to the apparatus. Welch ¶161. A POSITA would have further understood that the main operating steps are performed with respect to this reference orientation (*said location-based game is provided on said device with respect to said directional reference*) because as discussed above, the operation of the device and its drift compensator component require using parameters (e.g., an orientation rest position) that are measured during an initialization process. Welch ¶161; EX1008, 9:67-10:7, 11:1-7. Foxlin077’s process for manually setting a directional reference is consistent with that described in the ’270 Patent, which explains that a “user may be prompted to select a direction for gameplay,” which “may be determined by the device prompting the user to point the device in a particular direction...and recording this direction.” EX1001, 16:2-8; Welch ¶161.

After initialization, the “operating steps are repeated...until a command has been received,” where a command may be user-generated and includes operations such as a reinitialization process. EX1008, 10:9-11, 10:17-20. For example, as shown in Figure 4A below, a command may be received and parsed while the main operating steps (blue) are performed.



Id., FIG. 4 (annotated). As shown by the green arrows, when a command for “reinitializing the operation” is received, *see id.*, 10:17-20, the same initialization steps (red) as discussed above (i.e., those involving the initialization of an inertial sensor to establish a reference orientation) are performed again. And as shown by the orange arrows, the main operating steps resume when the reinitialization process is complete. In other words, the inertial sensor is reinitialized, thereby updating the

reference orientation (*said directional reference is operable to be updated*), in the middle of the performance of the main operating steps (*during said gameplay*).

Welch ¶¶162-3.

b. Motivation to Combine

When implementing Cheok's Human Pacman system, a POSITA would have been motivated to rely on the teachings of Foxlin077's initialization features to enhance Cheok. *Id.* ¶164. As discussed above, Cheok discloses that an InertiaCube2 inertial sensor is used and cites to the product manual, which further cites to Foxlin077 as covering the product. EX1006, 109, 116; EX1013, 2. Thus, a POSITA looking to implement the InertiaCube2 inertial sensor in Cheok's wearable computer would have looked to Foxlin077 and been instructed that the inertial sensor must be initialized through Foxlin077's described procedures. Welch ¶164.

Furthermore, Cheok discloses that its wearable computer uses "an inertial three degree-of-freedom orientation tracking system that gives yaw, pitch and roll of the object that it is attached on" and is "plac[ed]...on the cap of each player" to track head movement and orientation. EX1006, 109. Cheok also discloses that the wearable computer's dead-reckoning module "measures the displacement of the user from an initialization point by measuring the direction...and distance traveled...with each footstep taken." *Id.*, 108. Because Cheok discloses tracking movement with

respect to an “initialization” point, Cheok suggests that the sensors must be initialized prior to use. However, Cheok does not specifically disclose any particular initialization processes for the inertial sensors. A POSITA would have thus found it beneficial to implement Cheok based on Foxlin077’s teachings to implement an inertial sensor initialization/reinitialization where a user can manually set an orientation in response to a prompt. Welch ¶165. A POSITA would have consulted Foxlin077’s initialization/reinitialization process since it describes the same inertial sensor disclosed by Cheok. *Id.*

A POSITA would have been further motivated to rely on Foxlin077’s teachings in order to address sensor issues discussed by Cheok. *Id.* ¶166. Cheok suggests that the sensors incorporated in the wearable computer may have tracking issues, including unaddressed issues that exceed the scope of the paper. EX1006, 115 (“sensor tracking issues” not related to “Human Computer Interface design” exceed the scope of the paper); *see also id.*, 108 (GPS position data can be used to correct direction calculations from the dead-reckoning module), 115 (GPS “suffers from accuracy and selective availability”). Thus, Cheok provides express motivation for a POSITA to explore avenues to compensate for potential sensor issues, including issues associated with the inertial sensor. Welch ¶166. As discussed above, Foxlin077 explains that drift is a problem associated with inertial

trackers and offers a solution—a drift compensator, which uses parameters measured during an initialization/reinitialization process to help correct drift. A POSITA would have thus recognized the benefits of improving the Cheok system by implementing a similar inertial sensor initialization/reinitialization process to address accuracy or user experience issues associated with drift. *Id.*, ¶168.

A POSITA would have also understood that Foxlin077's initialization/reinitialization process would have improved user experience when interacting with the real environment. *Id.* ¶167. Foxlin077 discloses that while drift rates associated with certain embodiments are “tolerable for opaque VE applications with no interaction with the real environment,” that same drift rate may result in “drift accumulated after several minutes [that] would be enough to make contact with the real environment confusing.” EX1008, 17:30-35. Thus, in a virtual environment application like the Cheok system, in which a user must interact with the real environment, a POSITA would have understood that Foxlin077's manual reinitialization process would be beneficial to address accumulated drift when an automatic drift compensator component is not sufficiently removing drift. Welch ¶167; *see also* Sec. VII.A.

c. Reasonable Expectation of Success

A POSITA would have also had a reasonable expectation of success combining the teachings of Cheok and Foxlin077. *Id.* ¶¶169, 171. As discussed above, both references are in the same field of art. Indeed, as discussed above, Cheok discloses using an InertiaCube2 inertial sensor, which is the very product discussed in Foxlin077. Furthermore, a POSITA would have understood that implementing the combination would have involved implementing the Cheok system in a manner that Cheok suggests is feasible—implementing the real-time tracking system such that an initialization process for the inertial sensors is performed. *Id.* A POSITA would have also had the skill to implement and reasonable expectation of success in achieving such a combination, because it would have involved a combination of known technologies (e.g., known system of real-time tracking with respect to an initialization point (Cheok)) according to known methods (e.g., known methods of inertial sensor initialization (Foxlin077)) to yield the predictable result of a system in which inertial sensors are initialized and reinitialized by manually setting a directional reference for a direction of gameplay based on the direction a user is facing. *KSR*, 550 U.S. at 416. Accordingly, Cheok in view of Foxlin077 renders obvious this element. *Welch* ¶170; *see also* Sec. VII.B.

D. Dependent Claims

1. Claim 5:

Cheok in view of Foxlin077 renders obvious this limitation. Welch ¶172. As discussed for limitation 4[a.2], a POSITA would have found it obvious to implement the Cheok-Foxlin077 combination such that an inertial sensor may be reinitialized during gameplay, i.e., during performance of the sensor's main operating steps. Sec. VII.C.4; Welch ¶172-3. In such a reinitialization process, the reference orientation may be reset (*wherein said directional reference is reset*) in response to a manual reinitialization command received during gameplay (*during play of said location-based game*), and following reinitialization, the inertial sensors use the new parameters measured during reinitialization to perform drift compensation (*said location-based game is provided after reset with respect to said reset directional reference*). Sec. VII.C.4; Welch ¶172.

2. Claim 16:

Cheok discloses this limitation. Welch ¶¶177-179.

First, Cheok discloses that *said display is a head-mounted display* because as discussed for limitation 4[a], the wearable computer's display is a HMD. Sec. VII.C.2; EX1006, 110; Welch ¶178.

Second, Cheok discloses that *said device includes a power source*. As shown in red in Figure 4 below, Cheok discloses that the wearable computer (*device*)

receives power via “two Sony F960 InfoLithium batteries” (*said device includes a power source*). EX1006, 110.



Figure 4. Detail configuration of wearable computer

Id., FIG. 4 (annotated); Welch ¶179.

3. Claim 17:

Cheek discloses this limitation. Welch ¶¶180-182.

First, Cheek discloses *wherein said device includes a wireless communications device*. Cheek’s wearable computer (*device*) includes a wireless LAN card (*wireless communications device*) (red in Figure 4 below), which enables *wireless LAN communication* in the system. EX1006, 109.



Figure 4. Detail configuration of wearable computer

Id., FIG. 4 (annotated); Welch ¶181.

Second, Cheek discloses *location information associated with said location-based game is communicated through said wireless communications device*. For example, as further discussed for limitation 4[a.1], Cheek explains that the real-time position of each Pacman or Ghost player (*location information associated with said location-based game*) is communicated to the server through wireless LAN. Sec. VII.C.3; EX1006, 108. A POSITA would have understood that the wireless LAN communication happens through the wireless LAN card of the wearable computer (*communicated through said wireless communications device*). Welch ¶182.

4. Claim 19:

Cheok in view of Nakamura renders obvious this limitation. Welch ¶¶183-186.

First, Cheok *wherein said display is a head-mounted display* for the same reasons as discussed for claim 16. Sec. VII.D.2; Welch ¶184.

Second, Cheok discloses *said device includes a wireless communications device and location information associated with said location-based game is communicated through said wireless communications device* for the same reasons as discussed for claim 17. Sec. VII.D.3; Welch ¶185.

Third, Cheok discloses *said location-based game is a multiple player location-based game*. As further discussed for Section V.A and claim 4's preamble, the Human Pacman game incorporates multiple players representing Pacmen, Ghosts, and Helpers (*said location-based game is a multiple player location based game*). Secs. IV.A, VII.C.1. For example, a possible arrangement may include eight players "assigned to two opposing teams, namely the Pacman team and the Ghost team," where "[t]he former consists of two Pacman and two Helpers; [and] correspondingly, the latter consists of two Ghosts and two Helpers." EX1006, 110; Welch ¶186.

**VIII. GROUND 2: NAKAMURA IN VIEW OF BENINI RENDERS
OBVIOUS CLAIMS 4, 5, AND 17**

A. Motivation to Combine

A POSITA would have been motivated to implement the Nakamura system based on Benini's teachings, for example, to implement a method of manually rotating the virtual environment map on a mobile terminal display to align real and virtual displacement. Welch ¶187; Sec. VIII.C.4.b. A POSITA would have been motivated to rely on Benini's teachings, which discloses a method for manually changing the view of a virtual world map (e.g., to rotate the map), because Nakamura discloses a display rotation feature to align real and virtual displacement but does not disclose the specific processes for rotating the display. Welch ¶187. A POSITA would have also found it obvious to rely on Benini's teachings to improve Nakamura's system because both systems use similar components, e.g., a mobile terminal with directional buttons which displays a 2D map of a virtual world. *Id.* A POSITA would have further recognized that manually aligning a display such that virtual displacement points upwards would have been obvious because it would have been one of only several alignment options available (e.g., a north-up or forward-up alignment, and further set manually or automatically). *Id.*

Furthermore, a POSITA would have been motivated to implement Nakamura's system to implement a manual rotation feature because it would have

given users a choice in alignment, consistent with Nakamura's disclosures and a POSITA's knowledge of alignment modes at the time of the alleged invention. *Id.*, ¶188. For example, if a user using Nakamura's system encounters a physical obstacle in the real world that is not represented in the virtual world, the user is unable to avoid the obstacle without the avoidance (e.g., turning around) being reflected in the virtual world. *Id.* ¶210. The combination with Benini improves and enhances Nakamura by permitting the user to adjust the virtual world map so that the avoidance of the physical obstacle is not reflected in the virtual world. *Id.* ¶210.

B. Reasonable Expectation of Success

A POSITA would have had a reasonable expectation of success in combining the teachings of Nakamura and Benini. Welch ¶189; Sec. VII.C.4.c. Specifically, a POSITA would have relied on Benini's method for manually changing the view (e.g., rotating) of a mobile terminal's 2D map display to improve Nakamura's system. Welch ¶189. Nakamura and Benini use similar features, such as 2D maps on mobile terminals that have directional buttons, and thus a POSITA would have had a reasonable expectation of success in combining these teachings. *Id.*

C. Independent Claim 4

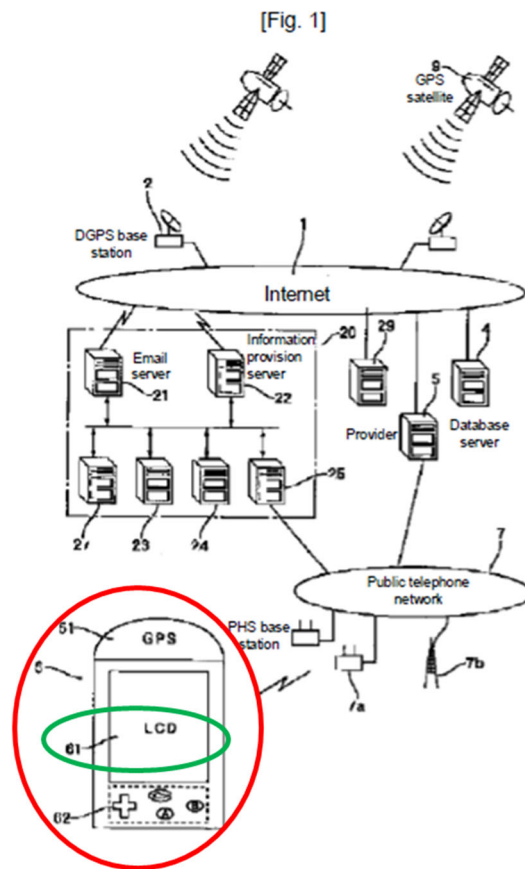
1. Preamble

To the extent limiting, Nakamura discloses the preamble. *Id.*, ¶190. As discussed in Section IV.C, Nakamura discloses a *system* for controlling a computer in which new virtual scenes/worlds of a virtual role-playing game open depending on certain conditions. *See also* EX1007, ¶[1101], [1005]. Nakamura explains that a mobile terminal with a GPS unit acquires the user's current location, which is tracked and reflected in real-time in the virtual world (i.e., on the mobile terminal's display), allowing the role-playing game to progress as the user moves through the real world. *Id.*

2. 4[a]

Nakamura discloses this limitation. Welch ¶¶191-196.

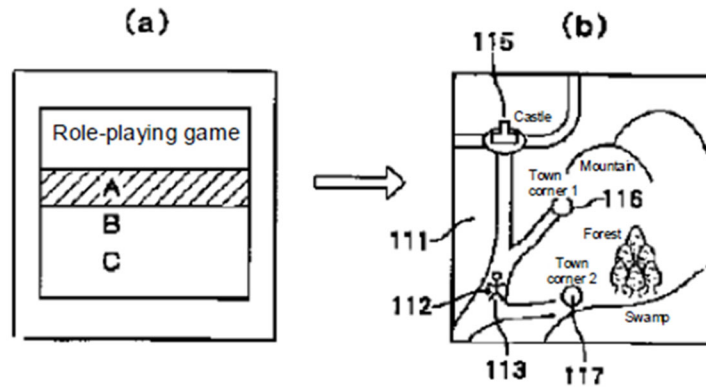
First, Nakamura discloses *a device having a display*. Nakamura discloses a mobile terminal *device* which runs the game system, EX1007, ¶[0018], and which further has an LCD display (*a device having a display*) and an operational panel with a touch panel or pointing device and switches, *id.*, ¶[0022]. The mobile terminal has a “display control unit” which “display[s] the virtual world” and has “several functions” for operating the game system with the display. *Id.*, ¶[0024]; *see also id.*, ¶¶[0024]-[0031] (describing functions). Figure 1 below shows the mobile terminal *device* (red) with LCD *display* (green). Welch ¶192.



Id., FIG. 1 (annotated); Welch ¶193.

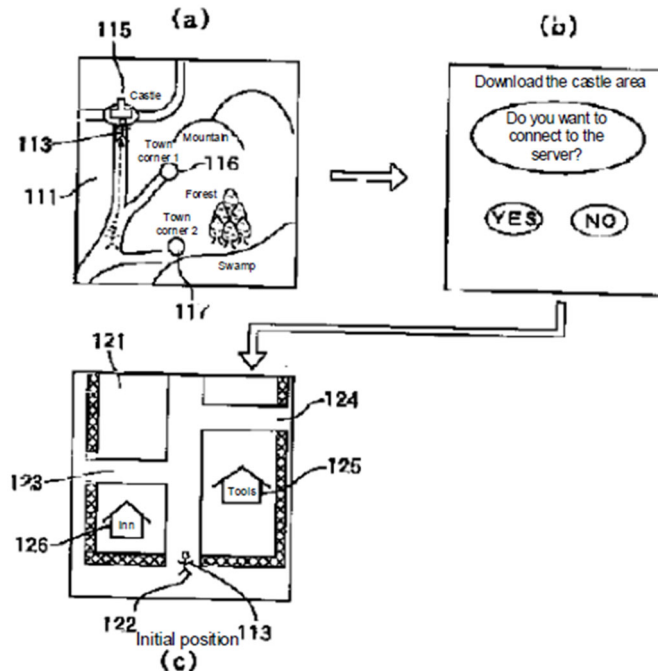
Second, Nakamura discloses *wherein a graphical user interface is provided on said display*. Welch ¶194. Nakamura discloses that the mobile terminal's "LCD" and "operation panel" (e.g., "touch panel") form an "input/output mechanism." EX1007, ¶[0022]. Nakamura describes several inputs that may be provided to the display. For example, as shown in Figure 9(a), a user uses the display interface to "select [a] role-playing game." *Id.*, ¶[0033].

[Fig. 9]



Id., FIG. 9. Similarly, in Figure 10(b), a user can choose one of several options on the display interface to determine whether to display virtual world information corresponding to a certain virtual location (e.g., a castle). *Id.*, ¶[0042].

[Fig. 10]



Id., FIG. 10. A POSITA would have understood that Nakamura's mobile terminal display provides a GUI (*wherein a graphical user interface is provided on said display*) because it provides a visual interface allowing users to provide input to control game play, such as the manual inputs recited in limitations 4[a.1] and 4[a.2]. Welch ¶196; Secs. VIII.C.3-4.

3. 4[a.1]

Nakamura discloses this limitation. Welch ¶¶197-201. As discussed for Section VII.C.3.a, Nakamura discloses a method for manually setting (*first manual input for setting*) the initial position setting (*origin location setting*) in a virtual world by arranging a position icon on the screen. Sec. VII.C.3.a; Welch ¶201.

As described for limitation 4[a], a POSITA would have understood that the mobile terminal's display has a GUI to receive user input. Sec. VIII.C.2; Welch ¶199. A POSITA would have similarly understood that the initial setting function, including the initial position setting, is performed by manual input to the display's GUI. Welch ¶199. As discussed in Section VII.C.3.a, the initial setting function is a feature of the display control unit (EX1007, ¶[0025]) and a user is able to arrange on the screen (i.e., manually) a position display icon according to the user's preference (*id.*, ¶[0036]). Sec. VII.C.3.a. Thus, the display's GUI may receive a manual user input to set an initial position setting (*a first manual input for setting*

a[n] origin location setting), like the '270 Patent, which similarly describes a user using a display screen to select a physical location at game start. EX1001, 8:66-9:11; Welch ¶199.

A POSITA would have also recognized that the initial position setting provides a *location reference for gameplay* because Nakamura discloses that “[w]hen the selected role-playing game is first executed, the starting position of the game will be the initial position 112” (EX1007, ¶[0036]) and the initial setup process helps “define[] the correspondence between the current location and the virtual position” (*id.*, ¶[0025]). Welch ¶¶200. The initial position setting thus provides a location reference that allows for a correspondence between real and virtual worlds as a user’s movement is tracked and gameplay proceeds through the virtual world. *Id.*

4. 4[a.2]

Nakamura in view of Benini renders obvious this limitation. Welch ¶¶202-204.

Nakamura discloses *setting a directional reference for a direction of gameplay for a virtual character of a location-based game provided on said device based on the direction of said device and said location-based game is provided on said device with respect to said directional reference*. Nakamura discloses that the

mobile terminal is a “device equipped with a direction sensor.” EX1007, ¶[0017]. “[I]t is possible to rotate the display of the virtual world so that the direction of real displacement aligns with the direction of virtual displacement,” *id.*, which allows for the “virtual displacement [to] always[] points upwards, based on the direction of movement (actual displacement) obtained from the GPS unit 51,” *id.*, ¶[0024]. Thus, Nakamura discloses rotating a display to set the directions of real and virtual displacement in alignment with one another (*setting a directional reference*), thereby establishing the direction of gameplay (*for a direction of gameplay*) for a user’s virtual character on a mobile terminal (*for a virtual character of a location-based game provided on said device*). Welch ¶203. Nakamura discloses that this *directional reference* is set based on the direction a user (holding a mobile terminal device) is facing in the real world (*based on the direction of said device*) because it relies on the device’s direction sensor to determine the direction of real displacement. *Id.* When the display has been rotated, the game progresses such that the corresponding virtual character’s virtual displacement always points upward (*said location-based game is provided on said device with respect to said directional reference*). *Id.*

While Nakamura does not explicitly disclose a second manual input for . . . and said directional reference is operable to be updated during said gameplay, a

POSITA would have been motivated and found it obvious to implement the underlined features in view of Benini. *Id.*, ¶204.

a. Benini

Like Nakamura, Benini relates to the use of wireless portable devices for exploring virtual environments. *Id.*, ¶205. For example, Benini discloses a “hardware/software system for PDA-based interaction with IVEs [(immersive virtual environments)] realized in the field of Virtual Heritage (VH): Virtual Reality applied to Cultural Heritage.” EX1009, 2. Benini aims to “reconstruct[] cultural heritage objects and environments” in an immersive virtual reality environment. *Id.*, 1. For example, “Virtual Heritage” applications may allow scholars to explore an archaeological site or the general public to explore a virtual museum. *Id.*, 2. Benini discloses “standard, consumer-market wearable interactive terminals, such as palmtop computers (Pocket PC and PDAs)...[are] the preferred interfacing device....” *Id.* As shown in Figure 3, the system has portable terminals interfacing with the virtual environment (e.g., virtual theatre) over a wireless network, and client-server software runs on the terminals (client) and virtual reality engine (server). *Id.*, 4.

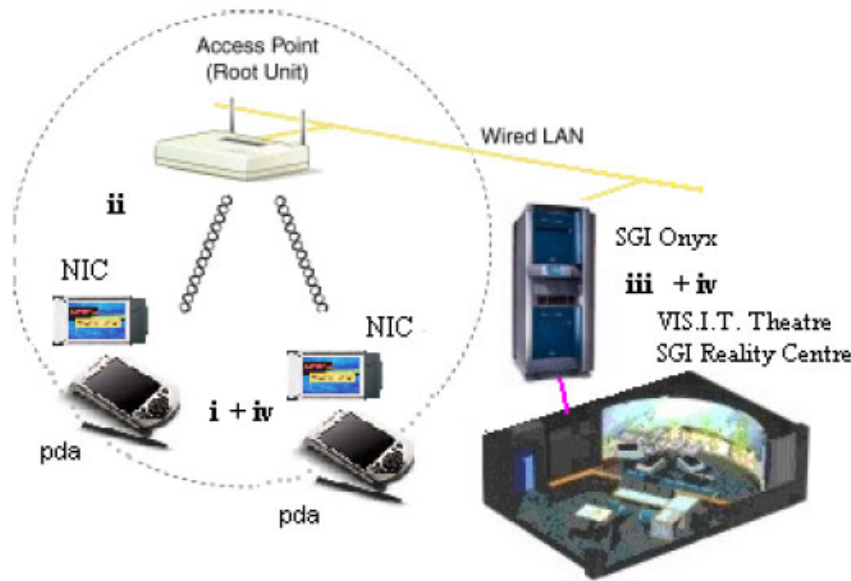


**Figure 3: Components of the interactive system:
portable terminals(i), wireless network(ii), virtual
theater (iii), client-server software (iv).**

Id., FIG. 3. Thus, Benini is similar to Nakamura, which as discussed for Section V.B and Ground 2, limitation 4[a], discloses portable mobile terminals for interfacing with a virtual environment. Secs. IV.B, VIII.C.2. A POSITA would have therefore been motivated to consider the teachings of Benini when implementing the Nakamura system. Welch ¶205.

Benini additionally explains how the portable palmtop computers/PDAs can be used to support basic interaction tasks in the field of 3D user interfaces—navigation, selection/manipulation, and system controls. EX1009, 2-3. For example, a PDA may incorporate a “‘2D map’ in which the users visualize their

position and orientation in the virtual world,” to allow users to see “which regions can be reached by their current position.” *Id.*, 3. Benini’s “UI features a two-dimensional map abstraction of the VR world, augmented with various navigation controls,” including “eight arrows to more intuitively navigate in the environment.” *Id.*, 3. The 2D map reproduces a view of the virtual environment, “enabl[ing] the user to visualize his/her position in the virtual world with a red rectangle and the direction of observation with a green rectangle.” *Id.*, 4. “[F]our arrows realizes the metaphor of moving forward, backward, left and right the avatar in the VE as if it is walking into it; and four arrows are used to turn around and to look up and down....” *Id.*, 4. Figure 2 below shows an example PDA with arrows (green) for visualizing position and direction in the virtual environment. Welch ¶206.



Figure 2: The User Interface developed for interacting via PDA with the Nu.M.E. VE

EX1009., FIG. 2 (annotated). The user interface arrows can be used to “change [the] camera’s position and orientation (interacting with the 2D map or with the arrows),” thereby changing the view in the virtual environment. *Id.*, 5; Welch ¶207. When “requesting to change camera’s position and orientation” according to interaction with the map/arrows, the portable terminal (client) has to send to the server (virtual reality engine) “a 6-dimensional vector that includes world coordinates (x, y, z) and the three angles: heading—the rotation about the Z axis—pitch—the rotation about the X axis—and roll—the rotation about the Y axis.” EX1009, 5. This allows the server “to increment [the] current camera’s position and orientation” to show a new view

in the virtual environment. *Id.* Benini thus discloses a user interface for manually providing a direction (*a second manual input for setting a directional reference*) that establishes the direction of exploration in the virtual environment (*for a direction of gameplay*), where the direction can be updated during exploration to show new views of the virtual environment (*said directional reference is operable to be updated during said gameplay*). Welch ¶208.

b. Combination

When implementing Nakamura's system, a POSITA would have been motivated to rely on Benini's user interface features to enhance Nakamura. Welch ¶209. As discussed above, Nakamura discloses a rotation feature to align the directions of real and virtual displacement so virtual displacement always points upwards, based on the direction the user (and the user's device with a direction sensor) is moving. However, Nakamura does not disclose the specific processes for rotating the display of the virtual world. A POSITA would have thus been motivated to rely on the teachings of Benini's user interface with 2D map, where a user uses arrows to manually change the view of a virtual world map (e.g., to rotate the map) to establish a new viewing direction. *Id.* A POSITA would have understood Benini's 2D map feature would have been a natural complement to Nakamura's system since both systems use a portable/mobile terminal to display a 2D map of a

virtual world (*see* Nakamura's Figure 9(b) (green), showing a screen of Nakamura's Figure 1 mobile terminal (left), and Benini's Figure 2, similarly showing a mobile terminal display screen (green)). *Id.*; EX1007, ¶[0008]; EX1009, 3.

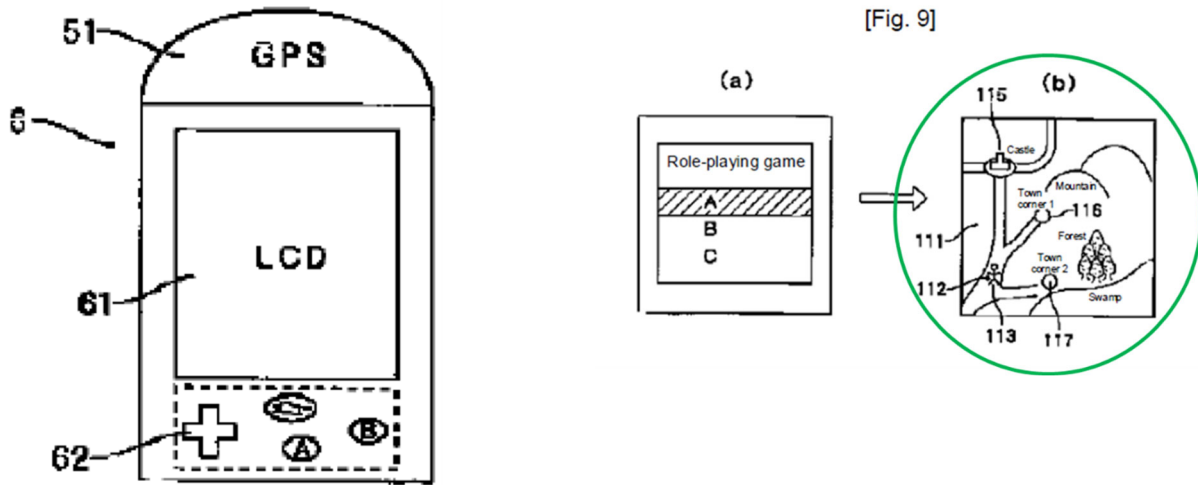


Figure 1 (excerpted)



Figure 2: The User Interface developed for interacting via PDA with the Nu.M.E. VE

EX1007, FIG. 1 (excerpted), FIG. 9 (annotated); EX1009, FIG. 2 (annotated). Moreover, as discussed above, Benini uses manual directional arrows to manipulate position and orientation on the map, similar to the prior art systems described in Nakamura, in which “players progress in the game by moving through the virtual world using directional buttons, joysticks, or other pointing devices.” EX1007, ¶[0005]. A POSITA would have thus understood that Nakamura’s system would have been easily improved by relying on features similar to Benini’s map user interface, since Benini uses components already disclosed by Nakamura. Welch ¶209.

A POSITA would have further understood that a manual method to rotate the display, such as disclosed by Benini, would have been one of only several options available for displaying Nakamura’s map display. Welch ¶214. Indeed, a POSITA would have understood that by 2004, virtual maps used for navigation in virtual environments could be displayed in either a north-up configuration, in which north is always at the top of the map, or a forward-up configuration, in which the map is rotated to correspond to the forward direction. EX1011, 2; EX1012, 2-3. A POSITA would have understood that Nakamura’s rotated display feature, in which virtual displacement is always pointing up, would have corresponded to a forward-up map configuration. Welch ¶214. A POSITA would have also understood that by 2004,

the alignment (e.g., forward-up) could be set automatically or could be updated manually by a user, and that it was beneficial to give a user a choice between automatic and manual modes. EX1012, 3, 10. Thus, manually aligning a display in a forward-up configuration, as contemplated by Nakamura-Benini, would have been obvious because it would have been one of only several alignment options available (e.g., north-up or forward-up, and further set manually or automatically), and thus one of a “finite number of identified, predictable solutions.” *Perfect Web Techs., Inc. v. InfoUSA, Inc.*, 587 F.3d 1324, 1331 (Fed. Cir. 2009).

Nakamura also describes the rotation feature as an optional feature, and thus a POSITA would have understood that implementing the feature with manual rotation, so as to give users a choice in alignment (between forward-up and north-up alignment), would have been beneficial. EX1007, ¶¶[0017], [0024]; Welch ¶214. Indeed, a POSITA would have recognized that allowing a user to manually manipulate the viewpoint of a map (e.g., to rotate it from one orientation to another), similar to the method disclosed by Benini, would have beneficially provided a user of the Nakamura system with the option to change/update the alignment direction during gameplay (*said directional reference is operable to be updated during said gameplay*), depending on user preference and environmental constraints (e.g., a dead end). Welch ¶215. For example, because of the constraints of the physical world

compared to the virtual world, a user would encounter a situation where one cannot or does not want to proceed in a particular physical world direction that is necessary or desired in the virtual world, thus necessitating a rotation to change/update the alignment direction during gameplay. *Id.*; *see also* Sec. VIII.A.

c. Reasonable Expectation of Success

A POSITA would have also had a reasonable expectation of success combining the teachings of Nakamura and Benini. Welch ¶216. As discussed above, both references are in the same field of art. Furthermore, Nakamura and Benini use similar features, such as 2D maps on mobile terminals that have directional buttons, and thus a POSITA would have had a reasonable expectation of success in combining these teachings. *Id.* A POSITA would have also had the skill to implement and reasonable expectation of success in achieving such a combination, because it would have involved a combination of known technologies (e.g., known system of exploring and displaying virtual environments using a map on a mobile terminal and rotating the display to align real and virtual displacement (Nakamura)) according to known methods (e.g., known methods of rotating/changing the orientation of a map viewpoint on a mobile terminal (Benini)) to yield the predictable result of a gaming system for exploring a virtual environment where a rotation feature to align real and virtual displacement (e.g. in a forward-up

alignment) is implemented by manually rotating the map (e.g., with directional buttons) to the appropriate orientation. *KSR*, 550 U.S. at 416.

D. Dependent Claims

1. Claim 5

Nakamura in view of Benini renders obvious this limitation. Welch ¶217. As discussed for limitation 4[a.2], a POSITA would have found it obvious to implement the combination such that Nakamura's rotation feature to align real and virtual displacement is achieved by allowing a user to manually rotate Nakamura's mobile terminal display (e.g., with directional buttons) to the appropriate orientation. Sec. VIII.C.4; Welch ¶217. As further discussed, such a rotation feature allow for the setting and resetting during gameplay of an orientation for viewing the virtual environment (*wherein said directional reference is reset during play of said location-based game*), and following rotation, the game is provided according to the aligned direction, e.g., by showing the virtual world such that virtual displacement is always pointing up (*said location-based game is provided after reset with respect to said reset directional reference*). Sec. VIII.C.4; Welch ¶217.

2. Claim 17

Nakamura discloses this limitation. Welch ¶¶218-222.

First, Nakamura discloses *wherein said device includes a wireless communications device*. Nakamura discloses that the system for displaying virtual

world information is installed on a mobile terminal (*device*), which may be equipped with a wireless communication means (*wireless communications device*) to enable wireless communication with a server system. EX1007, ¶¶[0012], [0016]; Welch ¶219.

Second, Nakamura discloses *location information associated with said location-based game is communicated through said wireless communications device*. Welch ¶220. For example, as discussed for the preamble and limitation 4[a.1], Nakamura discloses that a user's location (*location information associated with said location-based game*) is tracked to enable display of corresponding virtual world screens. *Id.* ¶221; Secs. VIII.C.1, VIII.C.3. Nakamura further discloses this location information is transmitted to the server in order to retrieve and display corresponding virtual world information. EX1007, ¶¶[0012]-[0014], [0043]. A POSITA would have understood that the user's current location (*location information associated with said location-based game*) is communicated to the server *through said wireless communications device* because as discussed above, the wireless communications means (*wireless communications device*) is the device used to communicate information to the server. Welch ¶222.

**IX. GROUND 3: NAKAMURA IN VIEW OF BENINI AND FOXLIN068
RENDERS OBVIOUS CLAIMS 16 AND 19**

A. Motivation to Combine

A POSITA would have been motivated to implement the Nakamura system based on the teachings of Foxlin068, for example, to implement a HMD as part of the user's gaming device. Welch ¶223; Sec. IX.C.1.b. Foxlin068 enables hand- and head-tracking while keeping a user's hands free to perform tasks, which a POSITA would have understood would have been beneficial to the Nakamura system, which requires a user to hold the mobile terminal. Welch ¶223. A POSITA would have also recognized that Foxlin068's tracking device would have enabled an increased range of VR and AR applications, allowing for both fully immersive virtual experiences and manual interaction with the environment. *Id.*

B. Reasonable Expectation of Success

A POSITA would have had a reasonable expectation of success in combining the teachings of Nakamura and Foxlin068. Welch ¶224; Sec. IX.C.1.c. Specifically, a POSITA would have relied on Foxlin068's teachings to implement a wearable computer device with a HMD in the Nakamura system to enable position and orientation tracking. Welch ¶224. Such a combination would have been easily achieved in the Nakamura system for tracking position and direction/orientation since both the Nakamura and Foxlin068 systems track these attributes. *Id.*

C. Dependent Claims

1. Claim 16

Nakamura in view of Foxlin068 renders obvious this limitation. Welch ¶¶225-228.

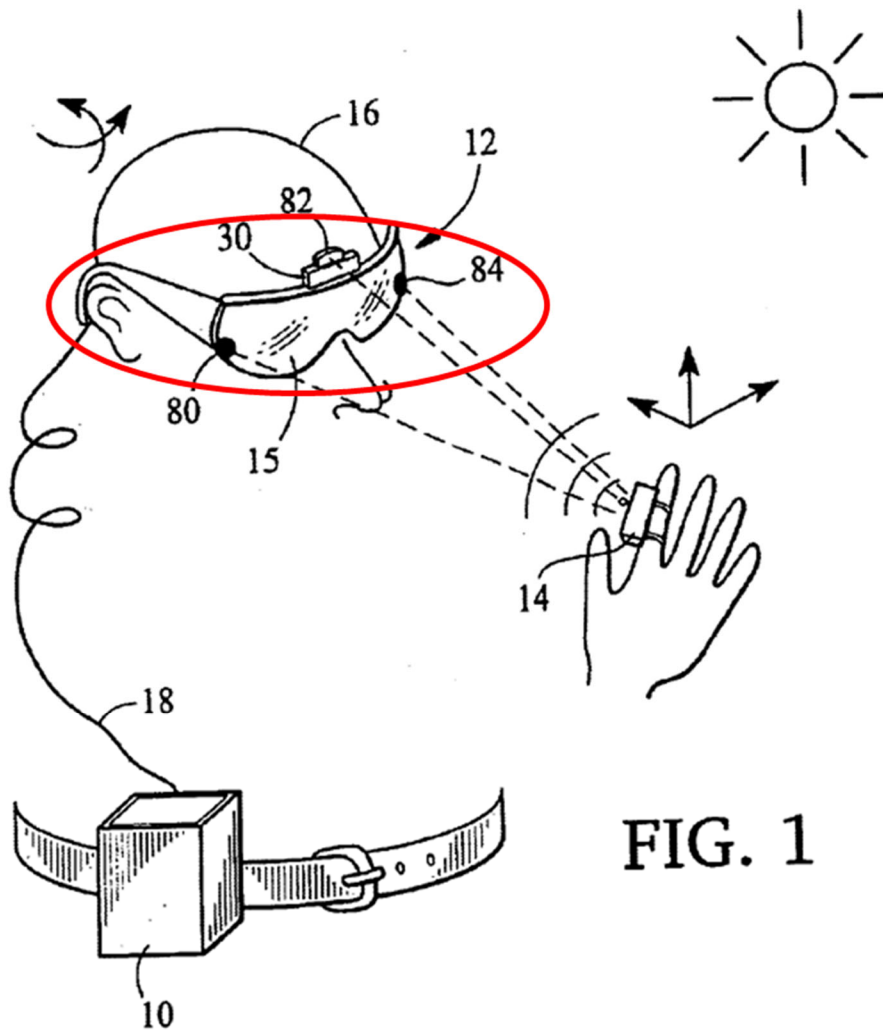
First, the combination renders obvious *wherein said display is a head-mounted display*. Welch ¶226. As discussed for Ground 2, limitation 4[a], Nakamura's mobile terminal *device* has a LCD *display*. Sec. IX.C.2; EX1007, ¶[0022]. While Nakamura does not explicitly disclose *wherein said display is a head-mounted display*, a POSITA would have been motivated and found it obvious to implement this feature in view of Foxlin068. Welch ¶226.

a. Foxlin068

Like Nakamura, Foxlin068 relates to wireless location tracking technologies for use in virtual reality games. *Id.* ¶227. For example, Foxlin068 discloses that its “invention may combine a sourceless head orientation tracker 30 with a head-worn tracking device 12 that tracks a hand-mounted 3D beacon 14 relative to the head 16.” EX1010, 5:5-8. Foxlin068 discloses that its “new tracking technique...can be used anywhere with no set-up of a source, yet it enables a much wider range of virtual environment-style navigation and interaction techniques than does a simple head-orientation tracker, including manual interaction with virtual objects.” *Id.*,

Abstract. Foxlin068's tracking device may incorporate an "inertial orientation tracker" and "position tracker," *id.*, 5:45-50, and may be used in virtual environments such as VR games, *id.*, 13:28-32, 14:5-42. Thus, Foxlin068 is similar to Nakamura, which as discussed for Ground 2, claim 4's preamble and limitation 4[a.2], discloses a gaming system in a virtual environment that enables tracking of a user's location (through GPS) and orientation (through a direction sensor). Secs. VIII.C.1, VIII.C.4. A POSITA would have therefore been motivated to consider the teachings of Foxlin068 when implementing the Nakamura system. Welch ¶227.

Foxlin068 additionally discloses that its "fully integrated wearable VR system," as shown in Figure 1, has "three parts (a wearable computer 10, a headset 15 with an integrated tracking system, and a hand-mounted beacon 14) and one cable connection 18." EX1010, 5:14-18.



Id., FIG. 1 (annotated). Foxlin068 explains that its headset may be a HMD (*wherein said display is a head-mounted display*), as shown in red above, on which the inertial sensor is mounted. *Id.*, 5:45-62, 6:30-38, 6:61-63; Welch ¶228.

b. Combination

When implementing Nakamura's system, a POSITA would have been motivated to rely on Foxlin068's HMD features to enhance Nakamura. Welch ¶229. Foxlin068 enables both hand- and head-tracking while still keeping a user's hands free to perform tasks. EX1010, 7:27-33. Nakamura, however, requires a user to hold the mobile terminal. EX1007, ¶[0055]. A POSITA would have thus recognized the benefits of a tracking device that allows a user's hands to remain free while tracking the hands. Welch ¶229. In contrast to previous sourceless tracking devices, Foxlin068's device is suitable for the "emerging fields of wearable computing and augmented reality (AR)" because it "allow[s] enough control to look around the virtual environment and fly through it," and "enable[s] the 'reach-out-and-grab' interactions that make virtual environments so intuitive and which are needed to facilitate computer interaction." EX1010, 1:23-32; Welch ¶230. Foxlin068's system thus "enables immersive visualization and intuitive manual interaction using a wearable system in arbitrary unprepared environments." EX1010, 5:39-41. Accordingly, a POSITA would have recognized that Foxlin068's tracking device would have enabled an increased range of virtual and augmented reality applications, allowing for both fully immersive virtual experiences as well as manual interaction with the environment. Welch ¶231.

c. Reasonable Expectation of Success

A POSITA would have had a reasonable expectation of success combining the teachings of Nakamura and Foxlin068. Welch ¶232. As discussed above, both references are in the same field of art. Furthermore, Foxlin068's tracking device also tracks position and direction, and thus it would have been obvious to rely on these features to improve the Nakamura system for tracking position and direction. A POSITA would have also had the skill to implement and reasonable expectation of success in achieving such a combination, because it would have involved a combination of known technologies (e.g., known system of real-time tracking in virtual environments (Nakamura)) according to known methods (e.g., known methods of tracking with a HMD (Foxlin068)) to yield the predictable result of a gaming system for exploring a virtual environment where real-time tracking incorporates a HMD tracking device. Welch ¶232; *KSR*, 550 U.S. at 416.

Second, the combination renders obvious *said device includes a power source*. Foxlin068 discloses that its wearable computer device with HMD incorporates “computer and batteries...contained in [a] backpack.” EX1010, 5:5-14. Accordingly, the Nakamura-Foxlin068 system described above would have had a wearable computer (*device*) powered by a battery pack (*power source*). Welch ¶233.

2. Claim 19

Nakamura in view of Foxlin068 renders obvious this limitation. Welch ¶¶234-237.

First, the combination renders obvious *wherein said display is a head-mounted display* for the same reasons as discussed for Ground 3, claim 16. Sec. IX.C.1; Welch ¶235.

Second, Nakamura discloses *said device includes a wireless communications device and location information associated with said location-based game is communicated through said wireless communications device* for the same reasons as discussed for Ground 2, claim 17. Sec. VIII.D.2; Welch ¶236.

Third, Nakamura discloses *said location-based game is a multiple player location-based game*. Nakamura discloses that its role-playing game may be played with multiple users to enable competitive gameplay and communication among users. EX1007, ¶¶[0009], [0014], [0029]; Welch ¶237.

X. SECONDARY CONSIDERATIONS

There are no secondary considerations known to Petitioner that affect, let alone overcome, this strong case of obviousness. Should PO proffer any relevant evidence of secondary considerations, Petitioner reserves its rights to address.

XI. THE BOARD SHOULD REACH THE MERITS

A. Institution is appropriate under § 325(d)

Institution is appropriate under § 325(d) because substantially the same art and arguments have never been presented to or considered by the Office. *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 at 6-11 (Feb. 13, 2020) (precedential). Specifically, Cheok, Nakamura, Foxlin077, and Foxlin068 were not considered during prosecution, and therefore, these combinations were never before the Office.

B. Institution is appropriate under § 314(a)

This petition should be instituted for efficiency and fairness considerations, and further in view of its overwhelming strength on the merits. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 at 5 n.7 (Mar. 20, 2020) (“Fintiv”) (precedential). If Patent Owner disagrees, Petitioner should be granted leave to Reply because the relevant facts will evolve over the coming months. Specifically, Petitioner has a transfer motion pending in the parallel litigation which will be decided by the POPR.

The merits of the instant petition are strong (Fintiv factor 6, other considerations). The ’270 Patent is directed to gaming system that tracks a user’s movement and physical location for a virtual game character on a virtual gamefield, identifying “HUMAN PACMAN” as an example. Critically, Cheok is directed to a

nearly-identical VR implementation of Human Pacman, and the distinguishing limitation was known and ubiquitous as demonstrated by the asserted references.

XII. MANDATORY NOTICES

A. Real Parties-in-Interest

The real party-in-interest is Meta Platforms, Inc.

B. Related Matters

U.S. Patent Office records indicate that the '270 Patent is assigned to Mullen Industries, LLC ("PO"), which is currently asserting the '270 Patent in the following concurrent litigation filed on April 4, 2024: *Mullen Industries LLC v. Meta Platforms, Inc.*, 1:24-cv-00354-DII (W.D. Tex).

Petitioner will file petitions for *inter partes* review against U.S. Patent No. 11,033,821, U.S. Patent No. 8,585,476, U.S. Patent No. 9,744,448, U.S. Patent No. 10,179,277, U.S. Patent No. 10,828,559, U.S. Patent No. 11,376,493, U.S. Patent No. 11,904,243, U.S. Patent No. 11,947,716, U.S. Patent No. 12,019,791, U.S. Patent No. 9,662,582, and U.S. Patent No. 10,974,151.

C. Notice of Counsel and Service Information

Petitioner provides the following designation of counsel:

Lead Counsel	Lisa K. Nguyen (Reg. No. 58,018) Paul Hastings LLP 1117 S. California Avenue
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Pursuant to 37 C.F.R. § 42.10(b), a Power of Attorney accompanies this petition. Petitioner consents to electronic service by e-mail.

D. Fee for *Inter Partes* Review

The Director is authorized to charge the fee specified by 37 C.F.R. § 42.15(a) to Deposit Account 50-2613.

E. Grounds for Standing

Petitioner certifies pursuant to 37 C.F.R. § 42.104(a) that the '270 Patent is available for *inter partes* review and that Petitioner is not barred or estopped from requesting an *inter partes* review challenging the patent claims on the grounds identified in this Petition.

XIII. CONCLUSION

For these reasons, Petitioner respectfully requests institution.

Dated : March 25, 2025

Respectfully submitted,

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META PLATFORMS, INC.

CLAIM LISTING APPENDIX

The following claim listing adds letters ([a], [b], etc.) and numbers (-1, -2, etc.) to the independent claims for clarity:

4. Preamble: “A system comprising:”

[a] “a device having a display, wherein a graphical user interface is provided on said display to receive”

[a.1] “a first manual input for setting a origin location setting for a location reference for gameplay and”

[a.2] “a second manual input for setting a directional reference for a direction of gameplay for a virtual character of a location-based game provided on said device based on the direction of said device and said location-based game is provided on said device with respect to said directional reference and said directional reference is operable to be updated during said gameplay.”

5. “The system of claim 4, wherein said directional reference is reset during play of said location-based game and said location-based game is provided after reset with respect to said reset directional reference.”

16. “The system of claim 4, wherein said display is a head-mounted display and said device includes a power source.”

17. “The system of claim 4, wherein said device includes a wireless communications device and location information associated with said location-based game is communicated through said wireless communications device.”
19. “The system of claim 4, wherein said display is a head-mounted display, said device includes a wireless communications device and location information associated with said location-based game is communicated through said wireless communications device, and said location-based game is a multiple player location-based game.”

CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(d), the undersigned certifies that foregoing
PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO.
10,967,270 exclusive of the parts exempted as provided in 37 C.F.R. §42.24(a),
contains 13,980 words and therefore complies with the type-volume limitations of
37 C.F.R. §42.24(a).

Dated: March 25, 2025

Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing **PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 10,967,270 AND EXHIBITS EX1001-1038** are being served on March 25, 2025, via Federal Express overnight mail on counsel of record for U.S. Patent No. 10,967,270 as addressed below:

JEFFREY D. MULLEN
2212 Hassinger Lane
Glenshaw, PA 15116

A courtesy copy is also being served on counsel for the patent holder in the pending litigation on:

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Dated: March 25, 2025

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