

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TESLA, INC.,
Petitioner,

v.

AUTONOMOUS DEVICES, LLC
Patent Owner

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 10,102,449**

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PETITIONER’S EXHIBIT LIST

Exhibit No.	Description
Ex. 1001	U.S. Patent No. 10,102,449 (the “449 patent)
Ex. 1002	Prosecution File History of U.S. Patent No. 10,102,449
Ex. 1003	Declaration of Jason Janet, Ph.D.
Ex. 1004	Curriculum Vitae of Jason Janet, Ph.D.
Ex. 1005	U.S. Patent No. 9,604,359 (“Grotmol”)
Ex. 1006	U.S. Patent No. 9,443,192 (“Cosic 192”)
Ex. 1007	U.S. Patent No. 8,639,644 (“Hickman”)
Ex. 1008	Service, Robert F., <i>Minds of Their Own</i> , Sci. Magazine. Oct. 10, 2014, 346(6206):182-183, available at, https://www.usna.edu/AcResearch/_files/documents/Science_Minds_of_Their_own_182.full1.pdf
Ex. 1009	<i>Reserved</i>

I. MANDATORY NOTICES

A. Real Party-in-Interest

Tesla, Inc. is the sole real party-in-interest.

B. Related Matters

The '449 patent is the subject of a civil action, *Autonomous Devices LLC v. Tesla, Inc.*, No. 22-cv-1466 (MN) (D. Del.), filed November 7, 2022. Tesla has also filed petitions for *inter partes* review involving U.S. Patent No. 10,452,974, U.S. Patent No. 11,238,344, U.S. Patent No. 11,055,583, U.S. Patent No. 10,607,134, and U.S. Patent No. 11,113,585 that were asserted in the Delaware litigation.

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II. GROUNDS FOR STANDING

Petitioner certifies that the '449 patent is available for *inter partes* review and that Petitioner is not barred or estopped from requesting *inter partes* review challenging the patent claims on the grounds identified in this Petition.

III. INTRODUCTION

The '449 patent was filed on November 21, 2017, and claims a system for autonomous device operation in which: (i) a memory stores pictures correlated with instructions for operating a first device where the instructions or pictures are learned during operation of the device by a user; (ii) new pictures are obtained; (iii) instructions for operating the first device are anticipated by determining a partial match between the new pictures and the stored pictures; and (iv) the correlated instructions are executed to autonomously operate the first device or a second device. As will be demonstrated in this Petition, the prior art anticipates and/or renders obvious claims 1-20 of the '449 patent.

Petitioner requests *inter partes* review based upon U.S. Patent No. 9,604,359 ("Grotmol"), U.S. Patent No. 8,639,644 ("Hickman"), and U.S. Patent No. 9,443,192 ("Cosic 192"). Grotmol and Hickman were not before the Examiner during prosecution; Cosic 192 is identified on the face of the '449 patent but was not discussed during prosecution. Grotmol discloses the same approach to autonomous operation claimed in the '449 patent:

A robotic vehicle may utilize a camera and stores the sequence of images of a visual scene seen when following a trajectory during training in an ordered buffer. Motor commands associated with a given image may be stored. During autonomous operation, an acquired image may be compared with one or more images from the training buffer in order to determine the most likely match.

Ex. 1005, Abstract. Grotmol further teaches that a robot's "trained configuration may be stored" and "loaded into one or more other robots in order to provide learned behaviors." *Id.*, 33:12-35.

Hickman—a reference cited in Grotmol—further discloses "shared robot knowledge bases for use with cloud computing systems," in which the cloud computing system "collects data from a robot about an object the robot has encountered in its environment, and stores the received data in the shared robot knowledge base . . . sends instructions for interacting with an object to a robot . . . [and] sends instructions to a robot for executing an application based on information stored in the shared robot knowledge base." Ex. 1007, Abstract.

Cosic 192 describes methods of tracing and instrumenting an application—routine techniques in computer programming—that are relevant to dependent claims 2 and 4.

Grotmol anticipates and/or renders obvious in combination with Hickman or Cosic 192 claims 1-20 of the '449 patent. Petitioner respectfully requests that the Board institute review.

IV. STATUTORY GROUNDS FOR THE CHALLENGES

Ground 1	Anticipation of Claims 1, 6-8, 10, and 12-20 based on U.S. 9,604,359 (“Grotmol”).
Ground 2	Obviousness of Claims 3, 5, and 11 based on Grotmol in view of the Knowledge of a POSITA.
Ground 3	Obviousness of Claims 2 and 4 based on Grotmol in view of U.S. 9,443,192 (“Cosic 192”).
Ground 4	Obviousness of Claim 9 based on Grotmol in view of U.S. 8,639,644 (“Hickman”).

V. LEVEL OF ORDINARY SKILL IN THE ART

A person having ordinary skill in the art (“POSITA”) relevant to the '449 patent as of November 21, 2017—the earliest possible priority date of the '449 patent—would have had at least: (1) a bachelor’s degree in electrical engineering, computer engineering, computer science, systems engineering, or equivalent course work with two to three years of work experience in computer vision, image/video processing, and/or machine learning; or (2) a master’s degree in electrical

engineering, computer engineering, computer science, systems engineering, or equivalent course work with a focus in computer vision, image/video processing, and/or machine learning.

VI. CLAIM CONSTRUCTION

The Petition applies the ordinary and customary meaning of the claim terms. Where appropriate, Petitioner explains the meaning of claim terms in its analysis of how the prior art anticipates and/or renders obvious the challenged claims.

VII. OVERVIEW OF THE '449 PATENT

The '449 patent was filed on November 21, 2017 and does not claim priority to any earlier-filed application. Jasmin Cosic is the sole named inventor.

The disclosure of the '449 patent relates to “devices, systems, methods, and/or applications for automating devices and/or systems.” Ex. 1001, Abstract. More specifically, the '449 patent describes a method of automation comprising “learning one or more digital pictures of a device’s surrounding along with correlated instruction sets for operating the device, storing this knowledge in a knowledgebase (i.e., neural network, graph, sequences, etc.), and autonomously operating a device.” Ex. 1001, 58:62-59:8. The '449 patent refers to this approach as “visual surrounding for autonomous device operation,” or “VSADO.” *Id.*, Figure 31, copied below, illustrates this functionality.

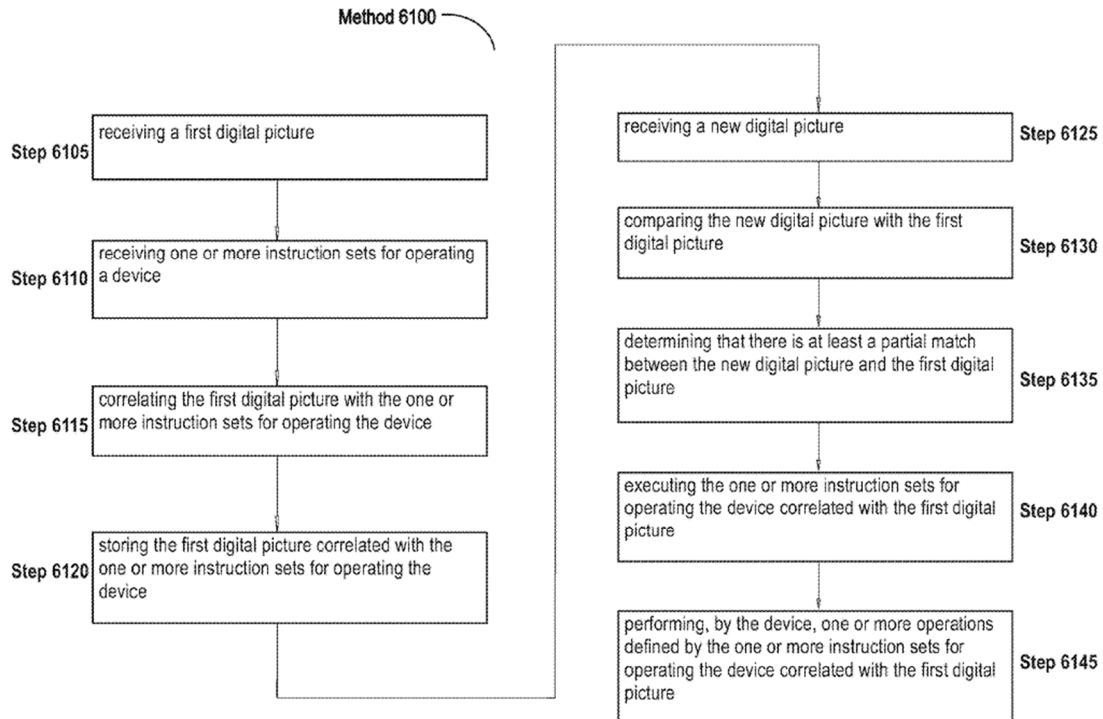


FIG. 31
Ex. 1001, Fig. 31

The '449 patent further describes that the VSADO functionality can be implemented on a “Server 96 accessible over Network 95,” such that “[a]ny number of Devices 98 may connect to such remote VSADO Unit 100 and the remote VSADO Unit 100 may learn their operations in various visual surroundings. In turn, any number of Devices 98 can utilize the remote VSADO Unit 100 for autonomous operation.” *Id.*, 85:36-42.

VIII. OVERVIEW OF THE PRIOR ART

This Petition relies on Grotmol, Hickman, and Cosic. Grotmol and Hickman were not considered during prosecution or cited on the face of the '449 patent. Cosic 192 is cited on the face of the '449 patent but was not discussed during prosecution.

A. U.S. 9,604,359 (“Grotmol”)

Grotmol is a U.S. patent filed on January 27, 2015, which issued on March 28, 2017. Grotmol is prior art to the ’449 patent under at least 35 U.S.C. §§ 102(a) and 102(d).

Grotmol relates to “[a]n apparatus and methods for training and/or operating a robotic device to follow a trajectory.” Ex. 1005, Abstract. Grotmol describes that “conventional approaches” to training a robot entailed a user “first control[ing] the robot one time or multiple times to move along the desired path.” *Id.*, 1:62-67. That would constitute the “training of the robot,” and thereafter, the robot would perform the same navigation autonomously. *Id.*, 1:67-2:2. A “typical approach” was to store the motor commands executed by a user during training then “simply replay them.” *Id.*, 2:3-5. Grotmol then describes its own approach, whereby user commands are associated with camera images captured during training, such that during “autonomous operation, an acquired image may be compared with one or more images from the training buffer” to determine how to control the robot. *Id.*, Abstract.

More specifically, Grotmol describes a “listen mode,” in which a robot observes a teacher’s commands in order to “learn an association.” *Id.*, 23:5-11. Grotmol also describes an “override mode,” in which a robot will operate autonomously until a teacher sends a command, in which case the robot will apply the teacher’s command and “try to remember it for the next time the same situation

occurs.” *Id.*, 23:12-22. “During training, images (e.g., raw and/or pre-processed) may be stored in a memory buffer (training buffer),” along with “[m]otor commands issued by a trainer corresponding to time instances when the images are acquired.” *Id.*, 39:13-22. The robot may then switch—either manually or automatically—into an “autonomous mode,” in which the robot performs tasks autonomously based on what it has learned. *Id.*, 23:46-48, 24:1-16. “During autonomous operation, control process of the robot may be configured to compare a given (e.g., the most recent, current) image with one or more images from the training buffer.” *Id.*, 39:23-28. “In some implementations, motor commands at a given time step may be obtained by taking the stored motor commands from the training buffer that may correspond to the best matching stored image.” *Id.*, 43:4-9.

Grotmol further teaches that a robot’s “trained configuration may be stored” and “loaded to one or more other robots in order to provide learned behaviors.” *Id.*, 33:12-35.

B. U.S. 8,639,644 (“Hickman”)

Hickman is a U.S. patent filed on May 4, 2012, which issued on January 28, 2014. Hickman is prior art to the ’449 patent under at least 35 U.S.C. §§ 102(a) and 102(d). Hickman is cited in Grotmol. Ex. 1005.002.

The disclosure of Hickman relates to “shared robot knowledge bases for use with cloud computing systems.” Ex. 1007, Abstract. Hickman teaches a method

whereby “information in the shared robot knowledge bases is updated based on robot experiences so that any particular robot may benefit from prior experiences of other robots.” *Id.* One embodiment of Hickman’s shared robot knowledge base is illustrated in Figure 4, copied below. *See id.*, 25:3-27:26 (describing figure).

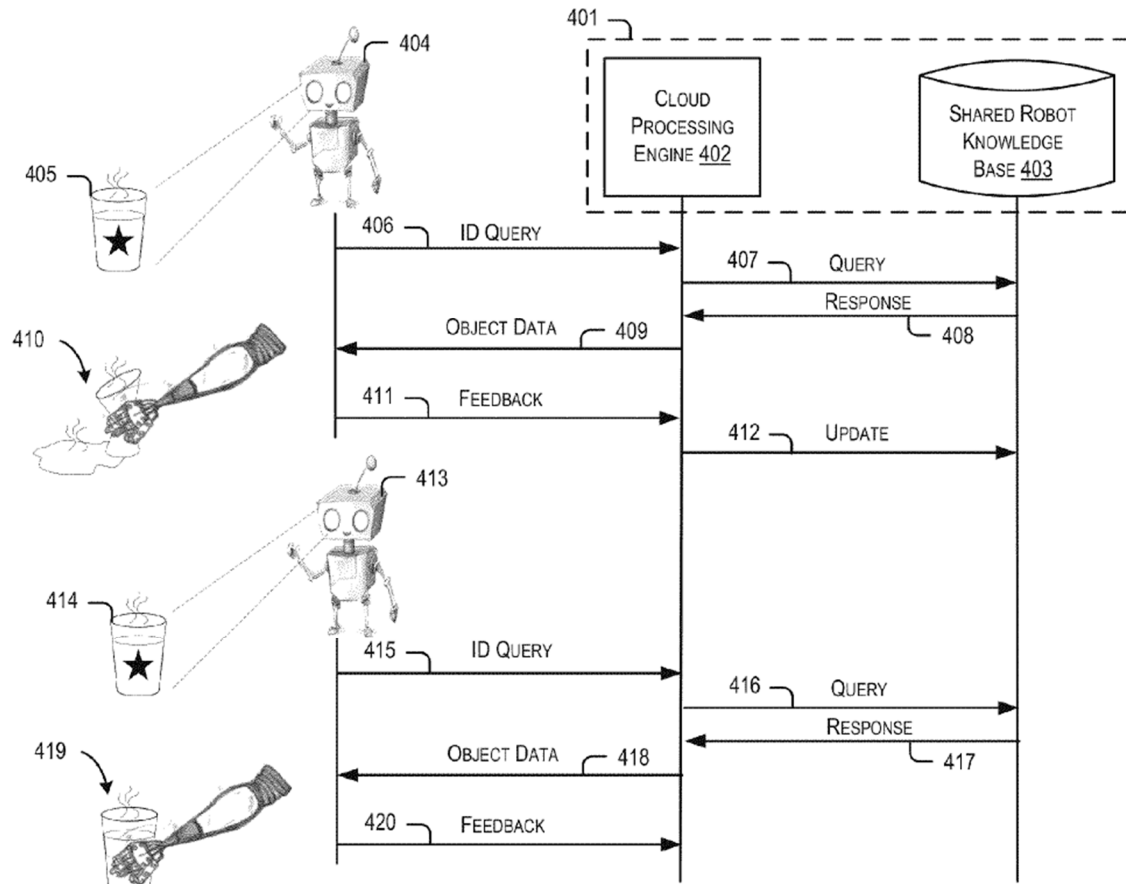


FIGURE 4

Ex. 1007, Fig. 4

As shown above, a first robot 404 encounters an object 405 and obtains image data associated with it. *Id.*, 25:14-26. The first robot attempts to grasp the object but crushes it (410). *Id.*, 26:38-56. “When an accident happens, a human can ‘coach’ the robot on how much force to use by, for example, manually controlling the robot’s

hand....” *Id.* “The cloud processing system 402 can then update” with this new training. *Id.* Later, a second robot may encounter an object 414 with similar image data to object 405. *Id.*, 26:57-27:6. The second robot may attempt to grasp the new object—but with less force based on the updated training data from the first robot—and this time be successful. *Id.*, 26:66-27:26.

C. U.S. 9,443,192 (“Cosic 192”)

Cosic 192 is a U.S. patent filed on August 30, 2015, which issued on September 13, 2016. Cosic is prior art to the ’449 patent under at least 35 U.S.C. § 102(a). Cosic 192 has the same inventor as the ’449 patent.

The disclosure of Cosic 192 is “generally directed to devices, systems, methods, and/or applications for learning the operation of a computing device or software application, storing this knowledge in a knowledgebase, neural network, or other repository, and enabling autonomous operation of the computing device or software application with partial, minimal, or no user input.” Ex. 1006, Abstract. Cosic 192 describes its system as a “universal artificial intelligence engine” or “UAIE.” *Id.*, 10:14-16.

Cosic 192 discloses an autonomous learning process for use with a robot that is substantially similar to the process claimed in the ’449 patent. *E.g., id.*, 201:45-202:51 (describing embodiment in which a “Robot 70 may detect an object through its vision sensor (i.e., video or other camera, etc.) and Control Application 120 may

execute one or more instructions (i.e. Instruction Sets 600 or Operations 610, etc.) to move Robot 70 closer to the object. . . . UAIE can then implement the subsequent operations autonomously based on similar operations performed in prior similar circumstances, thereby implementing anticipation of Control Application's 120 operations as previously described.”); *see generally Id.*, 196:60-202:51 (describing autonomous robot embodiments); Decl. ¶ 59.

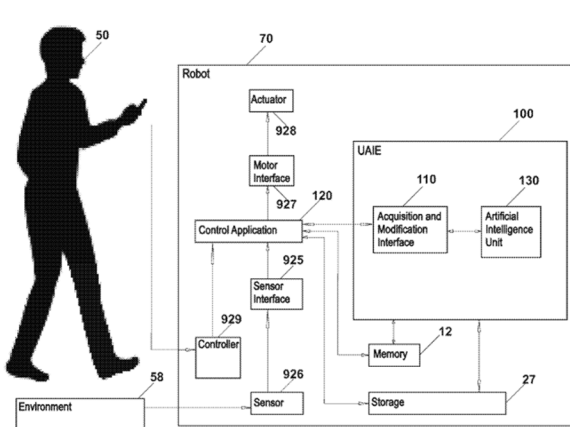


FIG. 63

Ex. 1006, Fig. 63

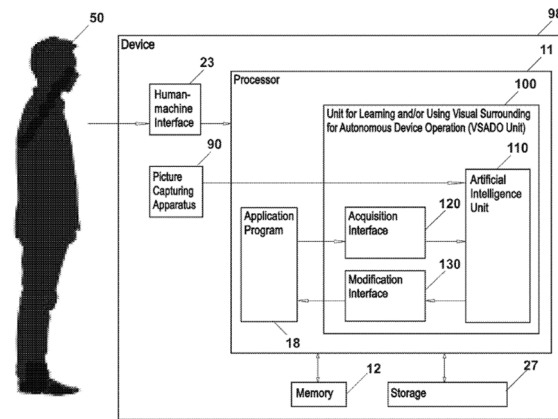


FIG. 7

Ex. 1001, Fig. 7

IX. IDENTIFICATION OF HOW THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Ground 1

Grotmol anticipates claims 1, 6-8, 10, and 12-20 of the '449 patent.

1. Claim 1

- a. [1.1] A system for autonomous device operating, the system comprising:

To the extent the preamble is limiting, Grotmol discloses “a system for autonomous device operating.” Grotmol discloses “[a]n apparatus and method for

training and/or operating a robotic device to follow a trajectory” that includes “autonomous operation.” Ex. 1005, Abstract; *see also id.*, 3:27-30, 10:45-48; Decl. ¶ 70.

b. [1.2] one or more processor circuits;

Grotmol discloses limitation [1.2]. Decl. ¶ 71.

Grotmol illustrates the system including a “processing” unit in Figure 7 that is connected to, *inter alia*, a sensory unit and a memory unit. Ex. 1005, Figure 7. Grotmol further defines “processor” as follows:

As used herein, the terms “processor”, “microprocessor” and “digital processor” are meant generally to include all types of digital processing devices including, without limitation, digital signal processors (DSPs), reduced instruction set computers (RISC), general-purpose (CISC) processors, microprocessors, gate arrays (e.g., field programmable gate arrays (FPGAs)), PLDs, reconfigurable computer fabrics (RCFs), array processors, secure microprocessors, and application-specific integrated circuits (ASICs). Such digital processors may be contained on a single unitary IC die, or distributed across multiple components.

Id., 8:5-15. Grotmol also discloses “a self-contained robotic apparatus, the apparatus comprising ... *one or more physical processors* configured to operate [the system].”¹ *Id.*, claim 12; *see also id.*, Figure 8.

¹ All emphasis has been added, unless noted otherwise.

- c. [1.3] a memory that stores at least a first one or more digital pictures correlated with a first one or more instructions sets for operating a first physical device,

Grotmol discloses limitation [1.3]. Decl. ¶¶ 72-76.

Grotmol discloses “a memory component,” which “may be configured to store training sets,” where each training set “may comprise an instance of the video frame [*a first one or more digital pictures*²] . . . and an instance of a motor control indication configured to cause the robot to execute an action [*a first one or more instruction sets*³].” Ex. 1005, 3:27-39. The video frames in Grotmol are “associated with” or “correspond to”—i.e., are correlated with⁴—motor control indications issued around the same time. Decl. ¶ 73. Grotmol describes training behaviors in a robotic device by “learning of *associations* between sensory context . . . and a respective action . . . during training.” Ex. 1005, 33:59-62; *see also id.*, Abstract (“Motor commands

² The ’449 patent describes that a “digital picture” may be a “frame” of “a stream of digital pictures (i.e. motion picture, video, etc.).” Ex. 1001, 87:27-32.

³ The ’449 patent describes that “instruction sets” may comprise, for example, instructions “causing [a] vehicle to stop,” “causing [a] change of direction,” and “causing [a] robotic arm to screw [a] screw,” among other examples. Ex. 1001, 92:48-93:24; *see also id.*, 159:26-67 (describing a device learning to “turn or steer right”). “Instruction Set 526 may include one or more instructions or commands of a high-level programming language such as Java or SQL, a low-level language such as assembly or machine language, an intermediate language or construct such as bytecode, and/or *any other language or construct*.” *Id.*, 82:64-83:19.

⁴ The ’449 patent describes that a device may “correlate Digital Pictures 525 from the stream of Digital Pictures 525 with *temporally corresponding* Instruction Sets”). Ex. 1001, 91:35-39.

associated with a given image may be stored.”). This association may be based on the timing of the images and the motor commands. *Id.*, 39:17-19 (“Motor commands issued by a trainer *corresponding to* time instances when the images are acquired may be stored.”); *see also id.*, 43:5-9 (“[M]otor commands at a given time step may be obtained by taking the stored motor commands from the training buffer that may *correspond to* the best matching stored image.”).

Accordingly, Grotmol discloses a memory that stores digital pictures correlated with instruction sets (e.g, motor commands) for operating a first physical device (e.g., robotic vehicle). Decl. ¶¶ 72-76.

d. **[1.4] wherein the first physical device includes an actuator for moving at least a portion of the first physical device,**

Grotmol discloses limitation [1.4]. Decl. ¶¶ 77-78.

Grotmol discloses a robotic vehicle capable of autonomous operation that include motors and actuators⁵ for moving the device and controlling behaviors of the robot. *E.g.*, Ex. 1005, 3:27-39 (“The platform may comprise a motor.”), Abstract (“An apparatus and methods for training and/or operating a robotic device to follow a trajectory. A robotic vehicle may utilize a camera...Motor commands associated

⁵ The ’449 patent describes an “actuator” as including, inter alia, a “motor.” Ex. 1001, 69:34-39.

with a given image may be stored. During autonomous operation...”), 24:66-67 (“The user may select which actuators are controlled by a particular behavior.”).

- e. **[1.5] and wherein at least a portion of the first one or more digital pictures or at least a portion of the first one or more instruction sets for operating the first physical device are learned in a learning process that includes operating the first physical device at least partially by a user;**

Grotmol discloses limitation [1.5]. Decl. ¶ 79.

Grotmol discloses that a human (“user”⁶) can operate the robot during a training process and “[t]rained behaviors of the robotic device may be configured based on *learning* of associations between sensory context (e.g., presence of an obstacle in front of the robotic vehicle) and a respective action (e.g., right turn) during training.” Ex. 1005, 33:59-62. In both the “listen mode” and “override mode,” Grotmol teaches that the robot will listen to commands sent by a teacher (user) “and try to remember it for next time the same situation occurs.” *Id.*, 23:3-29; *see also id.*, 24:57-25:5 (“While training a particular behavior, the *user* may concentrate on a particular behavior and may not show any examples of other behaviors thus making a prediction task for the classifier substantially easier (e.g., less computationally intensive).”), 34:49-55 (“In some implementations of supervised training of robots,

⁶ “User 50 (also referred to simply as user or other similar name or reference) comprises a human user or non-human user.” Ex. 1001, 68:64-66.

control instructions (also referred to as corrections) produced by the *trainer* (e.g., human) may be combined with control instructions produced by the robot controller instructions (predictions).”). Grotmol describes this training as a learning process. *E.g., id.*, 24:17-20 (“Apparatus and methods for hierarchical *learning* are disclosed herein, in accordance with one or more implementations. In *supervised learning*, a user may train simple tasks by demonstrating example tasks to the system.”), claim 12 (reciting “one or more physical processors configured to operate a random k-nearest neighbors *learning process*”). Accordingly, Grotmol discloses that a first digital picture and a first instruction set are learned during a learning process in which a user operates the first physical device. Decl. ¶ 79.

f. **[1.6] an optical camera that captures digital pictures; and**

Grotmol discloses limitation [1.6]. Decl. ¶ 80.

Grotmol discloses discloses that a “robotic vehicle may utilize a camera and stores the sequence of images of a visual scene seen when following a trajectory during training in an ordered buffer.” Ex. 1005, Abstract; *see also id.*, 10:16-22 (“In some implementations of robotic navigation in an arbitrary environment, the sensor component 166 may comprise a camera configured to provide an output comprising a plurality of digital image frames”); *id.*, 38:28-60; Decl. ¶ 80.

g. **[1.7] an artificial intelligence unit that:**

Grotmol discloses limitation [1.7]. Decl. ¶¶ 81-83.

During prosecution, the applicant for the '449 patent stated that the artificial intelligence unit “is specifically described in the specification to include hardware, programs, or a combination thereof.” Ex. 1002.099. The applicant further stated that the artificial intelligence unit may “be implemented entirely or in part as a computer program.” *Id.*, .100. Indeed, the '449 patent states that the “artificial intelligence unit” may be “part of, operating on, or coupled to the processor circuit.” Ex. 1001, 2:34-36. In other embodiments, the “artificial intelligence unit” may be “provided as a feature of an application running on the processor circuit.” *Id.*, 2:-60-62; *see also id.*, claim 11 (reciting “wherein the artificial intelligence unit includes . . . an application operating on the one or more processor circuits”).

Grotmol discloses an “artificial intelligence unit” as a part of or operating on its processor circuit. *See, e.g.*, Ex. 1005, claim 11 (reciting “one or more physical processors configured to operate a random k-nearest neighbors learning process to determine a motor control indication”).

As recited in claim 1 of the '449 patent, the “artificial intelligence unit” must perform the following functions: (i) receive a new picture (limitation [1.7.1]); (ii) anticipate an instruction set based on matching the new picture with a picture stored in memory (limitation [1.7.2]); and (iii) cause the processor to execute the instruction set in response to determining a match between the new picture and picture stored

in memory (limitation [1.7.3]). As described in the sections IX.A.1.h – IX.A.1.j below, Grotmol discloses an artificial intelligence unit that performs these functions.

h. [1.7.1] receives a new one or more digital pictures from the optical camera;

Grotmol discloses limitation [1.7.1]. Decl. ¶¶84-86.

Grotmol discloses an artificial intelligence unit—i.e., its processor or a feature of an application running thereon—that receives new digital pictures from the camera. Ex. 1005, 38:36-39 (“In some implementations, the robot may comprise a robotic vehicle (e.g., 160 in FIG.1) comprising a camera (e.g., 166). The robot may comprise a controller configured to store a sequence of images obtained during training phase.”), 39:23-28 (“During autonomous operation, control process of the robot may be configured to compare a given (e.g., the most recent, current) image with one or more the images from the training buffer.”), 9:8-22; Decl. ¶84.

As depicted in Figure 8 of Grotmol below, the “processing” functionality of Grotmol is connected to the “sensory” functionality, which may include camera input (*see* Ex. 1005, 9:1-3 (“[T]he output provided by the sensor component 166 may comprise a stream of pixel values associated with one or more digital images.”)).

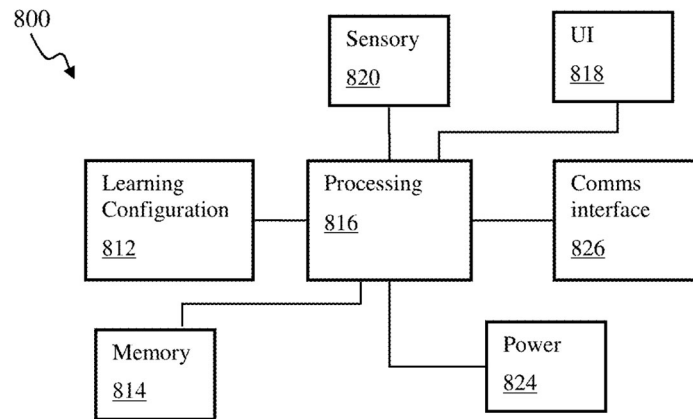


FIG. 8

Ex. 1005, Fig. 8

Accordingly Grotmol discloses an artificial intelligence unit receives digital pictures from an optical camera. Decl. ¶¶84-86.

- i. **[1.7.2] anticipates the first one or more instruction sets for operating the first physical device based on at least partial match between the new one or more digital pictures and the first one or more digital pictures, wherein the anticipates includes at least one of:**

determining that a number of at least partially matching portions of the new one or more digital pictures and portions of the first one or more digital pictures exceeds a threshold number, or

determining that a percentage of at least partially matching portions of the new one or more digital pictures and portions of the first one or more digital pictures exceeds a threshold percentage; and

Grotmol discloses limitation [1.7.2]. Decl. ¶¶87-89.

Grotmol discloses that “motor commands at a given time step may be obtained by taking the stored motor commands from the training buffer that may correspond

to the *best matching* stored image.” Ex. 1005, 43:5-9; *see also id.*, Abstract (“During autonomous operation, an acquired image may be compared with one or more images from the training buffer in order to determine the most likely match.”). Grotmol discloses that the matching step may comprise calculating a similarity measure between a new image and an old image, then determining whether that similarity measure breaches a threshold (i.e., “determining that a number of at least partially matching portions of the new one or more digital pictures and portions of the first one or more digital pictures exceeds a threshold number”).

The method may comprise, based on the comparison, determining a *similarity measure* for a given training set of the plurality of training feature sets. The similarity measure may characterize similarity between features of the subset and features of the given training set. The method may comprise, responsive to the similarity measure *breaching a threshold*, selecting one or more training sets from the plurality of training sets.

Ex. 1005, 2:29-37; *see also id.*, claim 1 (reciting “*responsive to the similarity measure breaching a threshold*, selecting one or more training sets from the plurality of training feature sets”). As used in Grotmol, “the term feature may be used to describe one or more integer or floating point values characterizing the input, e.g., the presence or absence of an edge, corner, shape, texture, color, object, at particular locations in the image, *values of pixels in an image*, patches of color texture,

brightness in the image, and/or in the image as a whole [.]” *Id.*, 28:19-24. As used in Grotmol, a “training set” may comprise “an *instance of the video frame*, an instance of the binary sensor signal, and an instance of a motor control indication configured to cause the apparatus to execute an action.” Ex. 1005, claim 12.

Both Grotmol and the ’449 patent disclose that determining “matching portions” may comprise pixel-wise difference analysis between the two digital pictures. *Compare* Ex. 1001, 21:12-35 (discussing “portion”), 67:27-31 (discussing “matching”), 112:23-54 (discussing RGB pixel matching) *with* Ex. 1005, 3:13-17 (“The first input type may comprise a digital image comprising a plurality of pixel values.”), 41:8-17 (“A similarity metric . . . may be determined by performing pixel-wise difference between the overlapping regions (e.g., the frames 2020, 2040 in FIG. 20B) of the given image and the matching image.”).

Accordingly, Grotmol discloses an artificial intelligence unit that anticipates an instruction set for operating the robotic vehicle based on a partial match between a new picture and a stored picture, which includes determining that the matching portions of the new picture and the stored picture exceed a threshold number. Decl. ¶¶ 87-89.

- j. [1.7.3] causes the one or more processor circuits to execute the first one or more instruction sets for operating the first physical device, wherein the causes is performed in response to the anticipates of the artificial intelligence unit, and wherein the first physical device or a second physical device autonomously performs one or more operations defined by the first one or more instruction sets for operating the first physical device.

Grotmol discloses limitation [1.7.3]. Decl. ¶¶ 90-95.

As described above, Grotmol discloses an artificial intelligence unit that anticipates the learned instruction sets for operating the device by comparing a new picture with a previously learned picture at least by matching portions of the pictures and determining whether those matching portions exceed a threshold number. *See supra* [1.7.2].

Grotmol further discloses that, in response to the “anticipates,” the system “causes the one or more processor circuits to execute the first one or more instruction sets for operating the first physical device.” Grotmol describes that after it is determined that the similarity measure between the new image and image from the training set breaches a threshold, one or more potential control signals corresponding to the image from the training set that were obtained during a training operation of the robot (the instruction sets correlated with the first digital picture) are determined and executed.

The method may comprise, responsive to the similarity measure breaching a threshold, selecting one or more training sets from

the plurality of training sets. The method may comprise determining one or more potential control signals for the robot. Individual ones of the one or more potential control signals may be associated with a corresponding training set of the plurality of training sets.

In some implementations, the control signal may be configured *to cause the robot to execute the action.*

Ex. 1005, 2:34-41, 3:12-13; *see also id.*, 43:4-11 (“In some implementations, motor commands at a given time step may be obtained by taking the stored motor commands from the training buffer that may correspond to the best matching stored image.”).⁷

Grotmol discloses autonomous performance of the operations defined by the first instruction set for operating the device. Ex. 1005, 34:56-62 (“In some implementations, the trainer may be provided with the control of the robot during training. Upon completion of the training, the robot may be configured to operate autonomously.”), Abstract (“During autonomous operation, an acquired image may

⁷ The ’449 patent similarly describes that this step may comprise simply causing an application to execute an instruction. Ex. 1001, 10:52-58 (“In certain embodiments, the causing the processor circuit to execute the one or more instruction sets for operating the device correlated with the first digital picture includes causing an application for operating the device to execute the one or more instruction sets for operating the device correlated with the first digital picture, the application running on the processor circuit.”).

be compared with one or more images from the training buffer in order to determine the most likely match.”), 43:4-11 (“In some implementations, motor commands at a given time step may be obtained by taking the stored motor commands from the training buffer that may correspond to the best matching stored image.”). Decl. ¶ 93.

Furthermore, Grotmol discloses that the robot autonomously performing the operations defined by the first instruction set can be the robot that was used during the training mode (i.e., first physical device), or it can be a different robot (i.e., second physical device) that is loaded with the training set of the first. Decl. ¶ 94; *see also* Ex. 1005, 33:27-32 (“The trained configuration may be stored. A saved configuration may be loaded into *the robot being trained* thereby providing one or more trained behaviors to the robot. In some implementations, the trained configuration may be loaded to *one or more other robots* in order to provide learned behaviors.”).

Accordingly, Grotmol discloses an artificial intelligence unit that causes a processor circuit to execute the anticipated instruction, and a first physical device or a second physical device autonomously performs operations defined by the first instruction. Decl. ¶¶ 90-95.

2. Claim 6

- a. **[6.1] The system of claim 1, wherein the second physical device autonomously performs one or more operations defined by the first one or more instruction sets for operating the first physical device,**

Grotmol discloses limitation [6.1]. Decl. ¶ 96. As explained above for limitation [1.7.3], Grotmol discloses a second physical device autonomously performs the operations defined by the anticipated instruction.

- b. **[6.2] and wherein the first one or more instruction sets for operating the first physical device are modified so that the second physical device can autonomously perform one or more operations defined by the first one or more instruction sets for operating the first physical device.**

Grotmol discloses limitation [6.2]. Decl. ¶¶ 97-99.

Grotmol discloses that autonomous operation of a robot may include modifying the learned instruction set to compensate for, e.g., “position mismatch” and “orientation mismatch.” Ex. 1005, 42:46-58; *see also id.*, Abstract (“An evaluation may be performed in order to determine if the image may correspond to a shifted (e.g., left/right) version of a stored image as previously observed. If the new image is shifted left, right turn command may be issued.”). Therefore, when a training configuration is loaded into a second physical device (“one or more other robots” – *see supra* limitations [1.7.3], [6.1]), and the second robot encounters “position mismatch” or “orientation mismatch” from the first robot, the instruction set is shifted. Decl. ¶ 99. Thus, Grotmol discloses that the anticipated first

instruction for operating the first physical device is modified so the second physical device can perform the operation defined by the instruction. Decl. ¶¶ 97-99.

3. Claim 7

Grotmol discloses “portions of the new one or more digital pictures include portions of the new one or more digital pictures that depict recognized objects and the portions of the first one or more digital pictures include portions of the first one or more digital pictures that depict recognized objects.” Decl. ¶¶ 100-103.

The '449 patent provides examples of objects in pictures such as “car, pedestrian, door, building, animal, person, etc.” Ex. 1001, 88:9-20. The '449 patent further describes various approaches to object recognition, such as “identifying and/or analyzing object features such as lines, edges, ridges, corners, blobs, regions, and/or their relative positions, sizes, shapes, etc.” *Id.*

Similarly, Grotmol discloses that images 2000 and 2010 may “comprise representations [of] one or more objects, e.g., a tree 2002, a rectangle, a ball 2008, and/or other objects.” Ex. 1005, 38:56-65.

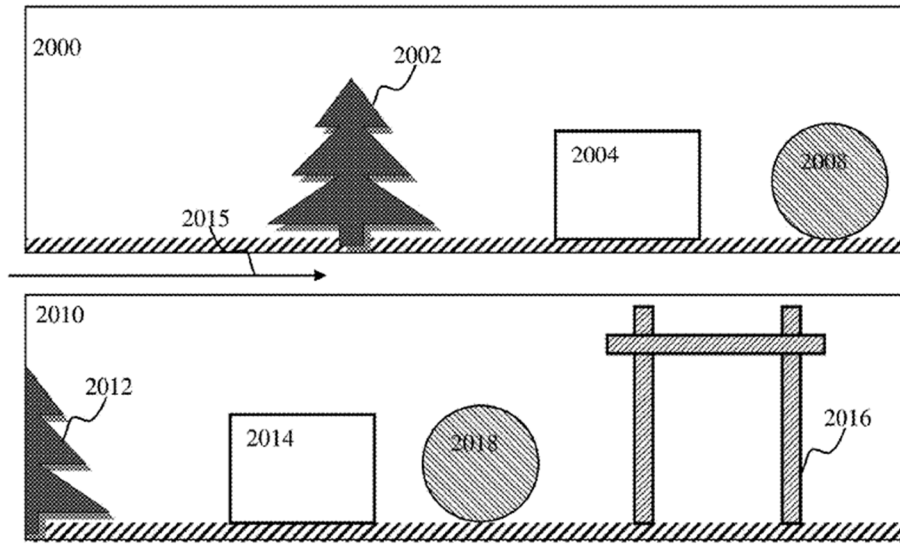


FIG. 20A
Ex. 1005, Fig. 20A

Grotmol likewise discloses that the sensor used to capture these images “may provide information associated with objects within the field-of-view []. In one or more implementations, such as *object recognition*, and/or obstacle avoidance, the output provided by the sensor component 166 may comprise a stream of pixel values associated with one or more digital images.” Ex. 1005, 8:57-9:3. *See, e.g., id.*, 9:41-52 (“In one or more implementations, object recognition and/or classification may be implemented”). Grotmol, like the ’449 patent, further includes edge detection. *Id.*, 7:60-63 (“[T]he term feature may refer to a representation of an object edge”).

Accordingly, Grotmol discloses new pictures and stored pictures may include portions that depict recognized objects. Decl. ¶¶ 100-103

4. Claim 8

- a. **[8.1] The system of claim 1, wherein the first physical device includes a robot, a vehicle, an appliance, an electronic device, or a mechanical machine and**

Grotmol discloses limitation [8.1]. Decl. ¶ 104. Grotmol discloses autonomous operation of a robotic vehicle. Ex. 1005, Abstract (“An apparatus and methods for training and/or operating a robotic device to follow a trajectory. A robotic vehicle may....”), 46:16-26 (“Implementations of the principles of the disclosure may be applicable to . . . processes associated with an industrial robot, autonomous and other vehicles . . .”).

- b. **[8.2] the second physical device includes a robot, a vehicle, an appliance, an electronic device, or a mechanical machine, and**

Grotmol discloses limitation [8.2]. Decl. ¶ 105. For example, Grotmol discloses that training sets and training configurations from a first robot can be loaded to “one or more other robots in order to provide learned behaviors.” Ex. 1005, 33:24-35.

- c. **[8.3] wherein the one or more processor circuits are included in at least one of: the first physical device, the second physical device, or a third device.**

Grotmol discloses limitation [8.3]. Decl. ¶ 106. For example, the “one or more processor circuits” (*see supra* limitation [1.2]) may be included in any of the robots described in Grotmol (i.e., the “first,” the “second,” or a “third” device). *E.g.*, Ex. 1005, 3:27-39 (“Another aspect of the disclosure relates to a self-contained robotic

apparatus. The apparatus may comprise a platform, a first sensor, a second sensor, a memory component, and *one or more physical processors*.”); *see also id.*, claim 12 (reciting “[a] self-contained robotic apparatus, the apparatus comprising . . . one or more physical processors configured to operate a random k-nearest neighbors learning process to determine a motor control indication”).

5. Claim 10

Grotmol discloses that “the first one or more digital pictures includes a one or more still digital pictures or one or more motion digital pictures and the new one or more digital pictures include one or more still digital pictures or one or more motion digital pictures.” Decl. ¶ 107. For example, Grotmol discloses that the digital pictures may comprise images and/or image frames, i.e., “still digital pictures” or “motion digital pictures.” *E.g.*, Ex. 1005, 9:12-17 (“The input signal may comprise a sequence of images and/or image frames. The sequence of images and/or image frame may be received from a CCD camera The image may comprise a two-dimensional matrix of red/green/blue (RGB) values refreshed at 25 Hz frame rate.”), 38:44-47 (“Images 2000, 2010 may be obtained with a variety of sensors, e.g., a video camera, IR camera, . . . and/or other device.”), claim 12 (reciting “[a] self-contained robotic apparatus, the apparatus comprising . . . a first sensor component configured to provide a signal configured to convey a video frame comprising a plurality of pixels”).

6. Claim 12

- a. [12.1] The system of claim 1, wherein the memory further stores at least a knowledge structure that includes: a first knowledge cell including the first one or more digital pictures correlated with the first one or more instruction sets for operating the first physical device, and a second knowledge cell including a second one or more digital pictures correlated with a second one or more instruction sets for operating the first physical device, and

Grotmol discloses limitation [12.1]. Decl. ¶¶ 108-112.

The '449 patent describes that a “knowledge cell” may “compris[e] the first digital picture correlated with the one or more instruction sets for operating the device.” Ex. 1001, 6:64-7:1. “Knowledge Cell 800 comprises the functionality for storing one or more Digital Pictures 525 correlated with any Instruction Sets 526 and/or Extra Info 527. Knowledge Cell 800 includes a unit of knowledge of how Device 98 operated in a visual surrounding.” *Id.*, 90:35-40. “Once created or generated, Knowledge Cells 800 can be used in/as neurons, nodes, vertices, or other elements in any of the data structures or arrangements (i.e. neural networks, graphs, sequences, etc.) used for storing the knowledge of Device’s 98 operation in various visual surroundings, thereby facilitating learning functionalities herein.” *Id.*, 90:40-46. “Knowledge Cell 800 may include any data structure or arrangement that can facilitate such storing.” *Id.*, 90:66-67.

The '449 patent further describes that “[k]nowledge cells may be connected, interrelated, or interlinked into knowledge structures using statistical, artificial intelligence, machine learning, and/or other models or techniques.” Ex. 1001, 143:65-144:1. “In some embodiments, Knowledge Structuring Unit 520 may correlate a Digital Picture 525 with one or more temporally corresponding Instruction Sets 526 and/or Extra Info 527.” *Id.*, 91:22-25.

Grotmol discloses the claimed “knowledge structure” that comprises “a first knowledge cell” and a “second knowledge” cell. Decl. ¶ 111. For example, Grotmol describes storing sequences of images and the corresponding instruction sets (i.e., a sequence of knowledge cells). Ex. 1005, Abstract (“Motor commands associated with a given image may be stored.”); *see also id.*, 38:21-42. Grotmol further discloses that its training data is stored as a “sequence” and may be stored in “an ordered buffer in a non-volatile memory.” *Id.*, 38:38-42. An ordered buffer is a region of memory that is allocated for storing data in a specific order or sequence. Decl. ¶ 111. Grotmol describes that the training buffer may be ordered according to when the images were acquired. *See* Ex. 1005, 39:65-40:4; Decl. ¶ 111; *see also id.*, 39:17-19 (“Motor commands issued by a trainer corresponding to time instances when the images are acquired may be stored.”). The training data stored in memory in a sequence corresponds to the claimed “knowledge cells” in a “knowledge structure.”

Furthermore, as explained with respect to limitations [1.3] and [1.5] of claim 1, Grotmol discloses that multiple images may be acquired during a training process, with images respectively stored in association with corresponding motor commands issued at the time the image was acquired. Decl. ¶ 112. Thus, Grotmol discloses first, second, third, etc. knowledge cells, where the knowledge cells include digital pictures correlated with instruction sets. Decl. ¶¶ 108-112.

b. **[12.2] wherein the first knowledge cell is connected with the second knowledge cell by a directed connection that indicates temporal order of the first knowledge cell and the second knowledge cell**

Grotmol discloses limitation [12.2]. Decl. ¶¶ 113-114.

The '449 patent does not define or discuss “directed connection” in its specification. The '449 patent does describe, however, that knowledge cells can be “connected” to other knowledge cells:

Knowledge cells may be *connected, interrelated, or interlinked into knowledge structures* using statistical, artificial intelligence, machine learning, and/or other models or techniques. Such interconnected or interrelated knowledge cells can be used for enabling autonomous device operation. The interconnected or interrelated knowledge cells may be stored or organized into a knowledgebase (i.e. Knowledgebase 530, etc.). . . . In further embodiments, knowledgebase may be or include a sequence (i.e. Sequence 533, etc.). In further embodiments, knowledgebase may be or include a collection of knowledge cells (i.e. Collection

of Knowledge Cells 530d, etc.). In general, knowledgebase may be or include any data structure or arrangement, and/or repository capable of storing the knowledge of a device's operation in various visual surroundings.

Ex. 1001, 143:65-144:18.

Grotmol discloses that its training data is stored as a “sequence” and may be stored in “an ordered buffer in a non-volatile memory.” Ex. 1005, 38:38-42. As discussed above, an ordered buffer is a region of memory that is allocated for storing data in a specific order or sequence. Decl. ¶ 114. Grotmol describes that the data in its “ordered buffer” is organized such that it indicates a temporal order (e.g., image 1 occurs first and is followed by (connected to in sequence) image 2). Ex. 1005, 39:65-40:4; Decl. ¶ 114. Thus, Grotmol’s first knowledge cell is connected with the second knowledge cell by a directed connection that indicates temporal order of the first knowledge cell and the second knowledge cell. Decl. ¶ 113-114.

7. Claim 13

Independent claim 13 is a non-transitory machine readable medium claim that corresponds to system claim 1. The analysis above explaining how Grotmol discloses the limitations of claim 1 applies to the limitations of claim 13 as set forth in the chart below. Decl. ¶ 115.

Claim 13	Disclosure of Grotmol
[13.1] A non-transitory machine readable medium having a stored thereon, instructions that when executed by one or more processor circuits cause the one or more processor circuits to perform operations comprising:	To the extent the preamble is limiting, Grotmol discloses “[a] non-transitory machine readable medium having a stored thereon, instructions that when executed by one or more processor circuits cause the one or more processor circuits to perform operations.” <i>E.g.</i> , Ex. 1005, claim 17 (reciting a substantially similar preamble); Decl. ¶ 115; <i>see supra</i> limitation [1.2].
[13.2] accessing a memory that stores at least a first one or more digital pictures correlated with a first one or more instructions sets for operating a first physical device, wherein	<i>See</i> analysis for limitation [1.3] above.
[13.3] the first physical device includes an actuator for moving at least a portion of the first physical device, and wherein	<i>See</i> analysis for limitation [1.4] above.
[13.4] at least a portion of the first one or more digital pictures or at least a portion of the first one or more instruction sets for operating the first physical device are learned in a learning process that includes operating the first physical device at least partially by a user;	<i>See</i> analysis for limitation [1.5] above.
[13.5] receiving a new one or more digital pictures from an optical camera;	<i>See</i> analysis for limitations [1.6] and [1.7.1] above.

Claim 13	Disclosure of Grotmol
[13.6] anticipating the first one or more instruction sets for operating the first physical device based on at least partial match between the new one or more digital pictures and the first one or more digital pictures, wherein the anticipating includes at least one of: determining that a number of at least partially matching portions of the new one or more digital pictures and portions of the first one or more digital pictures exceeds a threshold number, or determining that a percentage of at least partially matching portions of the new one or more digital pictures and portions of the first one or more digital pictures exceeds a threshold percentage; and	<i>See analysis for limitation [1.7.2] above.</i>
[13.8] causing the one or more processor circuits or another one or more processor circuits to execute the first one or more instruction sets for operating the first physical device, the causing performed in response to the anticipating, wherein the first physical device or a second physical device autonomously performs one or more operations defined by the first one or more instruction sets for operating the first physical device.	<i>See analysis for limitation [1.7.3] above.</i>

8. Claim 14

Claim 14 requires that the second physical device autonomously performs the operation defined by the anticipated instruction, and the instruction is modified so that the second physical device can perform the operation. Grotmol discloses claim

14 for the same reasons discussed above in Section IX.A.2, *supra*, for claim 6. Decl. ¶ 116.

9. Claim 15

Claim 15 requires that the new pictures and stored pictures include portions that depict recognized objects. Grotmol discloses claim 15 for the same reasons discussed above in Section IX.A.3, *supra*, for claim 7. Decl. ¶ 117.

10. Claim 16

Claim 16 requires the memory stores a knowledge structure that includes a first knowledge cell including a digital picture correlated with an instruction, a second knowledge cell including a digital picture correlated with an instruction, and the first knowledge cell and second knowledge cell are connected by a directed connection that includes temporal order of the cells. Grotmol discloses claim 16 for the same reasons discussed above in Section IX.A.6, *supra*, for claim 12. Decl. ¶ 118.

11. Claim 17

Independent claim 17 is a method claim that corresponds to system claim 1. The analysis above explaining how Grotmol discloses the limitations of claim 1 applies to the limitations of claim 17 as set forth in the chart below. Decl. ¶ 119.

Claim 17	Disclosure of Grotmol
[17.1] A method comprising:	To the extent the preamble is limiting, Grotmol discloses a method implemented using a “self-contained

	robotic apparatus” that includes “one or more physical processors.” Decl. ¶119; Ex. 1005, 3:27-30; <i>see also id.</i> , 2:14-18, 7:30-42.
[17.2] (a) accessing a memory that stores at least a first one or more digital pictures correlated with a first one or more instructions sets for operating a first physical device,	<i>See</i> analysis for limitation [1.3] above.
[17.3] wherein the first physical device includes an actuator for moving at least a portion of the first physical device,	<i>See</i> analysis for limitation [1.4] above.
[17.4] and wherein at least a portion of the first one or more digital pictures or at least a portion of the first one or more instruction sets for operating the first physical device are learned in a learning process that includes operating the first physical device at least partially by a user, the accessing of (a) performed by one or more processor circuits;	<i>See</i> analysis for limitations [1.2] and [1.5] above.
[17.5] (b) receiving a new one or more digital pictures from an optical camera, the receiving of (b) performed by the one or more processor circuits;	<i>See</i> analysis for limitations [1.6] and [1.7.1] above.
[17.6] (c) anticipating the first one or more instruction sets for operating the first physical device based on at least partial match between the new one or more digital pictures and the first one or more digital pictures, wherein the anticipating of (c) includes at least one of: determining that a number of at least partially matching portions of the new one or more digital pictures and portions	<i>See</i> analysis for limitation [1.7.2] above.

of the first one or more digital pictures exceeds a threshold number, or determining that a percentage of at least partially matching portions of the new one or more digital pictures and portions of the first one or more digital pictures exceeds a threshold percentage, the anticipating of (c) performed by the one or more processor circuits;	
[17.7] (d) executing the first one or more instruction sets for operating the first physical device, the executing of (d) performed by the one or more processor circuits or by another one or more processor circuits in response to the anticipating of (c); and (e) autonomously performing, by the first physical device or by a second physical device, one or more operations defined by the first one or more instructions ets [sic] for operating the first physical device.	<i>See</i> analysis for limitation [1.7.3] above.

12. Claim 18

Claim 18 requires that the second physical device autonomously performs the operation defined by the anticipated instruction, and the instruction is modified so that the second physical device can perform the operation. Grotmol discloses claim 18 for the same reasons discussed above in Section IX.A.2, *supra*, for claim 6. Decl.

¶ 120.

13. Claim 19

Claim 19 requires that the new pictures and stored pictures include portions that depict recognized objects. Grotmol discloses claim 19 for the same reasons discussed above in Section IX.A.3, *supra*, for claim 7. Decl. ¶ 121.

14. Claim 20

Claim 20 requires the memory stores a knowledge structure that includes a first knowledge cell including a digital picture correlated with an instruction, a second knowledge cell including a digital picture correlated with an instruction, and the first knowledge cell and second knowledge cell are connected by a directed connection that includes temporal order of the cells. Grotmol discloses claim 20 for the same reasons discussed above in Section IX.A.6, *supra*, for claim 12. Decl. ¶ 122.

B. Ground 2

Grotmol renders claims 3, 5, and 11 obvious in view of the knowledge of a POSITA.

1. Claim 3

- a. [3.1] The system of claim 1, wherein the first one or more instruction sets for operating the first physical device are obtained, via a hardwired connection, from at least one portion of the one or more processor circuits or from at least one portion of another one or more processor circuits, and

Grotmol renders obvious limitation [3.1]. Decl. ¶¶ 124-128.

Limitation [3.1] recites that the “first one or more instruction sets” are “obtained,” but the claim does not identify what is doing the obtaining. Claim 1 recites that the instructions are stored in a memory. *See supra* limitation [1.3]. For the purposes of this Petition, and without waiving its right to challenge this claim as indefinite in other proceedings, Petitioner interprets limitation [3.1] to encompass a memory receiving the “first one or more instruction sets.”

As shown in Figure 8, Grotmol discloses a system in which “[p]rocessing 816” is connected to “[m]emory 814.”

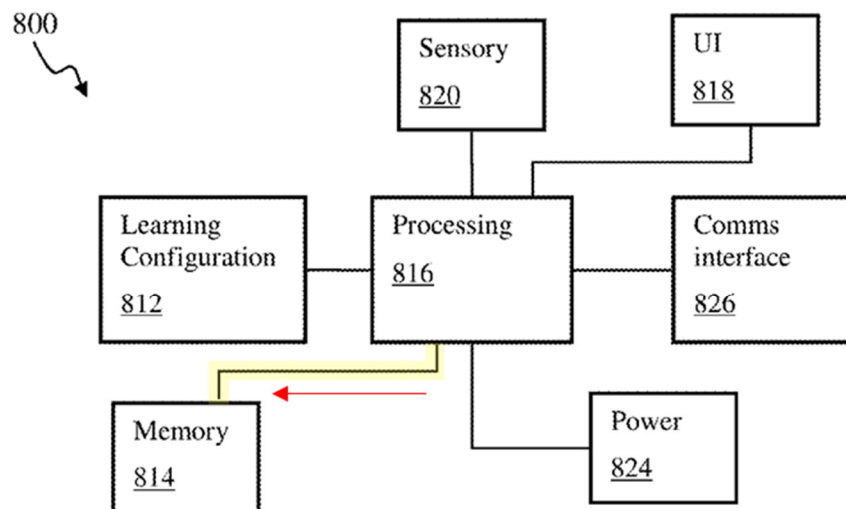


FIG. 8

Ex. 1005, Fig. 8 (annotated)

As discussed above with respect to limitation [1.3], Grotmol discloses “a memory that stores at least a first one or more digital pictures correlated with a first one or more instructions sets for operating a first physical device.” A POSITA would have

understood from Figure 8 that the memory in Grotmol “obtains” the instruction sets for storage from the processor. Decl. ¶ 126.

A POSITA would further have understood that the connection between Grotmol’s processor and memory is wired, i.e., it is a “hardwired connection.” Decl. ¶ 127. For one, Grotmol discloses a “self-contained robotic apparatus” that comprises a “memory component” and “one or more physical processors” (Ex. 1005, 3:27-30), which suggests to a POSITA that a hardwired connection would be used, rather than a wireless one, since the two components are not remote. Decl. ¶ 127. Moreover, a POSITA would have understood that a hardwired connection between a processor and its memory is typical. Decl. ¶ 127.

Even if Figure 8 of Grotmol did not expressly disclose a hardwired connection, the use of a “hardwired connection” to obtain the first one or more instruction sets from the processor to the memory would have been obvious to a POSITA because “there are a finite number of identified, predictable solutions, [and] a person of ordinary skill in the art has good reason to pursue the known options within his or her technical grasp.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 402 (2007); Decl. ¶ 128. In particular, there are two ways to transmit an electronic signal: with wires (hardwired), and without wires (wireless). Decl. ¶ 128. A POSITA would have been motivated to use hardwired connections for the reasons discussed above. Decl. ¶¶ 127-128. Furthermore, a POSITA would have had a reasonable expectation

of success in implementing a hardwired connection in Grotmol because it's a well known, routine way of connecting memory and a processor. Decl. ¶ 128.

b. **[3.2] wherein the one or more processor circuits or the another one or more processor circuits are used at least for operating the first physical device.**

Grotmol discloses limitation [3.2]. As described above for limitation [1.2], Grotmol discloses one or more processor circuits for operating the first physical device (robotic vehicle). *See supra* limitation [1.2]; Decl. ¶ 129.

2. Claim 5

Grotmol renders obvious claim 5 that depends from claim 1 and requires that “the causes the one or more processor circuits to execute the first one or more instruction sets for operating the first physical device includes inserting, via a hardwired connection, the first one or more instruction sets for operating the first physical device into at least one portion of the one or more processor circuits.” Decl. ¶¶ 130-132.

Claim 5 is similar to claim 3, but instead of reciting that the instruction sets are being “obtained . . . from” the processor, claim 5 recites that the instruction sets are “insert[ed] . . . into” the processor. Claim 5 also refers back to the “causes the one or more processor circuits” step, from limitation [1.7.3], which is performed by the artificial intelligence unit. As discussed above in limitation [1.7], Grotmol's

artificial intelligence unit is part of or operating on its processor circuit, for example as software.

As shown in Figure 8, Grotmol discloses a system in which “[p]rocessing 816” is connected to “[m]emory 814.”

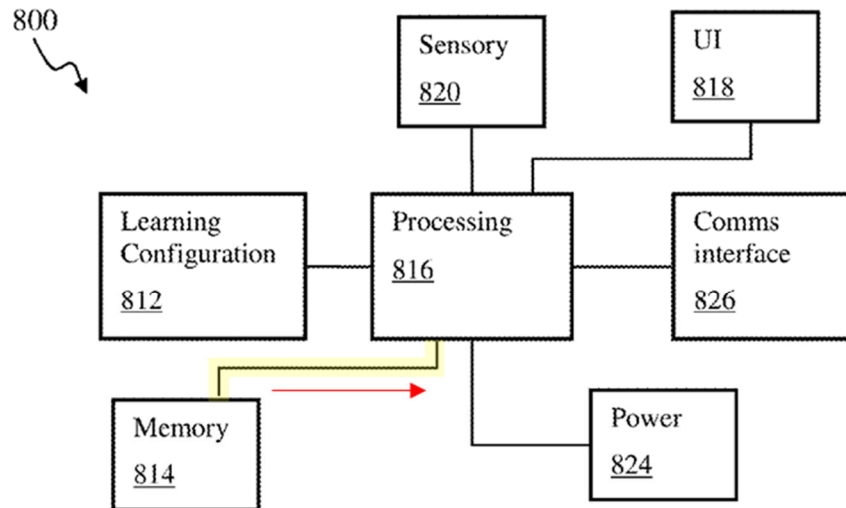


FIG. 8

Ex. 1005, Fig. 8 (annotated)

As discussed above with respect to limitation [1.3] Grotmol discloses “a memory that stores at least a first one or more digital pictures correlated with a first one or more instructions sets for operating a first physical device.” Grotmol also discloses that the “one or more processor circuits” ultimately “execute the first one or more instruction sets.” *See supra* limitation [1.7.3]. A POSITA would have understood from Figure 8 that the instruction sets to be executed are “inserted” into the processor via the same memory connection. Decl. ¶ 132. It would have been obvious to a

POSITA that this connection is hardwired for the same reasons discussed above for claim 3. Decl. ¶¶ 124-128, 132.

3. Claim 11

Grotmol renders obvious claim 11 that depends from claim 1 and requires that the artificial intelligence unit include at least one of “a hardware element that is included in the one or more processor circuits,” and “wherein the one or more processor circuits include one or more microcontrollers.” Decl. ¶¶ 133-138

As described above for claim 1, Grotmol discloses an artificial intelligence unit operating one or more processor circuits. *See supra* limitations [1.2], [1.7]. A POSITA would understand that the processor(s) described in Grotmol would include a hardware element. Ex. 1005, 8:5-15 (defining “processor”); Decl. ¶ 134.

Grotmol discloses the use of a “microcontroller” as a type of “processor” or “computing device.” Grotmol states that the terms “‘processor’, ‘microprocessor’ and ‘digital processor’ are meant generally to include all types of digital processing devices.” Ex. 1005, 8:5-15. Grotmol gives examples of “digital processing devices” such as digital signal processors (DSPs), field programmable gate arrays (FPGAs), programmable logic devices (PLDs), and application-specific integrated circuits (ASICs). *Id.* Grotmol further states that “the terms ‘computer’, ‘computing device’, and ‘computerized device’, include . . . literally any other device capable of executing a set of instructions and processing an incoming data signal.” *Id.*, 7:30-42.

A microcontroller is both a “digital processing device” and a “device capable of executing a set of instructions and processing an incoming data signal.” Decl. ¶ 135. Thus, a POSITA would understand that Grotmol discloses a system in which the “one or more processor circuits” includes “one or more microcontrollers.”

In addition, Grotmol discloses several processor circuits that a POSITA would have understood include one or more microcontrollers. For example, Grotmol discloses adaptive controllers that are designed to process and execute specific tasks. Grotmol discloses an “‘Adaptive controller’ of type ‘1’” that may learn to approach the target autonomously generating correction torques on the robot’s wheels and may not control the gripper (“output N”). Ex. 1005, 25:38-42. Grotmol also discloses an “‘Adaptive controller’ of type ‘2’” that is specifically designed to learn to turn the robot and appropriately grasp targets by autonomously effectuating correct torques on the robot’s wheels and gripper while not controlling another wheel. *Id.*, 26:14-19. Grotmol further discloses a “learning controller” that is used to process images that are outputted from the camera. *Id.*, 10:15-21. Grotmol further discloses a “predictor” that is specifically programmed and used to assign priorities to available tasks. *Id.*, 10:45-53. A POSITA would have understood that Grotmol’s “adaptive controllers,” “learning controller,” and “predictor” include one or more microcontrollers. Decl. ¶ 137.

Furthermore, it would have been obvious in view of the knowledge of a POSITA. As discussed above, Grotmol discloses the use of FPGAs or ASICs in place of a microprocessor. FPGAs and ASICs are programmable logic devices similar to a microcontroller.⁸ Decl. ¶ 138. The use of a microcontroller in place of an FPGA or ASIC would have been “the simple substitution of one known element for another.” *KSR*, 550 U.S. at 401. A POSITA would have been motivated to use a microcontroller instead of an FPGA, for example, because microcontrollers can be less complex and expensive. Decl. ¶ 138. Furthermore, a POSITA would have had a reasonable expectation of success in implementing a microcontroller in Grotmol in place of an FPGA because the two devices are similar in operation. *Id.* Implementing software on a microcontroller would have been well within the skill of a POSITA in 2017. *Id.*

C. Ground 3

Grotmol in view of Cosic 192 renders obvious claims 2 and 4.

1. Motivation to Combine Grotmol and Cosic 192

A person of ordinary skill in the art would have been motivated to combine the autonomous robotic system of Grotmol with Cosic 192’s teachings regarding

⁸ The term “microcontroller” is primarily used in the ’449 patent when describing “Logic Circuit 250.” The ’449 patent describes that its “Logic Circuit 250” may include “a microcontroller, field-programmable gate array (*FPGA*), application-specific integrated circuit (*ASIC*), and/or other computing circuit or device.” Ex. 1001, 81:56-82:5.

tracing and instrumentation in a similar system. Decl. ¶¶ 140-144.

Cosic 192 describes a substantially similar system to Grotmol in which an “autonomous robot” records “instructions . . . and/or contextual information . . . used to implement autonomous Robot’s 70 operations in various circumstances.” Ex. 1006, 201:45-202:51. The autonomous robot may thereafter recall and execute the instructions “based on similar operations performed in prior similar circumstances.” *Id.* Cosic 192 teaches that the system may obtain instructions via “tracing or profiling,” which “is used in software design as a technique of outputting an application’s instructions, data and/or other information during the application’s execution (runtime).” Ex. 1006, 72:63-73:7. Cosic 192 further teaches that the autonomous system can execute “anticipatory instructions” via “instrumentation” from “Artificial Intelligence Unit 130.” *Id.*, 114:45-53.

A POSITA would have been familiar with the teachings of both Grotmol and Cosic 192 and would have readily appreciated the advantages of their combination. Decl. ¶ 142. The two references are directed to the same field of the training and autonomous operation of robots and discuss substantially similar approaches. Decl. ¶ 142. Grotmol describes an autonomous robotic system in which, as part of a learning process, “[m]otor commands associated with a given image may be stored” (Ex. 1005, Abstract), but Grotmol does not expressly discuss how these commands are recorded in the robot’s programming. Cosic 192 teaches that *tracing* may be used

to record motor commands during operation. Grotmol further describes that during autonomous operation, the stored motor commands may be executed when a new, similar image is detected. Ex. 1005, Abstract, 43:4-11. Cosic 192 teaches that *instrumentation* may be used to insert and execute the anticipatory instructions before returning the application to its prior state.

The resulting combination of Grotmol's autonomous robotic system and Cosic 192's tracing and instrumentation teachings would have been expected and predictable, amounting to no more than the "[u]se of known technique to improve similar devices (methods, or products) in the same way." M.P.E.P. § 2143. Indeed, tracing and profiling are both common, well-understood programming techniques, and Cosic 192 teaches how they can be advantageously applied to a system similar to Grotmol's. Decl. ¶ 143.

For at least these reasons, it would have been obvious to a POSITA to combine Grotmol and Cosic 192.

2. Claim 2

- a. **[2.1] The system of claim 1, wherein the first one or more instruction sets for operating the first physical device are obtained from an application for operating the first physical device using at least a tracing of the application for operating the first physical device,**

Grotmol in view of Cosic 192 renders obvious limitation [2.1]. Decl. ¶¶ 145-149.

In the field of computer science, “tracing” generally refers to logging information about a program’s execution. Decl. ¶ 145. The ’449 patent describes that “tracing” may be used “to obtain instruction sets, data, and/or other information and provide them as input into Artificial Intelligence Unit 110.” Ex. 1001, 73:18-34. The ’449 patent describes several embodiments for obtaining instruction sets using existing tracing software. *Id.*, 74:46-59, 74:64-75:3, 75:64-76:9, 76:53-62, 77:8-27. The ’449 patent describes that “tracing” may include simply “adding trace code . . . to an application and/or outputting trace information to a specific target.” *Id.*, 73:22-24.

Grotmol discloses that “instruction sets for operating the first physical device are obtained from [the] application.” For example, Grotmol discloses that “[m]otor commands associated with a given image may be stored.” Ex. 1005, Abstract; *see also id.*, 33:21-24 (“Training of the robot’s controller may be based on the user observing [the] robot’s actions and sending one or more target control commands to the robot via the training handset.”), 39:17-19 (“Motor commands issued by a trainer corresponding to time instances when the images are acquired may be stored.”).

Grotmol does not expressly disclose that the tracing is used to store the motor commands (“using at least a tracing of the application for operating the first physical device”), but this would have been obvious in view of Cosic 192.

Cosic 192 discloses that, in some embodiments of its autonomous system, “the receiving the first, the second, and the new instruction sets includes at least one of: *tracing*, profiling, or instrumentation of an [*sic*] user input.” Ex. 1006, 3:19-22.

Cosic describes the use of tracing as follows:

Tracing or profiling is used in software design as a technique of outputting an application's instructions, data, and/or other information during the application's execution (runtime). Tracing or profiling may include adding trace code (i.e. instrumentation, etc.) to an application and/or outputting trace information to a specific target. The outputted trace information (i.e. Software Application's 120 instructions, data, and/or other information, etc.) can then be provided to or recorded into a file, a table, a database, a DBMS, a data structure, a repository, an application, and/or other system or target that may receive such trace information. As such, Instruction Acquisition Unit 111 can utilize tracing or profiling to obtain Software Application's 120 instructions, data, and/or other information and provide them as input into Artificial Intelligence Unit 130 that may structure them into knowledge for future autonomous operation of Software Application 120.

Ex. 1006, 73:2-19. Cosic 192 identifies various tracing tools existing in the prior art. *E.g., id.*, 75:26-77:10.

It would have been obvious to combine Cosic 192's use of tracing with Grotmol's autonomous robotic system in order to record motor commands input by

a user. Decl. ¶ 149. Such combination would have simply been the use of a known technique to improve a similar device in the same way. *Id.* In addition, it would have been obvious to try tracing because “there are a finite number of identified, predictable solutions, [and] a person of ordinary skill in the art has good reason to pursue the known options within his or her technical grasp.” *KSR* U.S. 550 at 402; Decl. ¶ 149. A POSITA would have had a reasonable expectation of success in combining the teachings of Grotmol and Cosic 192, which describe complementary systems. Decl. ¶ 149. This is especially true here, where the relied-upon teaching of Cosic 192 (tracing) is a well known, routine programming technique. Adding a snippet of code to an application to log received motor commands would have been well within the skill of a POSITA in 2017. *Id.*

b. **[2.2] wherein the application for operating the first physical device runs on the one or more processor circuits or on another one or more processor circuits.**

Grotmol discloses limitation [2.2]. Decl. ¶ 150-151.

Grotmol discloses that the robotic device may “comprise a controller operating a software component (e.g., the BrainOS[®] software platform) configured to enable training.” Ex. 1005, 33:14-17; *see also id.*, 2:14-20 (“One aspect of the disclosure relates to a method of determining a control signal for a robot. The method may be performed by a special purpose computing platform having one or more

processors executing instructions stored by a non-transitory computer-readable storage medium.”); Decl. ¶ 151.

3. Claim 4

- a. **[4.1] The system of claim 1, wherein the causes the one or more processor circuits to execute the first one or more instruction sets for operating the first physical device includes: instrumenting an application for operating the first physical device with the first one or more instruction sets for operating the first physical device, or instrumenting an application for operating the second physical device with the first one or more instruction sets for operating the first physical device, and**

Grotmol in view of Cosic 192 renders obvious limitation [4.1]. Decl. ¶¶ 152-156.

In the field of computer science, “instrumentation” generally refers to adding code to a program or modifying existing code. Decl. ¶ 152; *see also* Ex. 1001, 73:22-29 (“For instance, tracing or profiling may include adding trace code (i.e., instrumentation, etc.) to an application and/or outputting trace information to a specific target.”). The ’449 patent describes that “instrumentation” may comprise “application modifying code,” for example, “selective modifications such as insertion of alternate code (i.e. anticipatory Instruction Sets 526, etc.).” Ex. 1001, 138:40-139:10; *see also id.*, 131:55-58 (describing instrumentation to comprise “inserting additional code, overwriting or rewriting existing code, and/or branching to a separate segment of code”).

Grotmol discloses that the artificial intelligence unit “causes the one or more processor circuits to execute the first one or more instruction sets for operating the first physical device.” *See supra* limitation [1.7.3].

Grotmol does not expressly disclose that that this step is performed by “instrumenting an application for operating the first physical device with the first one or more instruction sets,” but this would have been obvious in view of Cosic 192.

Cosic 192 discloses that an “instrumented call” may be made to an “application modifying function” that “can be placed anywhere in the application's code and can be executed at any points in the application’s execution.” Ex. 1006, 109:21-38. In one embodiment, Cosic 192 teaches that the “application modifying function (i.e. modifyApplication, etc.) may include UAIE determined anticipatory instructions (i.e. anticipatory Instruction Sets 600 or Operations 610, etc.) that can modify the application.” *Id.*, 109:38-43.

For example, when an event occurs and an appropriate event handler is called, instrumentation can be implemented in the application’s source code to insert (including modifying, rewriting, overwriting, etc. of the source code) alternate instructions such as anticipatory instructions (i.e. anticipatory Operations 610 or Instruction Sets 600) from Artificial Intelligence Unit 130 at which point the modified source code can be recompiled and/or executed.

Ex. 1006, 114:45-53. Cosic 192 gives examples of existing software “utilized across different platforms” that can be used to instrument an application. *E.g., id.*, 112:41-113:39.

It would have been obvious to combine Cosic 192’s use of instrumentation with Grotmol’s autonomous robotic system in order to execute anticipatory motor commands. Decl. ¶ 156. Such combination would have simply been the use of a known technique to improve a similar device in the same way. *Id.* A POSITA would have had a reasonable expectation of success in combining the teachings of Grotmol and Cosic 192, which describe complementary systems. *Id.* This is especially true here, where the relied-upon teaching of Cosic 192 (instrumentation) is a well known, routine programming technique. Adding a snippet of code to an application to instrument a call to an anticipatory instruction set would have been well within the skill of a POSITA in 2017. *Id.*

- b. **[4.2] wherein the application for operating the first physical device or the application for operating the second physical device runs on the one or more processor circuits.**

Grotmol discloses limitation [4.2]. *See supra* claim 2; Decl. ¶ 157.

D. Ground 4

Grotmol in view of Hickman renders obvious claim 9.

1. Motivation to Combine Grotmol and Hickman

A person of ordinary skill in the art would have been motivated to combine the autonomous robotic system of Grotmol with the shared robot knowledge base of Hickman. Decl. ¶ 159-166.

Grotmol teaches that the training sets and training configurations from a first robot can be “stored” or “saved.” Ex. 1005, 33:12-58 (discussing saved training configurations). The saved training configuration may then be “loaded into the robot being trained thereby providing one or more trained behaviors to the robot.” *Id.*, 33:27-30. Further, the “trained configuration may be loaded to one or more *other robots* in order to provide learned behaviors.” *Id.*, 33:30-32.

Hickman teaches a shared robot knowledge base that could advantageously be paired with Grotmol’s autonomous robotic system in order to further facilitate the sharing of learned behaviors.

The advantages of a shared robot knowledge base 306 multiply as robots are deployed around the world. If information about a particular object is “public” and therefore accessible by all robots, then information that a single robot learns about that object and uploads to the shared robot knowledge base 306 may be accessible by other robots all around the world. In operation, many millions or even many billions of robots may ultimately access the shared robot knowledge base 306. As a result, the shared robot knowledge base 306 enables robots to benefit from the collective information learned by many other robots.

Ex. 1007, 11:31-41. Hickman additionally teaches that “dividing application execution and storage between client devices and the cloud computing system allows more processing to be performed by the cloud computing system, thereby taking advantage of the cloud computing system’s processing power and capability, for example.” Ex. 1007, 5:41-46. Hickman further teaches that cloud computing may “free users from certain hardware and software installation and maintenance tasks.” *Id.*, 1:38-41. Hickman describes that

A POSITA would have been familiar with the teachings of both Grotmol and Hickman and would have readily appreciated the advantages of their combination. Decl. ¶ 165. Indeed, a 2014 Science article—which included an interview with the CEO of Brain Corporation, i.e., the assignee of Grotmol—expressly contemplated the benefits of the kinds of shared robot learning described in Hickman:

Efficient chips can run complex—and normally power-hungry—algorithms that enable robots to learn. The Internet, in turn, will allow far-flung robots to share those lessons and skills. A robot that learns how to pick a strawberry without crushing it, for instance, could uplink that skill for the benefit of its kind around the globe. That means neuromorphic computing could offer robots something far more profound than enhanced perceptual skills. When humans collectively pass along life lessons, we call that culture.

Ex. 1008.002; Decl. ¶ 165. In addition, the two references are directed to the same field of training and autonomous operation of robots (Decl. ¶ 161), and Hickman is listed on the face of Grotmol as a cited U.S. patent document. Grotmol and Hickman also describe a similar problem in which a robot learns how to “fetch” from a human. *Compare* Ex. 1007, 23:49-24:25 *with* Ex. 1005, 24:31-48; 27:28-40, Figure 9. Grotmol describes the task as “quite complex.” Ex. 1005, 24:31-33. Hickman teaches that the fetch task can be “optimiz[ed] . . . based on the collective experiences of many different robots.” Ex. 1007, 24:18-25.

The resulting combination of Grotmol’s autonomous robotic system and Hickman’s shared robot knowledge base would have been expected and predictable. Decl. ¶ 166. Grotmol expressly contemplates the sharing of trained configurations among robots, and Hickman’s expansion upon this idea does not interfere with Grotmol’s autonomous robotic system. *Id.*

For at least these reasons, it would have been obvious to a POSITA to combine Grotmol and Hickman.

2. Claim 9

Grotmol in view of Hickman renders obvious claim 9, which requires: (i) storing a second digital picture correlated with a second instruction set for operating the second physical device; and (ii) that the second digital picture or instruction set

is learned during an additional learning process that involves operating the second device by a second user. Decl. ¶¶ 167-172.

As described above for claims 1, 6, and 8 in Ground 1, Grotmol discloses: (i) training a robot wherein images (digital pictures) detected by a camera during operation of the robot are correlated with motor commands (instructions); (ii) multiple training (learning) processes can be done to train multiple behaviors; and (iii) a robot can be loaded with a first trained configuration learned during a training process involving operation of that robot by a user, and can also be loaded with another trained configuration from a training process involving operation of a different robot by a user. Ex. 1005, 33:24-35; Decl. ¶ 168; *see supra* limitation [1.8], claim 6, claim 8.

Hickman discloses a “ shared robot knowledge bases for use with cloud computing systems” that “collects data from a robot about an object the robot has encountered in its environment, and stores the received data in the shared robot knowledge base ... sends instructions for interacting with an object to a robot ... sends instructions to a robot for executing an application based on information stored in the shared robot knowledge base.” Ex. 1007, Abstract. As noted in Hickman, the “information in the shared robot knowledge bases is updated based on robot experiences so that any particular robot may benefit from prior experiences of other robots.” *Id.*

Grotmol discloses that multiple learning processes can be done to train multiple behaviors for the robot, including “simple tasks” and “complex tasks.” Ex. 1005, 24:17-67, 26:1-20. Grotmol does not limit the number of users that can train the multiple behaviors for the robot, and a POSITA would have looked for other references, like Hickman, that explicitly discloses different users training different behaviors. Ex. 1007, 23:36-48 (disclosing that “robot experiences” may include “‘coaching’ from *humans*”); Decl. ¶ 170. In combination with Hickman’s shared robot knowledge base, Grotmol’s system could utilize different trainers to train behaviors involving different levels of complexity in order to take advantage of the varying skills and knowledge of trainers. Decl. ¶ 171 Thus, it would have been obvious to combine Hickman’s shared robot knowledge base with Grotmol’s autonomous robotic system such that the shared knowledge base includes the training of multiple robots by multiple users. *Id.*

Accordingly, the combination of Grotmol and Hickman renders obvious storing in memory a second digital picture correlated with second instructions for operating a second device, where the second digital picture or second instruction are learned in a learning process involving operating the second device by a second user. Decl. ¶ 172.

X. CONCLUSION

For the foregoing reasons, *inter partes* review should be instituted and claims 1-20 of the '449 patent should be cancelled as unpatentable.

Dated: June 30, 2023

Respectfully submitted,

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CERTIFICATE OF COMPLIANCE

1. The undersigned certifies that this brief complies with the type volume limitations of 37 CFR § 42.24(a)(1)(i). This brief contains 12,300 words (excluding the table of contents, the table of authorities, mandatory notices under 37 CFR § 42.8, the certificate of service, certificate of compliance, and appendix of exhibits), as calculated by the “Word Count” feature of Microsoft Word 2016, the word processing program used to create it.

2. The undersigned further certifies that this brief complies with the typeface requirements of 37 CFR § 42.6(a)(2)(ii) and typestyle requirements of 37 CFR § 42.6(a)(2)(iii). This brief has been prepared in a proportionally spaced typeface using Microsoft Word 2016 in Times New Roman 14 point font.

Dated: June 30, 2023

Respectfully submitted,

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.105 and § 42.6(e), the undersigned certifies that on June 30, 2023, a complete and entire copy of this **PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 10,102,449, PETITIONER TESLA, INC.'S POWER OF ATTORNEY, and all supporting exhibits** were sent via FedEx next business day delivery to the following:

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