IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the *Inter Partes* Review of U.S. Patent No. 11,880,207

Trial No.: Not Yet Assigned

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Inventors: Kameshwar Durvasula, et al.

Assignee: Zodiac Pool Systems LLC

Title: POOL CLEANING SYSTEM AND METHOD TO AUTOMATICALLY CLEAN SURFACES OF A POOL USING IMAGES FROM A CAMERA

MAIL STOP PATENT BOARD
Patent Trial and Appeal Board
United States Patent & Trademark Office
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Alexandria, Virginia 22313-1450

PETITION FOR *INTER PARTES* REVIEW UNDER 37 C.F.R. § 42.100

On behalf of Wybotics, Co. Ltd. f/k/a Tianjin Wangyuan Environmental Protection and Technology Co., Ltd. ("Wybotics" or "Petitioner"), and in accordance with 35 U.S.C. § 311 and 37 C.F.R. § 42.100, *inter partes* review ("IPR") is respectfully requested for claims 1-8, 11-14, and 19 of U.S. Patent No. 11,880,207 ("the '207 Patent").

The undersigned representative of Petitioner authorizes the Office to charge the Petition and Post-Institution Fees, and any additional fees, to Deposit Account 50-3013, ref: 103146-000007.

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EX1020	Merriam-Webster Dictionary, “object”, https://www.merriam-webster.com/dictionary/object (last visited Nov. 20, 2025)
EX1021-1029	Reserved
EX1030	U.S. Patent No. 3,439,368 (“Myers II”), invented by Robert R. Myers, filed January 3, 1967
EX1031	U.S. Patent No. 5,351,355 (“Chiniara”), invented by Paul Chiniara, filed May 26, 1993

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT 11,880,207

I. INTRODUCTION

This Petition presents a textbook case of why Congress created *inter partes* review to improve patent quality and provide a more efficient alternative to federal court litigation. The ’207 Patent is a classic example of a “bad” patent that IPRs were designed to weed out. At the Patent Owner’s urging, the Examiner performed essentially no substantive review of the prior art, issuing only one rejection for statutory double patenting that was overcome by a terminal disclaimer. As a result, the ’207 Patent issued even though its alleged inventions are neither novel nor nonobvious. The Board should institute review and find these claims unpatentable.

The ’207 Patent claims a self-propelled robotic pool cleaner that can detect debris and direct its motion in response to that detection. The first robotic pool cleaners were invented in the 1960s (*see e.g.,* EX1030), and self-propelled robotic pool cleaners have been known since at least the early 1990s (*see e.g.*, EX1031). *See* EX1010, ¶¶80-89. Most of the elements claimed by the ’207 Patent—a vehicle body, means for moving the vehicle body, and a filter—are common to all robotic pool cleaners and have been known for decades. In fact, according to the Examiner, the only purportedly novel feature of the ’207 Patent is “a controller … configured to generate, in response to the captured image, at least one control signal to cause movement of the body … .” EX1006, 133-135. However, as this Petition shows below, that feature is not new, either.

For example, Chinese Patent Application No. 200710119800.5 to Fu (EX1007), entitled "Underwater Cleaning Robot" and filed almost five years before the application that resulted in the '207 Patent, discloses a "control system" comprised of "a central processor, monitoring cameras, an image acquisition card, inertial navigation components, … motor drivers … cleaning driving wheel DC motors 7," and other elements. EX1007, ¶[0024]. "The monitoring cameras 2 and the image acquisition card constitute the ***environmental perception layer*** of the control system." *Id.* (emphasis added). The "inertial navigation components are installed in the robot control system box 8 and constitute the ***self-attitude and positioning*** layer of the control system." *Id.* (emphasis added). The "motor drivers and the cleaning driving wheel DC motors 7 constitute the cleaning driving ***execution layer*** of the control system." *Id.* (emphasis added). In the "autonomous mode, control signals are generated by the central processor, which autonomously plans paths and actions based on information from the environmental perception layer and its own attitude and positioning layer, in conjunction with a preset cleaning task, to drive the robot's execution layer and complete the underwater cleaning task." *Id.*, ¶[0025]. These disclosures fully anticipate the navigation elements of the '207 Patent—a controller that, based on an image of a location, generates at least one control signal to cause movement of the body to, or away from, that location—the only aspect of the Patent asserted as novel.

Additionally, as explained below, the claims are also obvious in light of Fu itself or in combination with U.S. Patent Pub. No. 2010/0299016 to Benzler, and over U.S. Patent Pub. No. 2012/0169497 to Schnittman, in combination with Benzler.

The Board should cancel claims 1-8, 11-14, and 19 of the ’207 Patent.

II. THE ’207 PATENT AND CLAIM CONSTRUCTION

A. Summary Of The ’207 Patent

The ’207 Patent, entitled “Pool Cleaning System and Method to Automatically Clean Surfaces of a Pool Using Images from a Camera,” issued with 20 total claims, of which claims 1, 2, and 12 are independent. EX1005, (54), claims 1-20. The claims are directed broadly to systems and methods that use an image captured by a camera to control a pool system or equipment, such as a pool cleaner. *Id.*, claims 1-20.

The ’207 Patent generally relates to “a robotic pool cleaner” comprising a vehicle 30 with propulsion mechanisms, a filter, a camera, and a controller. *Id.*, 2:67-3:3, 3:7-21, 3:31-43. Vehicle 30 uses propulsion mechanisms to move along submerged pool surfaces. *Id.*, 3:33-45. Using its filter, the pool cleaner draws water from the pool and retains any debris present in the water. *Id.*, 3:11-16. Cameras 32 capture an image of submerged pool surfaces, and Controller 42 “generate[s] control signals for steering vehicle 30 based upon signals received from cameras 32.” *Id.*, 3:46-55, 4:46-48.

B. Patent Family And File History

The ’207 Patent was filed on Jan. 10, 2022 as U.S. Patent Application No. 17/572,388. *Id*., (21), (22). The ’207 Patent is seventh in a series of continuation applications claiming priority to U.S. Patent Application No. 13/545,918 (now U.S. Patent No. 9,388,595), filed July 10, 2012. *Id*., (63). Without conceding its propriety, Petitioner applies July 10, 2012 as the priority date.

Originally filed claims 1-19 were copies of claims filed in a parent application, U.S. Patent Application No. 16/416,840 (the “’840 application”). *Compare* EX1006, 18-20 *with* EX1009, 17-19. Prior to examination, the applicant filed a preliminary amendment, canceling claims 1-19 and adding a new claim 20. EX1006, 41. The applicant characterized claim 20 as “similar in many respects to allowed claim 23 of the Allowed Parent Application” 17/143,624 (now U.S. Patent No. 11,262,766). *Id*., 42.

No prior art rejections were issued against claim 20. The sole Office Action contained only a nonstatutory double patenting rejection that was overcome via a terminal disclaimer. *Id*., 82-90. When responding to the Office Action, the applicant also added new claims 21-39. *Id*., 99-105. No prior art rejections were issued against claims 21-39 either.

The Notice of Allowance indicated claims 20-39, now claims 1-19 of the ’207 Patent, as allowed, identifying claim 1’s “controller” limitations as allegedly inventive. *Id*., 146-150 (also identifying claim 21's "controller" limitation as allegedly inventive). The Notice also identified claim 12 as allegedly inventive. *Id*.

C. Claim Construction And The Level Of Ordinary Skill In The Art

1. Claim Construction

In this proceeding, claims are interpreted under the same standard applied by Article III courts. *See* 37 C.F.R. § 42.100(b); *see also* 83 Fed. Reg. 197 (Oct. 11, 2018); *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312 (Fed. Cir. 2005) (en banc). Under this standard, words in a claim are given their plain meaning, which is the meaning understood by a person of ordinary skill in the art (POSA) in view of the patent and file history. *Phillips*, 415 F.3d at 1312-13. Other than the "means-plus-function" claim term discussed below, Petitioner proposes no claim terms for construction.

The term "means for moving the vehicle body within the swimming pool," of claim 1, is a means-plus-function (MPF) term governed by 35 U.S.C. § 112(f). Per 37 C.F.R. § 42.104(b)(3), Petitioner identifies specific portions of the specification that describe the structure and functions for this term:

Claim Limitation	**Structure**	**Function**
[1b] means for moving the vehicle	"In one implementation, vehicle 30 is propelled along the submerged pool surfaces using ***wheels, rollers, tracks or other surface contacting members***	Moving the vehicle body within

body within the swimming pool	***powered by a motor and the like***. … In one implementation vehicle 30 may also alternatively be propelled by means of the ***vacuum or liquid jets***. … In other implementations, vehicle 30 may include other propulsion mechanisms." EX1005, 3:31-43.	the swimming pool EX1005, claim 1.

Thus, the corresponding structures disclosed in the specification for "means for moving" include "wheels, rollers, tracks or other surface contacting members powered by a motor and the like" and "vacuum or liquid jets." EX1005, 3:34-45; *see also id.,* 10:11-30 (describing drive motor, "toothed track drive 900" and rollers 908 of Figs. 9 and 10).

2. POSA's Skill Level

A POSA as of July 10, 2012 would have possessed a bachelor's degree in mechanical or electrical engineering or a related field, and two years' experience in designing and developing robotic pool cleaners or similar products, with additional experience substituting for education and vice versa. EX1010, ¶¶30-32.

III. REQUIREMENTS FOR IPR UNDER 37 C.F.R. § 42.104

A. Grounds For Standing Under 37 C.F.R. § 42.104(a)

Wybotics certifies that the '207 Patent is eligible for IPR, and that Wybotics is not barred or estopped from requesting IPR of claims 1-8, 11-14, and 19 on the challenged grounds.

B. Identification Of Challenge Under 37 C.F.R. § 42.104(b) And Relief Requested

Wybotics requests IPR on the following grounds:

Ground	Claims	Basis
Ground 1a	1-3, 5-8, 12-14, 19	Fu (EX1007, CN 101139007 B) anticipates under § 102
Ground 1b	1-3, 5-8, 12-14, 19	Fu renders obvious under § 103
Ground 1c	1-8, 11-14, 19	Fu in view of Benzler (EX1013, U.S. Patent Pub. No. 2010/0299016) renders obvious under § 103
Ground 2a	1-7, 11-14, 19	Schnittman (EX1008, U.S. Patent Pub. No. 2012/0169497) in view of Benzler renders obvious under § 103
Ground 2b	8	Schnittman in view of Benzler, in further view of Fu renders obvious under § 103

IV. CLAIMS 1-8, 11-14, AND 19 ARE UNPATENTABLE

A. Ground 1a: Fu Anticipates Claims 1-3, 5-8, 12-14, And 19

1. Summary Of Fu

Fu, entitled "Underwater Cleaning Robot," was filed on July 31, 2007 as Application No. 200710119800.5 in China. EX1007, (54), (21), (22). Fu issued as Grant Publication No. CN 101139007B, and published on June 15, 2011. *Id.*, (10), (45). Fu is therefore prior art under at least pre-AIA 35 U.S.C. §§ 102(a) and (b).

Fu describes a robot designed "for the underwater cleaning of swimming pool floors and walls." *Id.*, Abstract.

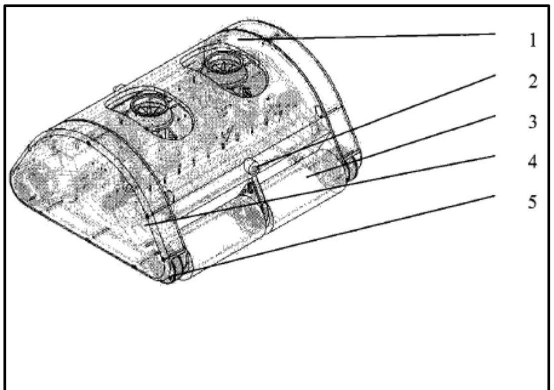


Fig. 1

Id., Fig. 1. The underwater cleaning robot has two operational modes: (i) manual mode, where a control keypad is used to send control signals to the robot; and (ii) autonomous mode, where the control system controls the robot's operations based on data received from cameras. *Id.,* ¶[0025].

The robot "comprises a drainage mechanism, a cleaning and mobility platform, and a control system." *Id.*, ¶[0024], Abstract.. These three units coordinate to "perform cleaning tasks autonomously or via remote control underwater on horizontal, vertical, and inclined surfaces." *Id.*, Abstract. The drainage mechanism filters pool water by drawing in water, filtering it to remove any debris, and discharging the filtered water into the pool. *Id.*, ¶¶[0024]-[0026]. The cleaning and mobility platform provides structural support and propulsion to the robot, while also performing "brush-cleaning" of pool surfaces via cleaning driving wheels 3. *Id.* The control system autonomously controls the robot's operations by generating control signals based on an image received from monitoring cameras 2, that are installed on the robot's housing. *Id.*

2. Claim 1

(a) Preamble: "A self-propelled pool cleaning system for cleaning debris from a submerged surface of a swimming pool, comprising:"

To the extent limiting, claim 1's preamble is disclosed by Fu. EX1010, ¶¶359-363. Fu discloses "an underwater cleaning robot" designed "for the underwater cleaning of swimming pool floors and walls." EX1007, Abstract.

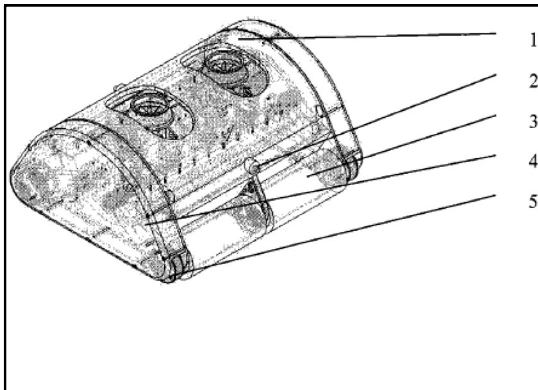


Fig. 1

Id., Fig. 1 (underwater cleaning robot). Fu's robot comprises "a drainage mechanism [and] a cleaning and mobility platform." *Id.*, ¶[0024]. The cleaning and mobility platform enables the robot to move around the pool and remove debris from its surfaces, *e.g.*, using brushes. *Id.*, ¶¶[0010], [0024]-[0026] ("brush-cleaning"). The drainage mechanism "draws pool water from the bottom of the robot" such that the "water passes through the water flow filter screen 23, which filters out debris, and the clean water is then discharged." *Id.*, ¶[0026]. Thus, Fu's robot is a "pool cleaning system for cleaning debris from a submerged surface of a swimming pool."

Fu's robot is also self-propelled. The robot's cleaning and mobility platform comprises "four independent cleaning driving wheels 3" that "are controlled by their respective motor drivers, allowing for independent movement." *Id.*, ¶[0026]. In the autonomous mode, "control signals are generated by the central processor, which autonomously plans paths and actions … to drive the robot's execution layer and complete the underwater cleaning task." *Id.*, ¶[0025]. The execution layer comprises motor drivers and cleaning driving wheel DC motors 7, which drive cleaning driving wheels 3. *Id.*, ¶[0024]. Fu's robot is thus "self-propelled" because it moves without external propulsion. Fu also describes various components for powering such movement, including an onboard "rechargeable battery box." *Id.*, ¶¶[0007], [0008], [0024], [0025].

As detailed below for elements 1a-1f, Fu's robot discloses all the features of claim 1, thus, Fu discloses a "self-propelled pool cleaning system [underwater cleaning robot] for cleaning debris from a submerged surface of a swimming pool."

(b) Element 1a: "a vehicle body;"

Fu discloses element 1a. EX1010, ¶¶364-366. Figure 1 illustrates "[o]verall schematic diagram of the underwater cleaning robot," including "1 - robot housing body" (EX1007, ¶[0014]):

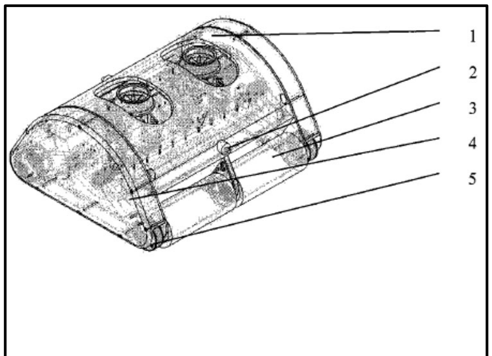


Fig. 1

Id., Fig. 1. The "housing body 1 comprises a robot top cover 18, robot side walls 20, and a robot main housing body 19." *Id*., ¶[0024].

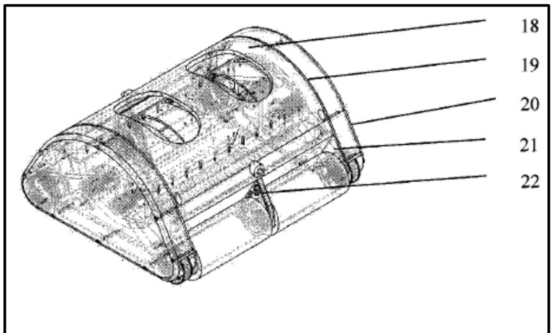


Fig. 4

Id., Fig. 4. Accordingly, Fu discloses "a vehicle body [robot housing body 1]."

(c) Element 1b: "means for moving the vehicle body within the swimming pool;"

Fu discloses element 1b. EX1010, ¶¶367-370. The term "means for moving the vehicle body within the swimming pool" is an MPF term, whose corresponding structures include "wheels, rollers, tracks or other surface contacting members powered by a motor and the like." EX1005, 3:33-45; Section II.C.1.

Fu's robot comprises a cleaning and mobility platform that enables controlled movement of the robot body. EX1007, ¶[0024]. The cleaning and mobility platform, illustrated in Figure 1, comprises "a robot housing body 1, cleaning driving wheels 3, synchronous belt gears 5, and a driving synchronous belt 4." *Id.* A driving DC motor 7 drives wheels 3 via synchronous belt gears 5 and driving synchronous belt 4. *Id.*, ¶¶[0007], [0024] ("Said cleaning driving wheel DC motors [7] are equipped with reduction gearboxes and encoders. They are installed and fixed via front flanges to the side wall of the driving and control sealed housing and the side wall of the robot main housing body [19], and they drive the cleaning driving wheels [3] via synchronous belt gears [5] and synchronous belts [4].").

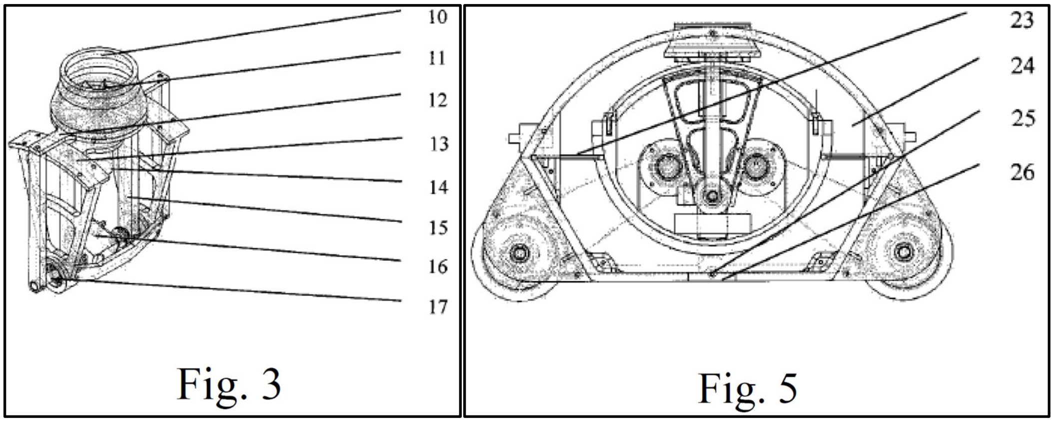
Further, cleaning driving wheels 3 "are controlled by their respective motor drivers, allowing for independent movement." *Id.*, ¶[0026]. "By using different combinations of wheel speeds, the robot can perform tasks such as moving forward, backward, turning, and brush-cleaning." *Id.*

Thus, Fu teaches "means for moving the vehicle body within the swimming pool [driving wheels 3 powered by cleaning driving wheel DC motors 7]."

(d) Element 1c: "a filter configured to retain debris collected from the submerged surface;"

Fu discloses element 1c. EX1010, ¶¶371-374. Fu's robot includes a "drainage mechanism" designed to draw in pool water, filter out debris from the water, and discharge the filtered water while retaining the debris. EX1007,

¶¶[0024]-[0026]. Figures 3 and 5 illustrate an example schematic of the drainage mechanism :



Id., Fig. 3 (water discharger), Fig. 5 (robot side cross-sectional view).

The drainage mechanism "comprises a water discharger, a water flow channel 24 …, a water flow filter screen 23, and a water inlet [26] with an anti-backflow device 25." *Id*, ¶[0024]. During operation, "the drainage propeller high-speed DC motor 14 … drives the drainage propeller 11 to rotate … expel[ling] water from within the robot's water flow channel 24, creating a high negative pressure inside." *Id.*, ¶[0026]. This negative pressure "draws pool water from the bottom of the robot into the water flow channel 24 through the water inlet [26]." *Id*. Once in flow channel 24, the "water passes through the water flow filter screen 23, which filters out debris, and the clean water is then discharged." *Id*.

The drainage mechanism also retains the debris that is filtered out from the water. "An anti-backflow device 25 is installed above the water inlet 26," which opens "[w]hen water flows in through the inlet," and closes "[w]hen the water flow stops," thus "prevent[ing] debris from flowing out of the water flow channel 24." *Id*. Thus, the debris is retained within water flow channel 24. Fu also describes that "[w]hen the debris [inside water flow channel 24] reaches a certain density, [the robot] issues a 'debris full' alarm," further confirming that the drainage mechanism retains the debris. *Id*.

Thus, Fu discloses "a filter [filter screen 23 of Fu's drainage mechanism] configured to retain debris collected from the submerged surface."

(e) Element 1d: "at least one camera for capturing an image of at least a first object within the swimming pool; and"

Fu discloses element 1d. EX1010, ¶¶375-378. Fu's robot comprises "2 – monitoring camera":

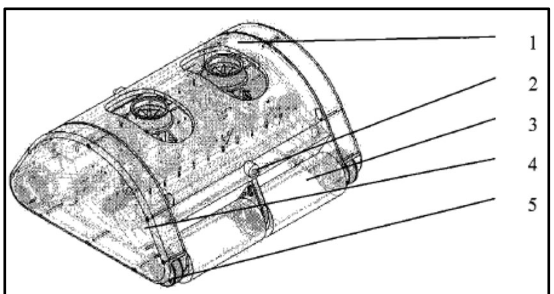


Fig. 1

EX1007, ¶[0014], Fig. 1. The robot "uses its monitoring cameras 2 to capture images of the pool floor and compares them with the [pool cleanliness image] threshold to determine the level of cleanliness." *Id.*, ¶¶[0010], [0026]. In doing so, cameras 2 necessarily capture an image of "at least a first object within the swimming pool," *e.g.*, the pool surface itself, as well as debris, dirt, or any other visible particles present on or near the pictured surface. EX1010, ¶¶375-378. Because the captured image is evaluated to determine the cleanliness of the pool floor, the image necessarily include any debris or foreign matter that is present, along with the pool surface itself that is pictured.

The '207 Patent includes no lexicography or disclaimer for "object," so it is given its plain and ordinary meaning. *Thorner v. Sony Comput. Entm't Am. LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012). As explained by Dr. Reinholtz, the plain and ordinary meaning of "object" in the context of the '207 Patent is any material thing that can be perceived by the senses, which constitutes any debris, dirt, or the pool surface. EX1010, ¶377; EX1020.

Therefore, Fu discloses "at least one camera [monitoring cameras 2] for capturing an image of at least a first object within the swimming pool."

(f) Element 1e: "a controller (i) in electronic communication with the at least one camera and"

Fu discloses element 1e. EX1010, ¶¶379-381. Fu discloses a control system comprising "a central processor, monitoring cameras, an image acquisition card, … motor drivers, … [and] cleaning driving wheel DC motors 7." EX1007, ¶[0024].

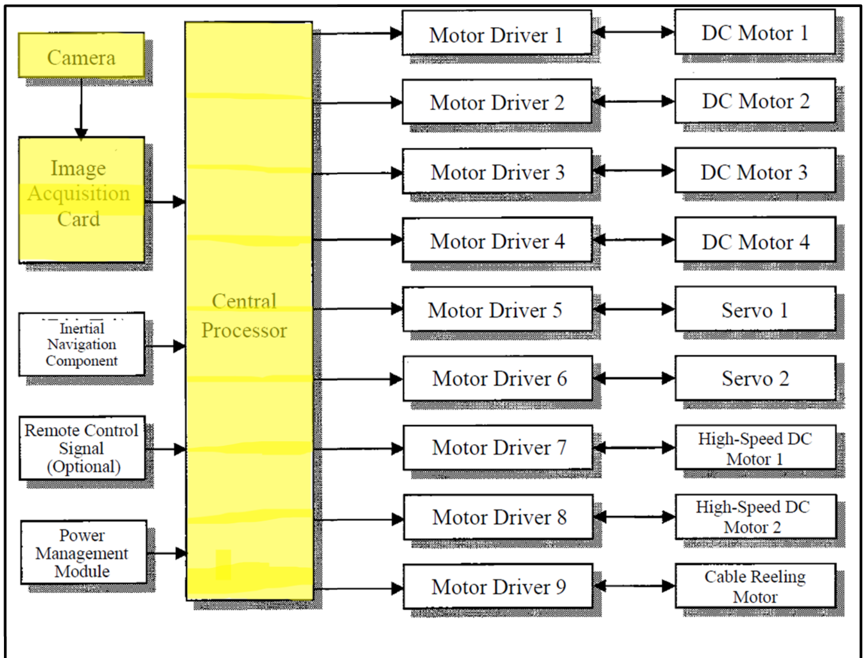


Fig. 6

Id., Fig. 6 (annotated). "The underwater cleaning robot controls its actions according to control commands issued by the central processor." *Id.*, ¶¶[0010], [0026]. Therefore, Fu's control system, comprising the central processor that generates control signals for controlling the robot, teaches the "controller." *Id.*

"[T]he monitoring cameras (2) are connected to the central processor via the image acquisition card." EX1007, claim 1, Fig. 6. The image acquisition card serves as an electronic interface that transmits an image from monitoring cameras 2 to the central processor for processing, such that the controller (control system with central processor) is "in electronic communication with the at least one camera [monitoring cameras 2]." EX1010, ¶¶379-381.

(g) Element 1f: "[the controller] (ii) configured to generate, in response to the captured image, at least one control signal to cause movement of the body within the swimming pool to, or away from, the first object."

Fu discloses element 1f. *Id.*, ¶¶382-387. Fu explains that "[t]he monitoring cameras 2 and the image acquisition card constitute the environmental perception layer of the control system," which "constitutes the input part of the control system." EX1007, ¶[0024]. "[I]nformation from the environmental perception layer," *i.e.*, the image captured by monitoring cameras 2 is expressly identified as the basis upon which "control signals are generated by the central processor … to drive the robot[]." *Id.*, ¶[0025].

As shown in Figure 6, the central processor receives the image captured by cameras 2 via the image acquisition card . *Id.*, claim 1, Fig. 6. Based on the captured image, "control signals are generated by the central processor, which autonomously plans paths and actions … to drive the robot's execution layer [*i.e.*, motor drivers that drive wheels 3] and complete the underwater cleaning task." *Id.*, ¶[0025]. Fu further describes this process in detail:

> During the autonomous cleaning process, a pool cleanliness image threshold is set. The robot uses its monitoring cameras 2 to capture images of the pool floor and compares them with the threshold to determine the level of cleanliness. It then plans its cleaning movements and adjusts the working state of the four cleaning driving wheels 3 and the water discharger to complete the cleaning task. Specifically, the speed of each wheel 3 can be adjusted. By using different combinations of wheel speeds, cleaning actions of varying intensity can be achieved.

> For example, if the front wheels rotate quickly clockwise and the rear wheels rotate slowly counter-clockwise, the underwater cleaning robot will advance in the direction determined by the clockwise rotation of the front wheels.

EX1007, ¶[0026].

Fu also explains that "[b]y using different combinations of wheel speeds, the robot can perform tasks such as moving forward, backward, [and] turning," (*id*. [0010]) thus confirming that the generated signals cause the robot to move "to, or away from, the first object" based on the cleanliness determination of the pictured region. *Id.*

Thus, Fu's central processor receives the image captured by cameras 2, which includes visible dirt or debris constituting "a first object," to assess the "level of cleanliness" of the pictured region. *Id.*, ¶¶[0024]-[0026]. Based on that assessment, the central processor "plans its cleaning movements and adjusts the working state of the four cleaning driving wheels 3" to "perform tasks such as moving forward, backward, [and] turning." *Id.*, ¶[0026]. A POSA would have recognized that any robot movement would necessarily be "to, or away from, the first object" captured by Fu's cameras 2. EX1010, ¶¶382-387.

Further, as Dr. Reinholtz explains, because the central processor generates control signals in response to the "level of cleanliness" of the captured image, and those signals drive movement in "forward, backward, [or] turning" directions, a POSA would have understood that the controller directs the robot toward the first object when it is located in a sub-threshold (*i.e.*, relatively dirty) region and away from the first object when it is located in an above-threshold (*i.e.*, relatively clean) region. *Id*.

Fu anticipates claim 1. *Id.*, ¶¶358-388.

3. Claim 2

(a) Preamble: "A pool system comprising:"

To the extent limiting, claim 2's preamble is disclosed by Fu. *Id.*, ¶389. Claim 2's preamble is broader than claim 1's because it merely recites a "pool system," imposing no requirements, as claim 1 does, that the pool system be "self-propelled" or dedicated to "cleaning debris from a submerged surface of a swimming pool." Because Fu anticipates the narrower preamble of claim 1, Fu likewise anticipates the broader preamble of claim 2. Thus, Fu discloses the "pool system [underwater cleaning robot]."

(b) Element 2a: "at least one piece of equipment for a swimming pool or spa;"

Fu discloses element 2a. *Id.*, ¶¶390-392. Fu discloses "an underwater cleaning robot" designed "for the underwater cleaning of swimming pool floors and walls." EX1007, Abstract. Figure 7 illustrates the robot performing "long-duration, global cleaning" of a swimming pool:

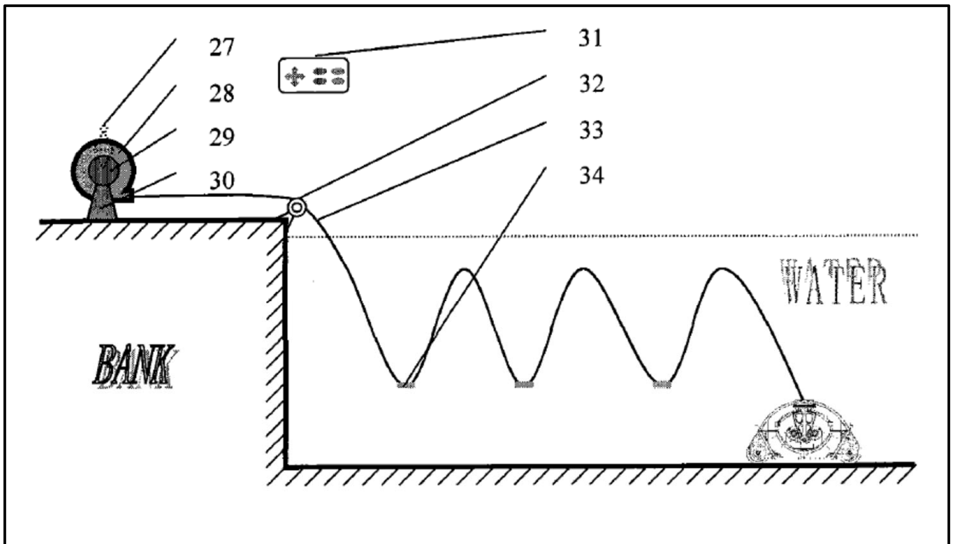


Fig. 7

Id., Fig. 7. Accordingly, Fu discloses "at least one piece of equipment [underwater cleaning robot] for a swimming pool or spa."

(c) Element 2b: "one or more cameras configured to capture video or images of at least a portion of a location including the swimming pool or spa; and"

Fu discloses element 2b. EX1010, ¶¶393-395. Fu's robot comprises "monitoring cameras 2 … installed on the two front panels of the robot main housing body 19":

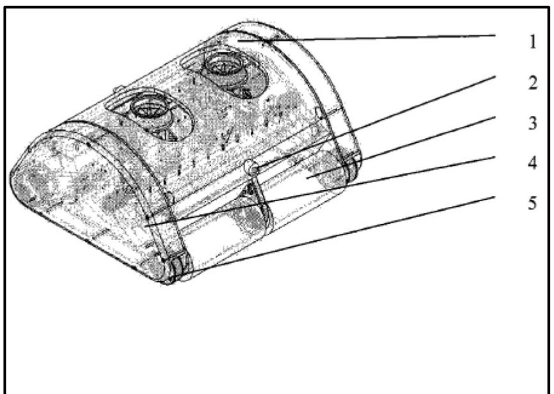


Fig. 1

EX1007, Fig. 1, ¶¶[0014], [0024]. The robot "uses its monitoring cameras 2 to capture images of the pool floor," which is a part of the swimming pool. *Id.*, ¶[0026].

Therefore, Fu discloses "one or more cameras [monitoring cameras 2] configured to capture video or images of at least a portion of a location including the swimming pool [images of the pool floor] or spa."

(d) Element 2c: "a controller in communication with the at least one piece of equipment and the one or more cameras, the controller configured to receive visual data from the one or more cameras and determine a control action for the at least one piece of equipment based on the received visual data."

Fu discloses element 2c. EX1010, ¶¶396-403. As explained for element 1e, Fu teaches a controller (control system with central processor) in communication with one or more cameras (monitoring cameras 2). Section IV.A.2.f.

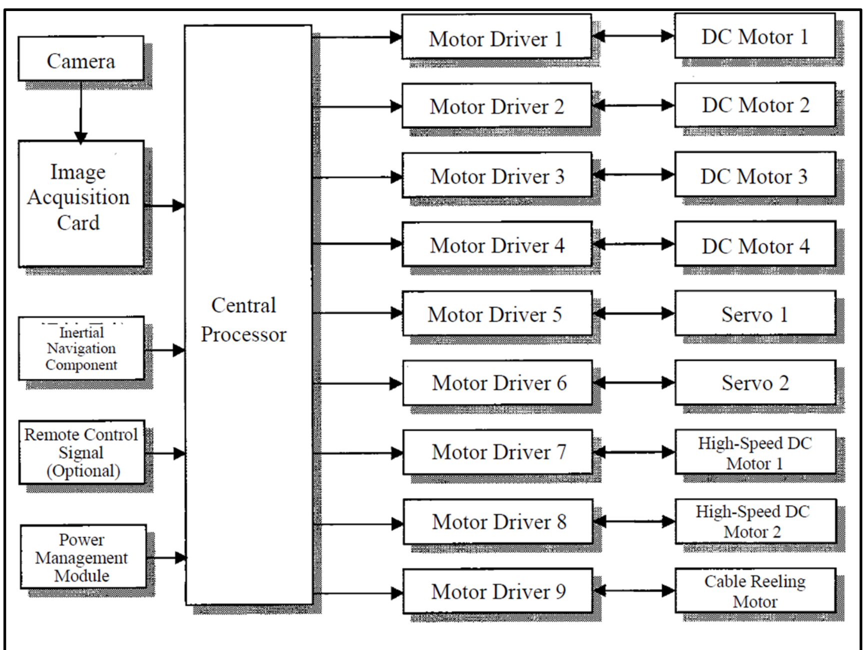


Fig. 6

EX1007, Fig. 6.

Additionally, "[t]he underwater cleaning robot controls its actions according to control commands issued by the central processor," which establishes communication between controller and the robot (*i.e.,* "piece of equipment") via control commands. *Id.*, ¶¶[0010], [0026]. As explained for element 1f, the central processor receives captured images (*i.e.*, "visual data") from monitoring cameras 2, and assesses the "level of cleanliness" of the pictured region by comparing the image with the "pool cleanliness image threshold." Section IV.A.2.g; EX1007, ¶¶[0024]-[0026]. Based on that assessment, the central processor generates control signals to drive the robot's "cleaning movements and adjusts the working state of the four cleaning driving wheels 3." Section IV.A.2.g; EX1007, ¶[0026].

Accordingly, Fu discloses "a controller [control system with central processor] in communication with the at least one piece of equipment [underwater cleaning robot] and the one or more cameras [monitoring cameras 2], the controller configured to receive visual data [images] from the one or more cameras and determine a control action [control signals regarding cleaning movements and wheel adjustments] for the at least one piece of equipment based on the received visual data."

Fu anticipates claim 2. *Id.*, ¶¶389-403.

4. Claim 3

Fu discloses claim 3. *Id.*, ¶¶404-408. As explained for element 2a, Fu's robot teaches "at least one piece of equipment." Section IV.A.3.b. The robot is designed for cleaning a swimming pool by, for *e.g.*, filtering pool water and brush-cleaning pool surfaces, so it constitutes "a cleaning device." EX1007, Abstract, ¶¶[0010], [0024]-[0026]. As explained for element 1b, the robot includes "one or more propulsion mechanisms," *e.g.*, driving wheels 3 powered by cleaning driving wheel DC motors 7. Section IV.A.2.c.

Additionally, Fu's robot "possesses autonomous mobility and can be used for cleaning underwater horizontal, vertical, and inclined surfaces via remote or autonomous control, enabling it to autonomously complete underwater cleaning tasks in place of human labor." *Id.*, ¶[0001], Abstract. The robot "can adhere to the vertical walls of a swimming pool for cleaning, achieving vertical wall-climbing movement" because of "the high negative pressure within its water flow channel 24 and the force from the drainage mechanism." *Id.*, ¶¶[0011],[0026]. For vertical wall-climbing, the robot adjusts the position and discharge direction of water outlets 10 to generate a propulsive force for upward movement. *Id.*, claim 9, ¶¶[0012], [0026] ("The coordinated movement or positioning of multiple water outlets 10 along the water outlet sliding grooves 9 changes the discharge direction of the water outlets 10, generating different forces that affect the robot's movement. … Particularly when the robot is climbing a wall, factors such as pool steps may cause the chassis to be lifted, rendering the four cleaning driving wheels 3 ineffective. In this situation, the position of the water outlets must be adjusted to provide a propulsive force to the robot, returning it to a normal operating state.”). Because Fu’s robot travels underwater on the pool floor as well as vertical walls, it travels “adjacent to submerged or water containing surfaces of the swimming pool” just like the ’207 Patent’s pool cleaning system 20 with vehicle 30.

Thus, Fu anticipates claim 3: “the at least one piece of equipment comprises a cleaning device [underwater cleaning robot] with one or more propulsion mechanisms [driving wheels 3 powered by cleaning driving wheel DC motors 7], the cleaning device configured to travel adjacent to submerged or water-containing surfaces of the swimming pool [pool floor and vertical pool walls] or spa and to perform a cleaning operation [filtering pool water and brush-cleaning pool surfaces].” EX1010, ¶¶404-408.

5. Claim 5

Fu discloses claim 5. *Id.*, ¶409. As explained for element 2b, Fu’s monitoring cameras 2 are “installed on the two front panels of the robot main housing body.” Section IV.A.3.c; EX1007, ¶[0024]. Thus, Fu anticipates claim 5: “ the one or more cameras [monitoring cameras 2] are mounted on the at least one piece of equipment [underwater cleaning robot].”

6. Claim 6

Fu discloses claim 6. EX1010, ¶¶410-411. As explained above, Fu's cameras 2 are installed on the robot body, and the robot is designed for underwater pool cleaning. Figure 7 shows the robot submerged in a swimming pool performing "long-duration, global cleaning":

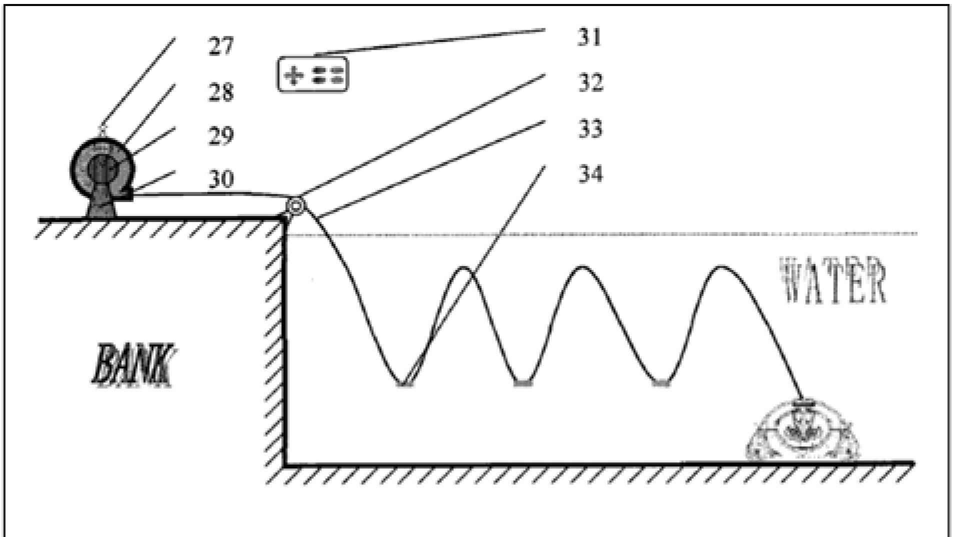


Fig. 7

EX1007, Fig. 7, ¶¶[0008], [0025]. Thus, Fu anticipates claim 6: "the one or more cameras [monitoring cameras 2] are submergible or submerged within the swimming pool or spa."

7. Claims 7-8

Fu discloses claims 7-8. EX1010, ¶¶412-415. As explained for element 2c, Fu's central processor receives captured images (*i.e.*, "visual data") from monitoring cameras 2, and assesses the "level of cleanliness" of the pictured region by comparing the image with the "pool cleanliness image threshold." Section IV.A.3.d. Based on that cleanliness assessment, *i.e.*, determining whether the captured image falls above or below the pool cleanliness image threshold, the central processor generates control signals to drive the robot's "cleaning movements and adjusts the working state of the four cleaning driving wheels 3." *Id*.

Thus, Fu anticipates claim 7: "[t]he pool system of claim 2, wherein the controller is configured to detect a characteristic of the location [level of cleanliness of pictured region] based on the visual data and control the piece of equipment [adjust cleaning movements and wheel speeds of the underwater cleaning robot] based on the detected characteristic." Fu also anticipates claim 8: "the characteristic comprises a cleanliness of a surface of the swimming pool [level of cleanliness of pictured region], and wherein the controller is configured to control the piece of equipment [adjust cleaning movements and wheel speeds of the underwater cleaning robot] based on the detected cleanliness being outside of a threshold [pool cleanliness image threshold]."

8. Claim 12

(a) Preamble: "A method for monitoring a pool system, the method comprising:"

To the extent limiting, claim 12's preamble is disclosed by Fu. EX1010, ¶¶416-417. In the autonomous mode, Fu's robot uses monitoring cameras 2 to monitor pool conditions and operate accordingly. *Id*., Abstract, ¶¶[0024]-[0025]. The robot uses cameras 2 to capture images of the pool floor, and compares them with the pool cleanliness image threshold to determine the level of cleanliness of the pictured region. *Id*. Based on this assessment, the robot autonomously adjusts its cleaning operations. *Id*. This continuous image capture and analysis of cleanliness comprises a "method for monitoring a pool system."

Thus, Fu discloses a "method for monitoring a pool system."

(b) Element 12a: "receiving images of at least a portion of a location including a swimming pool or spa from one or more cameras;"

Fu discloses element 12a. EX1010, ¶¶418-421. As explained for elements 1d-e, Fu's control system receives, via the image acquisition card, images captured by monitoring cameras 2 of the pool floor. Section IV.A.2.e-f.

Thus, Fu discloses "receiving images of at least a portion of a location including a swimming pool [images of the pool floor] or spa from one or more cameras [monitoring cameras 2]."

(c) Element 12b: "determining a target area and detecting a characteristic of the target area based on the images; and"

Fu discloses element 12b. EX1010, ¶¶422-424. Fu's robot "uses its monitoring cameras 2 to capture images of the pool floor and compares them with the [pool cleanliness image] threshold to determine the level of cleanliness." EX1007, ¶[0026]. The robot analyzes the specific region of the pool captured in the images to determine whether that region meets the cleanliness threshold. *Id*. That region corresponds to the "target area" because it is the specific area identified, *i.e.*, "determine[ed]" for assessing the level of cleanliness. *Id*.

Thus, Fu discloses "determining a target area [pictured region of the pool floor that is assessed for cleanliness] and detecting a characteristic of the target area [level of cleanliness] based on the images."

(d) Element 12c: "generating a control response based on the detected characteristic of the target area."

Fu discloses element 12c. EX1010, ¶¶425-428. As explained for element 1f, based on the determined level of cleanliness, the central processor generates control signals to drive the robot's "cleaning movements and adjusts the working state of the four cleaning driving wheels 3." Section IV.A.2.g.

Thus, Fu discloses "generating a control response [control signals to adjust the robot's cleaning movements and working state of the wheels] based on the detected characteristic [level of cleanliness] of the target area [pictured region of the pool floor that is assessed for cleanliness]."

Fu anticipates claim 12. EX1010, ¶¶416-428.

9. Claim 13

Fu discloses claim 13. *Id.*, ¶¶429-431. As explained for element 12b, the "target area" comprises the pool area captured in the images of the pool floor, whose "level of cleanliness" is assessed in comparison to a threshold. Section IV.A.8.c; EX1007, ¶[0026].

Thus, Fu anticipates claim 13: "the target area comprises a portion of a surface of the swimming pool [pictured region of the pool floor that is assessed for cleanliness] or spa, and wherein the characteristic comprises a cleanliness characteristic [level of cleanliness] of the portion of the surface of the swimming pool or spa." EX1010, ¶¶429-431.

10. Claim 14

Fu discloses claim 14. *Id.*, ¶¶432-433. As explained for element 12c, based on the "level of cleanliness" of the pictured region of the pool, Fu's central processor generates control signals that autonomously adjust the robot's cleaning movements and working state of the wheels. Section IV.A.8.d; EX1007, ¶[0026].

Thus, Fu anticipates claim 14: "generating the control response comprises controlling an operation of a piece of equipment of the swimming pool [control signals to adjust the robot's cleaning movements and working state of the wheels] or spa." EX1010, ¶¶432-433.

11. Claim 19

Fu discloses dependent claim 19. *Id.*, ¶¶434-436. As explained for claim 3, Fu's robot teaches a "cleaning device" "configured to travel adjacent to submerged or water-containing surfaces of the swimming pool or spa and to perform a cleaning operation." Section IV.A.4. Fu further teaches that, based on the determined level of cleanliness, its central processor generates control signals that autonomously adjust the robot's working state of the wheels 3. EX1007, ¶[0026]. "By using ***different combinations of wheel speeds***, ***cleaning actions of varying intensity can be achieved***. For example, if the front wheels rotate quickly clockwise and the rear wheels rotate slowly counter-clockwise, the underwater cleaning robot will advance in ***the direction determined by the clockwise rotation*** of the front wheels." *Id*., (emphasis added)).

Thus, Fu anticipates claim 19: "generating the control response [control signals to adjust the robot's cleaning movements and working state of the wheels] comprises controlling operation of a cleaning device [underwater cleaning robot] configured to travel adjacent to submerged or water-containing surfaces of the swimming pool [pool floor and vertical pool walls] or spa and to perform a cleaning operation [filtering pool water and brush-cleaning pool surfaces], wherein controlling operation of the cleaning device comprises one or more of controlling a path or route of the cleaning device [controlling the direction of the robot], an aggressiveness of cleaning chemicals deployed, an aggressiveness of mechanical cleaning [cleaning actions of varying intensity], or a speed of the cleaning device [controlling the speed of cleaning wheels 3]." EX1010, ¶¶434-436.

B. Ground 1b: Claims 1-3, 5-8, 12-14, And 19 Would Have Been Obvious Over Fu

1. Claim 1

Fu anticipates claim 1. Section IV.A.2. However, to the extent the Board finds that Fu does not anticipate claim 1 for allegedly lacking at least one control signal that causes movement of the body "to, or away from, the first object,"[1] Fu nevertheless would have rendered obvious this claim. EX1010, ¶¶437-440.

Fu already teaches acquiring an image of submerged pool surfaces, comparing the image to a cleanliness image threshold, and "plan[ning] … cleaning movements" and "adjust[ing] the working state of the four cleaning drive wheels 3 … to complete the cleaning task" based on this comparison. EX1007, ¶[0026]. A POSA would have found it obvious to implement motion control in Fu to direct the cleaning robot toward (i) pictured regions containing a first object falling below the cleanliness threshold, and (ii) away from pictured regions containing the first object falling above the cleanliness threshold. EX1010, ¶¶437-440.

Given Fu's use of image-based cleanliness determination to adjust wheel speeds and movement paths, it would have been a routine and predictable application for a POSA to configure Fu's central processor to generate control signals directing the robot toward the first object when it is in a subthreshold (*i.e.*, relatively dirty)

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[1] As explained in Section IV.A.2.g, such a finding would be erroneous because claim 1 encompasses any control signal generated in response to the captured image that causes movement of the body: Once the camera captures an image of at least a first object within the pool, the vehicle occupies some finite position relative to that first object. *Any* movement commanded by the control signal—whether forward, backward, laterally, vertically, or along any trajectory—will necessarily decrease or increase the distance between the vehicle body and that imaged first object, *i.e.*, it will be movement "to, or away from" that first object. EX1010, ¶437 n.15.

area. *Id*. A POSA would have been motivated to do so because moving the robot toward dirtier areas improves cleaning efficiency and task completion time. *Id*. Likewise, it would have been a routine and predictable application to configure Fu's central processor to generate control signals directing the robot away from the first object when it is present in an above-threshold (*i.e.*, relatively clean) area. *Id*. As explained by Dr. Reinholtz, implementing such control behaviors in Fu would have required no more than routine software configuration within a POSA's skill. *Id*. Such implementation would reflect routine, predictable applications of well-known control techniques, requiring no new hardware and instead leveraging Fu's disclosed central processor. *Id*. A POSA would have thus had a reasonable expectation of success in implementing Fu with the "at least one control signal to cause movement of the body within the swimming pool to, or away from, the object." *Id*.

Accordingly, Fu would have rendered obvious claim 1. *Id*.

2. Claims 2, 3, 5-8, 12-14, And 19

Independent claims 2 and 12 recite limitations similar to claim 1's, and are obvious over Fu for the reasons explained for claim 1. Fu also discloses the limitations added in dependent claims 3, 5-8, 13, 14, and 19 (*see* Ground 1a in Section IV.A), such that these dependent claims are likewise obvious over Fu. EX1010, ¶441.

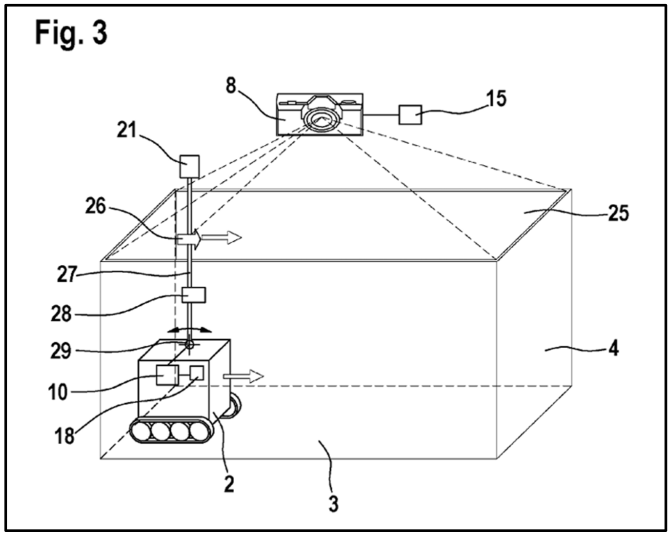
C. Ground 1c: Claims 1-8, 11-14, And 19 Would Have Been Obvious Over Fu In View Of Benzler

1. Summary Of Benzler

Benzler, EX1013, entitled "Activation System for a Robotic Vehicle," was filed on May 16, 2008 as PCT/EP08/56016, and published on Nov. 25, 2010 as U.S. Patent Pub. No. 2010/0299016. EX1013, (10), (22), (43), (86). Benzler is therefore prior art under at least pre-AIA 35 U.S.C. §§ 102(a), (b), and (e).

Benzler describes "an activation system (1) for a robotic vehicle (2)" that uses image-based navigation to autonomously control movement of vehicle (2) within a work area 3. *Id.*, ¶[0037], Abstract. The system includes at least one "camera (8) configured for generating image data of a work area (3)," and a "logic unit (10) configured for determining the position of the at least one robotic vehicle (2) based on the image data generated by the camera (8)." *Id.*, Abstract. "The logic unit 10 calculates driving instructions for the robotic vehicle 2 based on the image data," and the driving instructions are transmitted to robotic vehicle 2 for execution. *Id.*, ¶¶[0044]-[0046].

Benzler describes several example embodiments of the activation system, such as "a snow cleaning vehicle, [a] leaf collecting vehicle, [a] grass collecting vehicle, thatching vehicle, or [a] weeding vehicle …[and] as a lawnmower." *Id.*, ¶[0023]. In a "particularly preferred" embodiment, "the robotic vehicle is construed as [a] pool-robotic vehicle, thus in particular as [a] filter vehicle and/or cleaning or purifying vehicle … [that] drive[s] in particular on the bottom of a pool, which then creates the work area." *Id.*, ¶[0028]. In this pool embodiment, "[t]he external border 4 of the work area 3 is created by the surrounding pool walls." Figure 3 illustrates the activation system as pool robotic vehicle 2 (*id.*, ¶¶[0036], [0051]-[0056]):



Id., Fig. 3.

Camera 8 transmits data via logic unit 10 to "control unit 18, which controls the not shown drive means" for driving robotic vehicle 2. *Id.*, ¶[0054].

2. Motivation To Combine

The similar disclosures of Fu and Benzler would have motivated a POSA to consider them together. EX1010, ¶¶442-443. Fu discloses capturing an image of the pool floor, comparing it to a cleanliness threshold to determine a level of cleanliness, and then adjusting the robot's operations accordingly. EX1007, ¶[0026]. Likewise, Benzler describes an autonomous robotic cleaning system, with a pool cleaning embodiment, that makes movement and cleaning decisions based on an image of the work area. Section IV.C.1; EX1013, Abstract, ¶¶[0016], [0018], [0028], [0037], [0044]-[0046], [0053]. Thus, Benzler, like Fu, is directed to an autonomous robotic cleaner that uses an image to guide its operations, particularly in a pool-cleaning embodiment.

A POSA's motivation for combining Fu and Benzler and further described below with respect to the claims.

3. Claim 1

To the extent the Board determines that Fu alone does not anticipate or render obvious the "at least one control signal to cause movement of the body within the swimming pool to, or away from, the first object," claim 1 is nonetheless obvious over Fu in combination with Benzler. EX1010, ¶¶444-448.

Benzler describes various embodiments of its robotic vehicle, such as an autonomous lawnmower. In this embodiment, "the logic unit … is … [constructed] in such a way that differently conditioned sections (mowed/not mowed) … are detected and the driving instructions are calculated in such a way that preferably the mowed section … is driven along." EX1013, ¶¶[0018], [0023], [0045]. In embodiments, "the logic unit detects differently conditioned sections of the work area, for example a mowed or a not mowed section of the work area based on the image data and then considers this information when calculating the driving instructions, in particular in such a way that the robotic vehicle does only or preferably move on one of those sections, in particular the not mowed lawn section." *Id.*, ¶[0016]. Thus, Benzler uses an image to cause motion "only or preferably" toward target sections and away from non-target sections. *Id.*, ¶¶[0016], [0018], [0045].

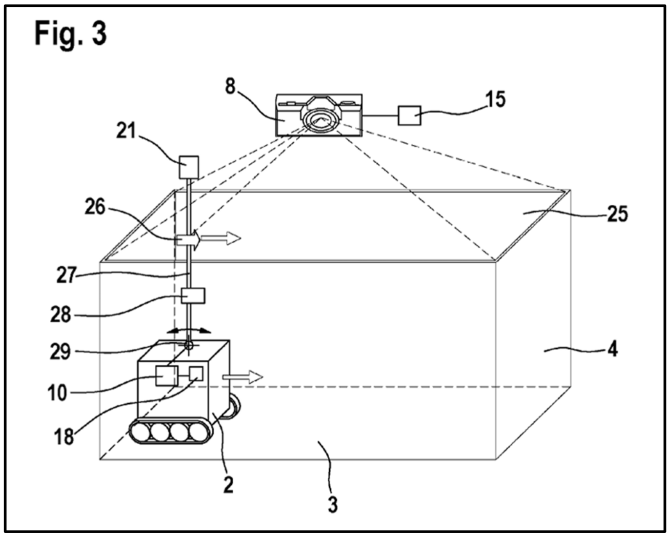
A POSA would have been motivated to incorporate Benzler's image-based classification-driven motion control into Fu because it is a known technique for improving coverage efficiency and cleaning performance, satisfies design needs to prioritize dirty areas and reduce redundant cleaning, and represents one of a finite, predictable set of control options once regions are classified with respect to a threshold. EX1010, ¶¶444-448. Applying Benzler's classification-driven motion to Fu's thresholded cleanliness determinations would have yielded the control signal for causing movement "to, or away from" a portion of the submerged surface captured by the camera, with the robot moving toward sub-threshold (dirtier) regions and away from above-threshold (cleaner) regions. *Id.* A POSA would also have had a reasonable expectation of success. The combination does not require new hardware or unconventional algorithms; Fu already discloses cameras, processor, and wheels, and it "plans" movement and "adjusts" wheel states based on cleanliness determinations. Implementing Benzler's classification-based movement entails routine controller configuration that would have been within a POSA's skill. *Id.*

Thus, Fu in view of Benzler renders obvious claim 1's "to, or away from" control-signal limitation by teaching and motivating use of image-based region classification to control motion toward target (dirtier) regions and away from non-target (cleaner) regions. *Id*.

Claim 1 would have been obvious over Fu in view of Benzler. *Id.*, ¶¶442-448.

4. Claim 4

Claim 4 would have been obvious over Fu in view of Benzler. *Id.*, ¶¶449-453. While Fu's robot comprises onboard cameras that are submerged in the pool, Benzler's pool robotic vehicle 2 uses external camera 8. Sections IV.A.5-6, IV.C.1. A POSA would have recognized the advantages of implementing Fu with Benzler's external camera 8. Benzler emphasizes that external camera 8 is positioned above the work area, *i.e.*, pool, so it can capture a broad, global view of the entire pool. Ex. 1013, ¶[0010] ("The camera is preferably arranged above the work area, so that a section of the work area can be detected that is as big as possible with the camera ... It is furthermore possible to arrange the at least one camera … in such a way that it follows the movement of the robotic vehicle.").



EX1013, Fig. 3. A POSA would understand that this overhead perspective provides additional information that Fu's submerged, onboard cameras cannot capture; while Fu's onboard cameras observe only a partial, local region within the pool, Benzler's external camera provides a complete, unobstructed view of the entire pool along with the robot's exact location, orientation, and trajectory. EX1010, ¶¶449-453.

A POSA would have had a reasonable expectation of success in making this combination because Fu already provides an existing communication infrastructure for easily integrating Benzler's external camera 8 into Fu. Figure 7 illustrates a "control and power management system" that is external to the pool, including components such as signal relay and cable manager 28, and signal and power cable 33:

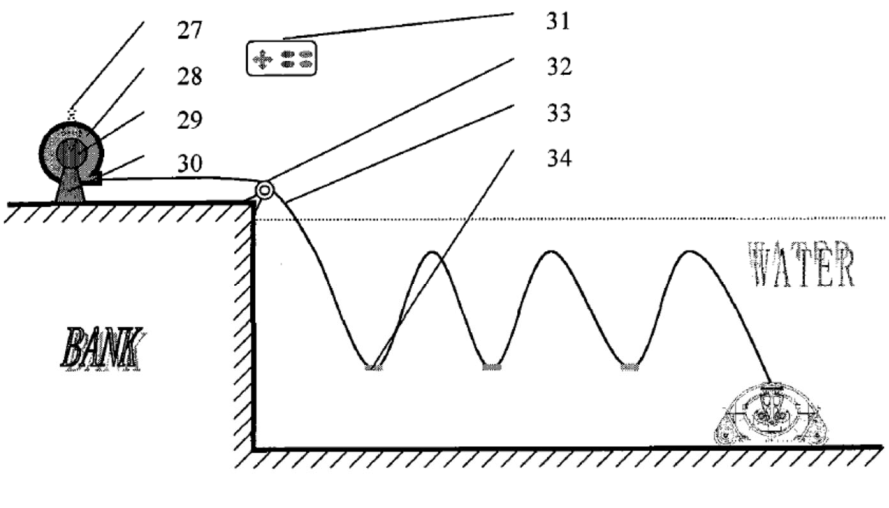


Fig. 7

Id., Fig. 7. This system establishes a communication path for transmiting controls signals and power between external hardware and the underwater robot. EX1007, ¶[0024] (*e.g.*, floating antenna 27 relays signals from keypad 31 to the robot via cable 33). A POSA would understand that this same communication path could be used to transmit data from Benzler's camera 8, and/or control signals derived from images captured by camera 8, to the robot. As explained by Dr. Reinholtz, this would be a straightforward integration well within a POSA's skill. EX1010, ¶¶449-453.

Thus, Fu in view of Benzler renders obvious claim 4: "the one or more cameras [Benzler's camera 8] are mounted external to the swimming pool or spa." *Id.*

5. Claim 11

Claim 11 would have been obvious over Fu in view of Benzler. *Id.*, ¶¶454-455. Fu discloses an onboard controller (control system with central processor) in communication with the camera. EX1007, ¶¶[0024]-[0026]. A POSA would have recognized the advantages of implementing Benzler's external camera 8 with Fu's onboard controller (Section IV.C.4), making "the controller [onboard control system with central processor] [] remote from the camera [Benzler's camera 8]" in Fu's robot.

Thus, Fu in view of Benzler renders obvious claim 11. EX1010, ¶¶454-455.

6. Claims 2, 3, 5-8, 12-14, And 19

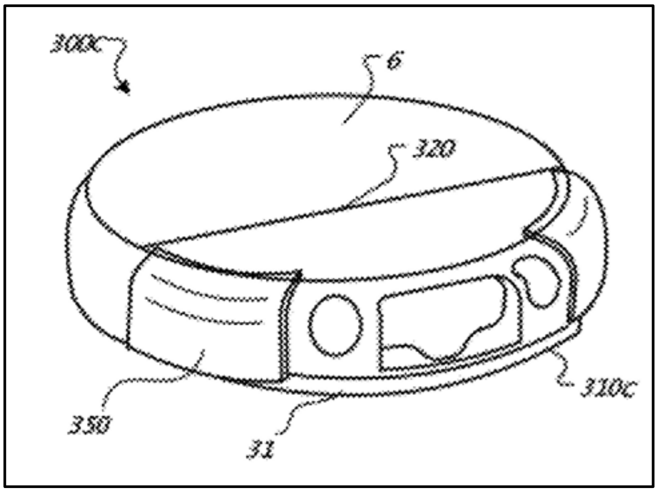
Independent claims 2 and 12 recite limitations similar to claim 1's, and are obvious over Fu in view of Benzler for the reasons explained in Sections IV.C.2-3 for claim 1. Fu also discloses the limitations added in dependent claims 3, 5-8, 13, 14, and 19 (*see* Section IV.A for Ground 1a), such that these dependent claims are likewise obvious over Fu in view of Benzler. EX1010, ¶456.

D. Ground 2a: Claims 1-7, 11-14, And 19 Would Have Been Obvious Over Schnittman In View Of Benzler

1. Summary Of Schnittman

Schnittman, EX1008, entitled "Debris Monitoring," was filed December 30, 2011, and published July 5, 2012. EX1008, (22), (43). Schnittman incorporates by reference and claims priority to U.S. Provisional Application No. 61/428,808 (the "'808 provisional"), filed December 30, 2010. *Id.*, (60). Schnittman is prior art under at least pre-AIA 35 U.S.C. §§ 102(a) and (e).

Schnittman discloses an autonomous cleaning robot having a debris monitoring system and onboard sensing for navigation and safety. *Id.*, Abstract, ¶¶[0002], [0004]-[0006].



Id., Fig. 3C (example cleaning robot). Embodiments of Schnittman's cleaning robot include a drive assembly, cleaning assemblies, and a sensor suite, enabling behaviors such as debris-dependent spot cleaning, edge/cliff avoidance, and autonomous return to a maintenance/charging station. *Id.*, Fig. 2; ¶¶[0113], [0118]-[0119], [0191]-[0203], [0216]-[0227].

In embodiments, Schnittman's cleaning robot further includes a microprocessor 245 that executes routines and issues control signals to move the robot (*id.*, ¶¶[0118]-[0119]):

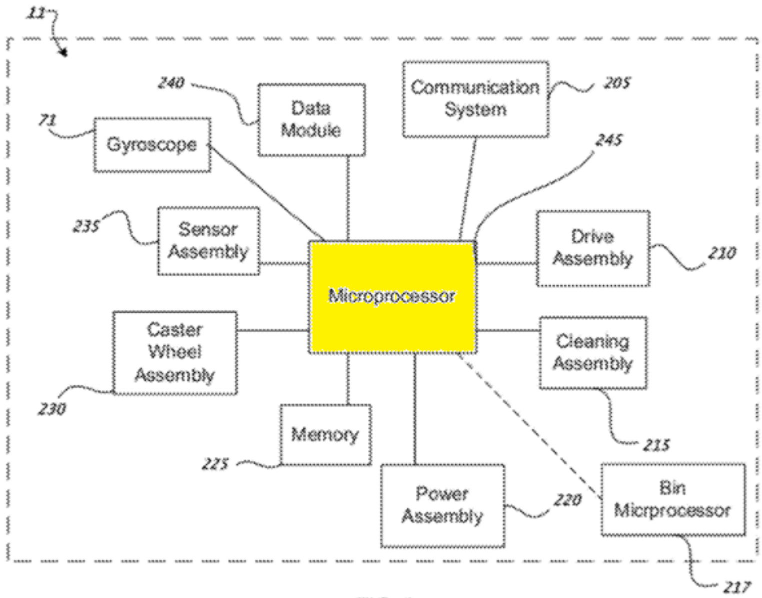


FIG. 2

Id., Fig. 2 (annotated). Microprocessor 245 is connected to drive assembly 210, which includes differentially driven right and left wheels, wheel motors, and encoders. *Id.*, ¶[0119]. "The drive assembly 210 is operable to receive commands from the microprocessor 245." *Id.*

Additionally, "in some implementations, the robot 11 includes a camera 1190 disposed toward the forward portion of the robot 11, with a field of view beyond the perimeter of the robot 11" (*id.*, ¶[0204]):

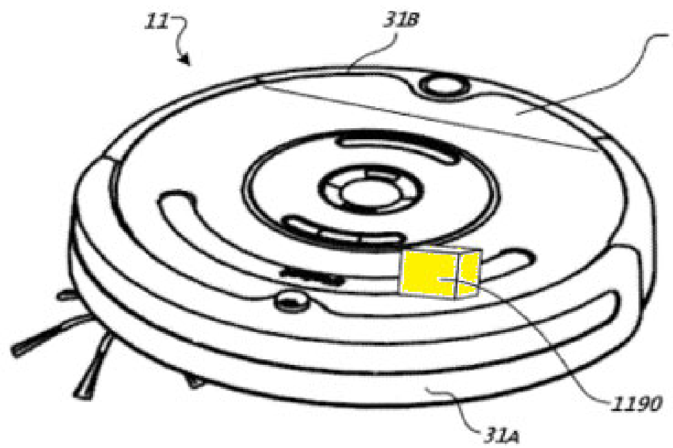


FIG. 11

Id., Fig. 11; *see also id.*, ¶[0045] ("In some implementations, the debris sensor includes a camera directed substantially forward of the cleaning apparatus. In certain implementations, the camera is movable to scan an area substantially forward of the cleaning apparatus."). Camera 1190 is "in communication with the microprocessor 245," which controls the robot based on signals received from the camera. *Id.*, ¶[0204].

Schnittman is analogous art to the '207 Patent because (1) it is from the same field of endeavor as the '207 Patent, and (2) it is reasonably pertinent to the problem faced by the inventors of the '207 Patent. EX1010, ¶109; s*ee Airbus S.A.S. v. Firepass Corp.*, 941 F.3d 1374, 1379 (Fed. Cir. 2019).

First, the '207 Patent and Schnittman are in the same field of endeavor: autonomous cleaning robots. *Compare* EX1005, 1:26-2:36 (automated, robotic cleaners for cleaning surfaces) *with* EX1008, ¶¶[0002]-[0003] ("This application relates to robots, and more particularly to autonomous coverage robots" for "removing debris from a surface.").

Second, Schnittman is reasonably pertinent to at least one problem purportedly addressed by the '207 Patent: ensuring "that all portions of … pool surfaces are satisfactorily cleaned." EX1005, 1:26-31. Schnittman describes adaptive cleaning based on detected debris: In response to an identification of debris on a surface, Schnittman's autonomous cleaning robot can perform various actions, including altering its path, running spot cleaning patterns, and steering toward the debris. EX1008, Figs. 10A-10B; ¶¶[0024], [0191]-[0203]. This focuses cleaning efforts where they are most necessary and enables better cleaning coverage, thus ensuring satisfactory cleaning of a surface. EX1010, ¶109. A POSA making a debris detecting pool cleaner would have thus "consulted [Schnittman] and applied [its] teachings in seeking a solution to the problem [POSA] was attempting to solve." *Airbus S.A.S*, 941 F.3d at 1382.

2. Schnittman Is Prior Art As Of December 30, 2010

Schnittman is entitled to the December 30, 2010 priority date of the '808 Provisional because the Provisional supports at least claim 1 of Schnittman. A later patent enjoys the priority date of the provisional so long as the provisional "contain[s] a written description of the invention … in such full, clear, concise, and exact terms, to enable an ordinarily skilled artisan to practice the invention claimed in [the later patent or published patent application].” *Amgen Inc. v. Sanofi*, 872 F.3d 1367, 1380 (Fed. Cir. 2017) (quotation omitted).

As shown below, the ’808 Provisional fully supports at least claim 1 of Schnittman:

Schnittman (US2012/0169497, EX1008)	**U.S. Provisional Application 61/428,808 (EX1011)**
1[a] A debris monitoring system comprising:	“In one aspect, a debris monitoring system includes a receptacle, a first and a second emitter, and a first receiver.” EX1011, ¶[0003].
1[b] a receptacle defining an opening to receive debris into the receptacle, the opening having a top portion and a bottom portion, the top portion above the bottom portion as debris is received into the receptacle;	“In one aspect, a debris monitoring system includes **a receptacle**, a first and a second emitter, and a first receiver. **The receptacle defines an opening to receive debris into the receptacle**.” *Id.*, ¶[0003]. “In certain implementations, **the opening has a top portion and a bottom portion, the top portion above the bottom portion as debris is received into the receptacle** ….” *Id.*, ¶[0006].
1[c] a first and a second emitter, each arranged to emit a signal across at least a portion of the opening; and	“In one aspect, a debris monitoring system includes a receptacle, **a first and a second emitter**, and a first receiver…. The first and second emitter are **each arranged to emit a signal across at least a portion of the opening**.” *Id.*, ¶[0003].
1[d] a first receiver proximate to the first emitter to receive reflections of the signal emitted by the first emitter, the first receiver disposed along a top portion of the opening and toward the opening to receive an unreflected portion of the signal emitted by the second emitter across the largest dimension of the opening.	“In one aspect, a debris monitoring system includes a receptacle, a first and a second emitter, and **a first receiver**…. **The first receiver is proximate to the first emitter to receive reflections of the signal emitted by the first emitter**, and the first receiver is **disposed toward the opening to receive an unreflected portion of the signal emitted by the second emitter across at least a portion of the opening**.” *Id.*, ¶[0003]. “In some implementations, the first receiver and the

	second emitter are disposed substantially opposite one another **across the largest dimension of the opening**." *Id.*, ¶[0005]. "In certain implementations, the opening has a top portion and a bottom portion, the top portion above the bottom portion as debris is received into the receptacle, **and the first and second emitters and the first receiver each disposed toward a top portion of the opening, with the first receiver disposed above the first and second emitters**." *Id.*, ¶[0006]. "The debris monitoring system of claim 21 wherein the opening has a top portion and a bottom portion, the top portion above the bottom portion as debris is received into the receptacle, and the first and second emitters and **the first receiver each disposed toward a top portion of the opening**, with the first receiver disposed above the first and second emitters." *Id.*, claim 24.

Additionally, the '808 provisional describes the subject matter of Schnittman that Petitioner relies upon as prior art. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc*., 800 F.3d 1375, 1380-81 (Fed. Cir. 2015). EX1012 is a redline comparison showing textual differences between the '808 provisional and Schnittman. Blue and underlined text reflects material present in only Schnittman, while unmarked text reflects material common to both Schnittman and the provisional. Additionally, the Petition-cited Schnittman passages are highlighted in yellow. As EX1012 shows, none of the Petition-cited Schnittman passages appear as blue, underlined text, demonstrating that every portion of Schnittman relied upon in the Petition is present verbatim or in substance in the '808 provisional. Additionally, all the figures of Schnittman cited in the Petition (*i.e.*, Figs. 1A, 1B, 1C, 2, 3C, 10A, 10B, 11, 14D) are present in the '808 provisional.

3. Motivation To Combine

A POSA would have been motivated to consider Schnittman and Benzler together because they describe similar technology (*e.g.*, autonomous cleaning robots that employ computer vision) and address the same problem: enabling a robot to make cleaning and navigation decisions based on an image of the cleaning surface. EX1010, ¶¶457-466. Schnittman discloses an autonomous cleaning robot 11 with movement and cleaning decisions tied to an image received from a debris sensor, including embodiments where the debris sensor is a camera 1190. Section IV.D.1. Likewise, Benzler describes an autonomous robotic cleaning system, with a pool cleaning embodiment, that makes movement and cleaning decisions based on an image of the work area. Section IV.C.1.

At the time of the '207 Patent, POSAs working in the field of autonomous, image-based cleaning robots, whether for floors, lawns, or pools, were addressing the same problem: using an image to enable a robot to perceive its cleaning surface, and execute cleaning operations autonomously. EX1010, ¶¶457-466. Both Schnittman and Benzler address that problem, and offer complementary, overlapping teachings. *Id*. Importantly, Schnittman is not limited to any specific environment; its teachings apply generally to cleaning robots that analyze an image of the cleaning surface. As explained by Dr. Reinholtz, this image-based control represented a state-of-the-art approach to autonomous cleaning at the time, and a POSA designing a pool-cleaning robot would have recognized that Schnittman's teachings and stated advantages (*e.g.*, robust, debris-responsive cleaning coverage) could be advantageously leveraged in a pool-cleaning context as taught by Benzler. *Id.*; EX1008, Figs. 10A-10B; ¶¶[0024], [0191]-[0203].

POSA would have understood that robotics principles underlying image-based cleaners, like those developed by leading manufacturers such as iRobot (assignee of Schnittman), are readily adaptable to different environments. EX1010, ¶¶457-466. Robotics, like any other technology, develops by building on existing technology and adapting existing technology to new contexts. *Id.* POSAs in the field of autonomous pool cleaners were not working in isolation; they routinely drew on technologies from the broader field of autonomous cleaning. *Id.* Indeed, Benzler itself confirms this: it describes the same image-driven framework as Schnittman, while applying this framework to both land and water embodiments, such as a lawnmower, a snow cleaning vehicle, a pool cleaning vehicle, etc. Section IV.C.1; EX1013, ¶¶[0028], [0037], [0044]-[0046]. By describing the same image-based system across multiple domains, land and water alike, Benzler demonstrates that a POSA understood how to adapt the principles of image-based robotic navigation and cleaning across various environments.

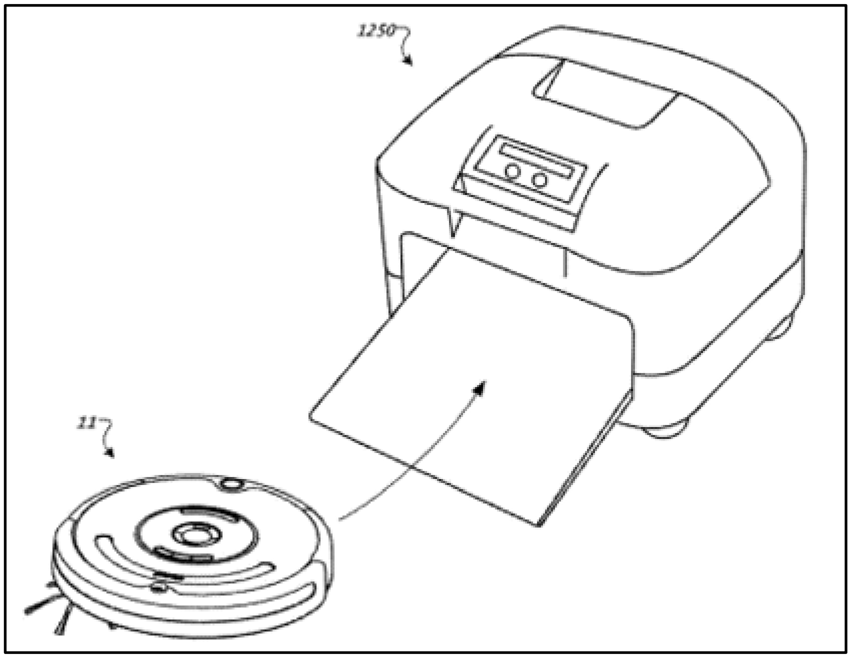
Benzler would have further reinforced a POSA's understanding that Schnittman's cleaning robot could be adapted for underwater use. For example, Benzler's teaching of a "moisture-sealed housing" for the internal logic unit (EX1013, ¶[0011]) contemplates operation in wet environments (*id.*, Fig. 3 (showing onboard logic unit 10 submerged in a pool)), providing a practical implementation detail that a POSA would have easily incorporated when adapting Schnittman's robot for underwater use. Likewise, Benzler's teaching of "pool robotic vehicles [that] drive in particular on the bottom of a pool" using wheels powered by a drive motor (*id.*, ¶¶[0028], [0051], Fig. 3) reinforces that Schnittman's similar motor-powered wheels 45 could be readily adapted for underwater use. Schnittman's image-based debris detection and navigation system, combined with Benzler's known underwater implementation of a similar image-based pool cleaner, would predictably yield an image-based underwater pool cleaner that is driven based on an image of the pool surface.

A POSA would have had a reasonable expectation of success in making this combination. EX1010, ¶¶457-466. By the time of the '207 Patent, the necessary adaptations to render a system water-ready were straightforward and within a POSA's skill, such as moisture-sealing or potting electronics, waterproofing, ensuring stable mobility and traction along submerged pool surfaces to counter buoyancy and slippage, and applying known image-processing techniques to extract useful information from underwater camera imagery. *Id*. For example, in the same period, the use of cameras on underwater cleaning vehicles was well known. *See, e.g.*, EX1014 ("underwater sediment cleaning apparatus … wherein the controller … comprises: a camera unit"), EX1015 ("Robotic submersible cleaning system" including "use of an intelligent camera system 81 [to] assist in maintaining the positional accuracy … along an underwater surface"), EX1016 ("apparatus and method of … inspecting a submerged surface of a fluid reservoir" including a "navigation camera 6"). Researchers documented effective techniques to improve the effectiveness of underwater imaging. For *e.g.*, literature from around that time described various normalization, filtering, and color-space methods that extract target information from underwater environments in real time. *See* EX1017, 7. These developments would have reinforced a POSA's motivation to extend the teachings of Schnittman to the underwater context, with Benzler providing clear guidance and confirmation that such an adaption was both known and would be successful.

4. Claim 1

(a) Preamble

To the extent limiting, claim 1's preamble would have been obvious over Schnittman in view of Benzler. EX1010, ¶¶467-471. Schnittman discloses autonomous robotic cleaners for removing debris from cleaning surfaces (*e.g.*, floors) (EX1008, ¶¶[0002], [0023], [0032], [0033]):



Id., Fig. 14D (example robotic cleaner 11 and maintenance station 1250); ¶¶[0097], [0216]-[0217]. In embodiments, Schnittman's robotic cleaners include "debris agitator[s]," such as brushes, that "sweep or otherwise agitate debris from the cleaning surface." *Id.*, ¶¶[0026], [0027], [0031], [0115], [0119], [0128], [0130]-[0131].

Further, Schnittman's autonomous robotic cleaners are "self-propelled" because they include an onboard drive system and wheels that move and steer the robot without external propulsion. *See, e.g., id.*, ¶[0005] ("The drive system is coupled to the housing and configured to maneuver the robot across a cleaning surface."), [0112] ("installed along either side of the robot body 31 are differentially driven wheels 45, each rotatable about a transverse axis, to mobilize the robot 11"),

[0119] ("right and left wheel motors" for the respective "right and left differentially driven wheels 45"). In embodiments, power for moving Schnittman's robotic cleaner is provided via an onboard battery that is charged at a maintenance station 1250. *Id.*, ¶¶[0048], [0050], [0054], [0115], [0118], [0216]-[0217], [0221], [0227], [0230].

As detailed below for elements 1a-1f, Schnittman's cleaning robot discloses all the features recited in claim 1, thus it discloses the preamble's "pool cleaning system." Additionally, a POSA would have been motivated to apply Schnittman's teachings in the pool-cleaning context for cleaning submerged surfaces in view of Benzler. Section IV.D.3.

Therefore, Schnittman in view of Benzler renders obvious the preamble's "self-propelled pool cleaning system [robotic cleaner 11] for cleaning debris from a submerged surface of a swimming pool." EX1010, ¶¶467-471.

(b) Element 1a

Schnittman discloses element 1a. *Id.*, ¶¶472-474. Embodiments of Schnittman's robotic cleaners include "a robot body 31 (*e.g.*, a chassis and/or housing) which carries an outer shell 6 connected to a bumper 5" (EX1008, ¶[0111]):

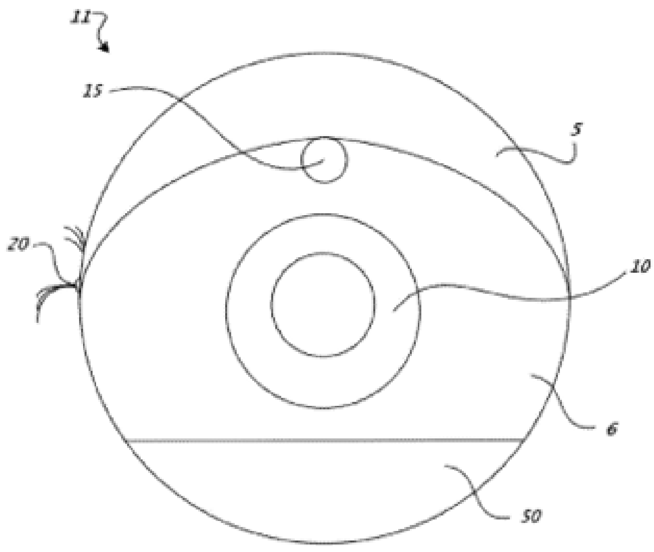


FIG. 1A

Id., Fig. 1A.

Thus, Schnittman's discloses "a vehicle body [robot body 31]." EX1010, ¶¶472-474.

(c) Element 1b

Schnittman in view of Benzler would have rendered obvious element 1b. *Id.*, ¶¶475-478. The term "means for moving the vehicle body within the swimming pool" is an MPF term, and the corresponding structures in the '207 Patent include "wheels, rollers, tracks or other surface contacting members powered by a motor and the like." EX1005, 3:33-45; Section II.C.1.

Schnittman's robotic cleaners include an onboard drive system (or "drive assembly") for moving the robot. EX1008, ¶¶[0005], [0040], [0044], [0119], [0177]. The drive system "includes right and left differentially driven wheels 45, right and left wheel motors, and wheel encoders" in embodiments (*id.*, ¶[0119]):

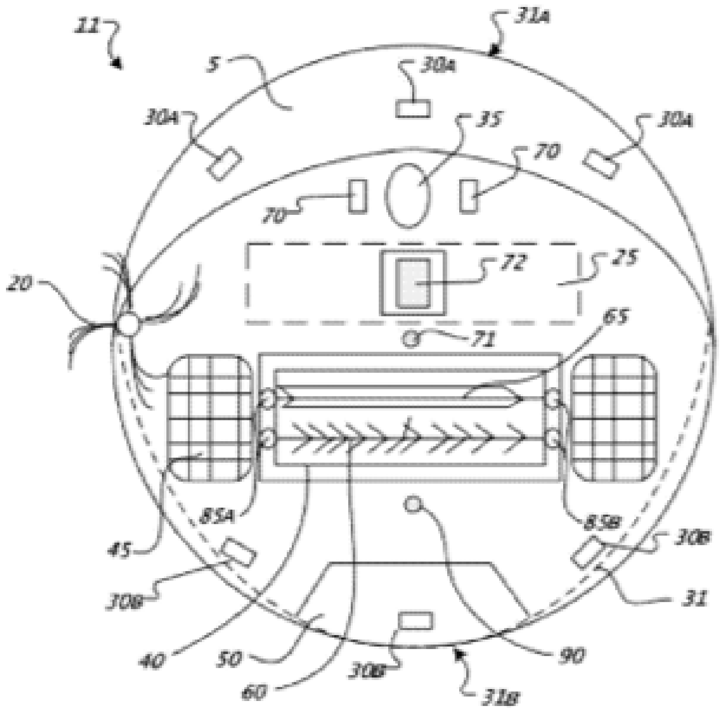


FIG. 1B

Id., Fig. 1B.

Schnittman's "drive system is coupled to the [robot's] housing and configured to maneuver the robot across a cleaning surface." *Id.*, ¶[0005]. Further, the drive system is "operable to receive commands from the microprocessor 245" for controlling the robot's movement. *Id.*, ¶¶[0119], [0177].

While Schnittman does not disclose moving "within [a] swimming pool" specifically, Benzler's teaching of "pool robotic vehicles [that] drive in particular on the bottom of a pool" using wheels powered by a drive motor provides a drive system similar to Schnittman's, reinforcing that Schnittman's similar motor-powered wheels 45 could be readily adapted for underwater use. Section IV.D.3.

Therefore, Schnittman in view of Benzler renders obvious "means for moving the vehicle body within the swimming pool [drive system with wheels 45].” EX1010, ¶¶475-478.

(d) Element 1c

Schnittman in view of Benzler would have rendered obvious element 1c. *Id.*, ¶¶479-480. Schnittman discloses that its robotic cleaners include an “internal filter 54” (EX1008, ¶[0117]):

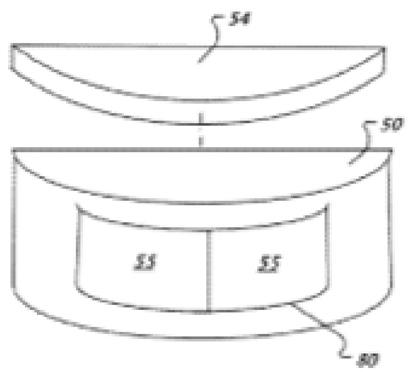


FIG. 1C

Id., Fig. 1C; *see also id.*, ¶¶[0120]-[0124], [0129].

Internal filter 54 is part of the robot’s cleaning bin 50, and it retains collected debris. *Id.*, ¶¶[0117], [0121], [0123]-[0124] (internal filter must be cleaned to remove collected debris), [0129], [0242], [0248]. As explained by Dr. Reinholtz, a pool-cleaner implementation of Schnittman in view of Benzler would include a filter like filter 54, with the filter retaining debris collected by the robot while passing filtered, clean water back into the swimming pool. EX1010, ¶¶479-480. Benzler describes use of debris-retaining filters in pool-cleaning robots. EX1013, ¶[0028] (“the robotic vehicle is construed as [a] pool-robotic vehicle, thus in particular as [a] filter vehicle and/or cleaning or purifying vehicle"), Claim 22 ("a working element of the [pool-cleaning] robotic vehicle, in particular the width of a filter unit"). Such on-board filters for pool-cleaning robots were well-known at the time of the alleged invention, and a POSA would have understood how to modify or replace Schnittman's filter for use in a pool-cleaning context. EX1010, ¶¶479-480; Section IV.D.3.

Therefore, Schnittman in view of Benzler renders obvious "a filter [internal filter 54] configured to retain debris collected from the submerged surface." *Id.*, ¶¶479-480.

(e) Element 1d

Schnittman in view of Benzler would have rendered obvious element 1d. *Id.*, ¶¶481-484. Schnittman discloses embodiments of its robotic cleaners including a camera 1190:

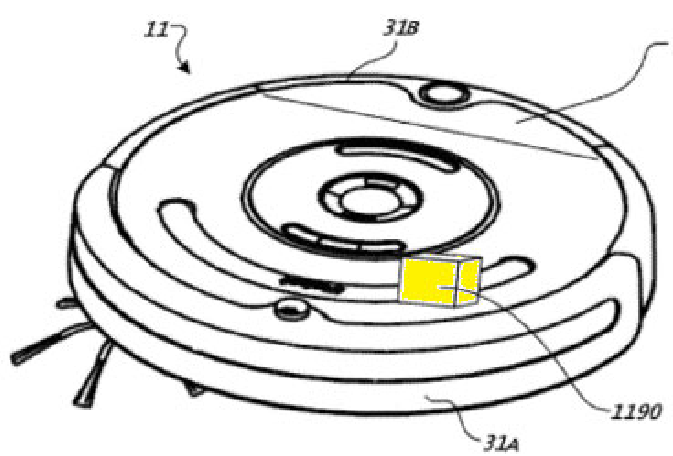


FIG. 11

EX1008, Fig. 11; *see also id.*, ¶¶[0045], [0204]-[0205].

The camera "scan[s] an area substantially forward of the [robot]" as the "robot [moves] over the cleaning surface." EX1008, ¶¶[0045], [0204]. The camera is "in communication with [a] microprocessor 245," and "microprocessor 245 … process[es] [a] signal from the camera … to recognize debris on the cleaning surface and maneuver the robot 11 toward the debris." *Id.*, ¶[0204]. Additionally, "the microprocessor 245 can process the signal from the camera 1190 to recognize obstacles . . . in the vicinity of the robot 11 and maneuver the robot 11 to avoid obstacles . . . larger than a specific size threshold[.]" *Id.*, ¶[0205].

The debris, obstacles, and cleaning surface itself captured by Schnittman's camera and recognized by its microprocessor are examples of a first object. *See* Section IV.A.2.e. As explained by Dr. Reinholtz, a POSA would have thus understood that Schnittman's camera captures an image of at least a first object: The microprocessor could not "recognize debris on the cleaning surface" absent an image of these objects captured by the camera. EX1010, ¶¶481-484.

While Schnittman does not disclose capturing an image "within the swimming pool" specifically, a pool-cleaner implementation of Schnittman in view of Benzler would capture such an image. Section IV.D.3.

Accordingly, Schnittman in view of Benzler renders obvious "at least one camera [camera 1190] for capturing an image of at least a first object within the swimming pool." EX1010, ¶¶481-484.

(f) Element 1e

Schnittman discloses element 1e. *Id.*, ¶¶485-487. Schnittman discloses embodiments of its robotic cleaners including a microprocessor 245 (EX1008, ¶[0118]):

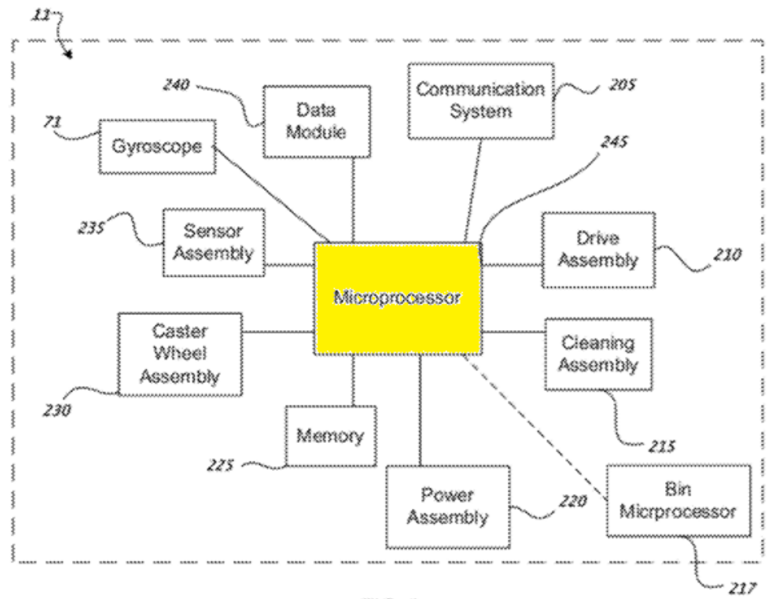


FIG. 2

Id., Fig. 2 (annotated).

Schnittman's microprocessors are "capable of executing routines and generating and sending control signals" for "controlling [the robot's] drive assembly" and other components. *Id.*, ¶¶[0118]-[0119], [0177]. In Figure 2, the routines executed by microprocessor 245 are stored in memory 225, and data module 240 is configured to "upload new software routines or values to the robot 11." *Id.*, ¶[0118]. Schnittman's microprocessor thus discloses the "controller" because it controls operation of the cleaning robot and is similar to controllers described in the '207

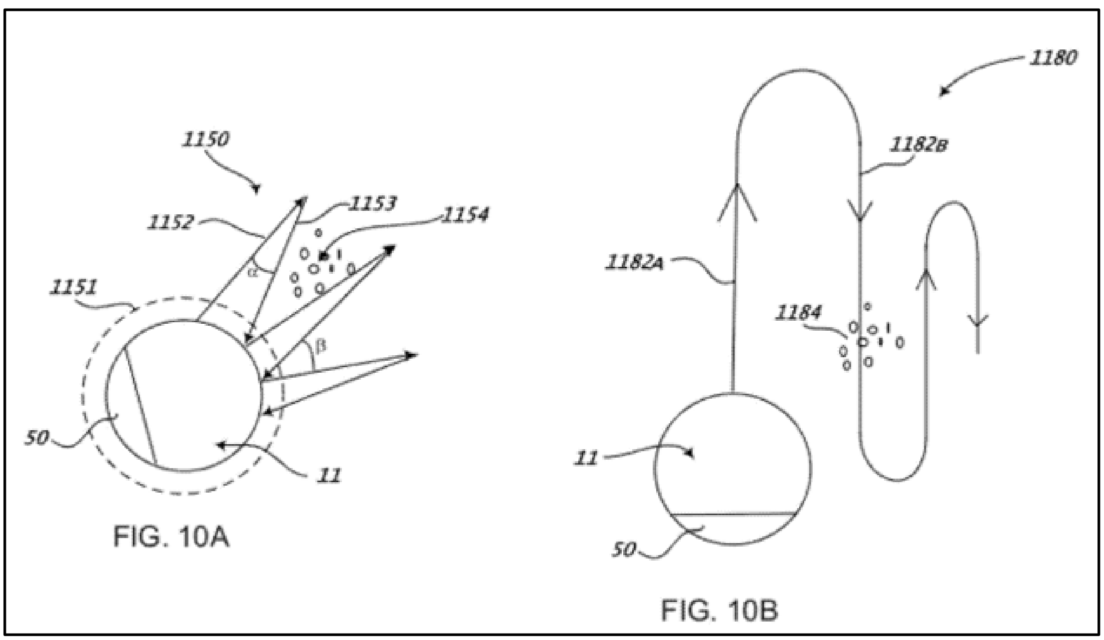
Patent. EX1010, ¶¶485-487. For instance, the ’207 Patent describes that its controller may be implemented using “one or more processing units … that execute[] sequences of instructions contained in a memory,” with the execution of such sequences “caus[ing] the processing unit to perform steps such as generating control signals.” EX1005, 4:18-28 (“The instructions may be loaded in a random access memory (RAM) for execution by the processing unit from a read only memory (ROM), a mass storage device, or some other persistent storage.”). Schnittman’s microprocessor 245 likewise executes routines stored in memory to generate control signals for controlling the robot. EX1008, ¶¶[0118]-[0119], [0177].

Schnittman further discloses that “camera 1190 can be in communication with the microprocessor 245 …. [T]he microprocessor 245 can process the signal from the camera 1190 to recognize debris on the cleaning surface and maneuver the robot 11 toward the debris. Additionally or alternatively, the microprocessor 245 can process the signal from the camera 1190 to recognize obstacles and/or debris in the vicinity of the robot 11 and maneuver the robot 11 to avoid obstacles and/or debris ….” EX1008, ¶¶[0204]-[0205].

Thus, Schnittman discloses “a controller [microprocessor 245]” “in electronic communication with the at least one camera [camera 1190].” EX1010, ¶¶485-487.

(g) Element 1f

Schnittman in view of Benzler would have rendered obvious element 1f. *Id.*, ¶¶488-492. Schnittman's microprocessor ("controller") generates commands ("control signals") to cause movement of the robot: "The drive assembly 210 is connected to the microprocessor 245" and "is operable to receive commands from the microprocessor 245." EX1008, ¶[0119]; *see also id.*, ¶[0177] ("The microprocessor [245] can move the robot 11 through one or more of the spot coverage patterns below by controlling the drive assembly 210 based at least in part on a signal received from the gyroscope 71."). The control signals generated by Schnittman's microprocessor can cause the robot to move based on detected debris and/or in different cleaning patterns (*id.*, ¶¶[0177], [0191]-[0203]):



Id., Figs. 10A, 10B (example cleaning patterns). Accordingly, Schnittman discloses the controller configured to generate control signals to cause movement of the robot's body. EX1010, ¶¶488-492.

Schnittman further discloses the generation of such control signals "in response to the captured image." Schnittman's camera "can be in communication with the microprocessor 245 such that the movement of the robot 11 over the cleaning surface can be based at least in part on the detection of debris and/or an obstacle by the camera 1190." EX1008, ¶[0204]. Further, the microprocessor "can process the signal from the camera" and control movement of the robot accordingly. *Id.*, ¶¶[0204]-[0205]. Such control signals "cause movement of the [robot's] body … to, or away from, the first object":

> [T]he microprocessor 245 can process the signal from the camera 1190 to recognize debris on the cleaning surface and ***maneuver the robot 11 toward the debris***. Additionally or alternatively, the microprocessor 245 can process the signal from the camera 1190 to recognize obstacles and/or debris in the vicinity of the robot 11 and ***maneuver the robot 11 to avoid obstacles and/or debris*** larger than a specific size threshold (e.g., a value less than about the smallest opening defined by the cleaning head).

EX1008, ¶¶[0204]-[0205].

As explained by Dr. Reinholtz, the image captured by Schnittman's camera depicts an object, such as debris, obstacles, and cleaning surfaces (*see* Section IV.A.2.e), and the microprocessor processes the image to recognize debris or obstacles in it. EX1010, ¶¶488-492. Based on the recognized objects in the image, the microprocessor generates control signals for moving the robot toward or away from the objects. *Id.*

While Schnittman does not disclose control signals for causing movement "within the swimming pool" specifically, a POSA would have understood, in view of Benzler, how to adapt Schnittman's robotic cleaners for use in this context. Section IV.D.3; EX1010, ¶¶488-492. Therefore, Schnittman discloses "a controller [microprocessor 245]" "configured to generate, in response to the captured image, at least one control signal to cause movement of the body within the swimming pool to, or away from, the first object." EX1010, ¶¶488-492.

Schnittman in view of Benzler renders obvious claim 1. *Id.*, ¶¶467-493.

5. Claim 2

(a) Preamble

To the extent limiting, claim 2's preamble would have been obvious Schnittman in view of Benzler . *Id.*, ¶494. Claim 2's preamble is broader than claim 1's because it merely recites a "pool system," imposing no requirements, as claim 1 does, that the pool system be "self-propelled" or dedicated to "cleaning debris from a submerged surface of a swimming pool." Because Schnittman in view of Benzler would have rendered obvious the narrower preamble of claim 1, they likewise would have rendered obvious the broader preamble of claim 2. Thus, Schnittman in view of Benzler renders obvious the "pool system [robotic cleaner 11]." *Id.*, ¶494.

(b) Element 2a

Schnittman in view of Benzler would have rendered obvious element 2a. *Id.*, ¶¶495-497. Schnittman describes a robotic cleaner 11 for removing debris by, for *e.g.*, using "debris agitators," from cleaning surfaces (*e.g.*, floors). Section IV.D.4.a. A POSA would have been motivated to apply Schnittman's teachings in the pool-cleaning context for cleaning submerged surfaces in view of Benzler. Section IV.D.3. Therefore, Schnittman in view of Benzler renders obvious "at least one piece of equipment [robotic cleaner 11] for a swimming pool or spa." EX1010, ¶¶495-497.

(c) Element 2b

Schnittman in view of Benzler would have rendered obvious element 2b. *Id.*, ¶¶498-500. Schnittman discloses a camera 1190 that captures images of the cleaning surface. Section IV.D.4.e. While Schnittman does not disclose that the images capture a swimming pool specifically, in a pool-cleaner implementation of Schnittman in view of Benzler, the cleaning surface would comprise a pool. Hence, camera 1190 would capture images of submerged pool surfaces. Section IV.D.3; EX1010, ¶¶498-500. Accordingly, Schnittman in view of Benzler renders obvious "one or more cameras [camera 1190] configured to capture video or images of at least a portion of a location including the swimming pool or spa." *Id.*

(d) Element 2c

Schnittman discloses element 2c. EX1010, ¶¶501-505. As explained for element 1e, Schnittman teaches a controller (microprocessor 245) in communication with one or more cameras (camera 1190). Section IV.D.4.f. Additionally, microprocessor 245 is "capable of executing routines and generating and sending control signals" for "controlling [the robot's] drive assembly" and other components, which establishes communication between microprocessor 245 and robot 11 (*i.e.*, "piece of equipment") via control signals. EX1008, ¶¶[0118]-[0119], [0177]. As explained for element 1f, microprocessor 245 processes signals receives from camera 1190 (*i.e.*, visual data), and controls robot 11 accordingly. Section IV.D.4.g. For example, microprocessor 245 can "maneuver the robot 11 towards the debris" detected by camera 1190, or it can "maneuver the robot 11 to avoid obstacles and/or debris larger than a specific size." EX1008, ¶¶[0204]-[0205].

Therefore, Schnittman discloses "a controller [microprocessor 245] in communication with the at least one piece of equipment [robotic cleaner 11] and the one or more cameras [camera 1190], the controller configured to receive visual data from the one or more cameras and determine a control action [maneuver the robot 11 toward debris, or away from obstacles/debris] for the at least one piece of equipment based on the received visual data." EX1010, ¶¶501-505.

Schnittman in view of Benzler renders obvious claim 2. *Id.*, ¶¶494-505.

6. Claim 3

Schnittman in view of Benzler would have rendered obvious claim 3. *Id.*, ¶¶506-510. As explained for element 2a, Schnittman's robotic cleaner 11 in view of Benzler teaches "at least one piece of equipment. Section IV.D.5.b. Robotic cleaner 11 removes debris from cleaning surfaces, so it comprises "a cleaning device." *Id*. As explained for element 1b, robot 11 includes "one or more propulsion mechanisms," *e.g.*, right and left differentially driven wheels 45, right and left wheel motors, and wheel encoders. Section IV.D.4.c.

Additionally, Schnittman's "drive system is coupled to the [robot's] housing and configured to maneuver the robot across a cleaning surface." EX1008, ¶[0005]. In a pool-cleaner implementation of Schnittman in view of Benzler, the cleaning surface would comprise a pool. Thus, robot 11 would travel along underwater pool surfaces.

Thus, Schnittman in view of Benzler renders obvious claim 3: "the at least one piece of equipment [robotic cleaner 11] comprises a cleaning device with one or more propulsion mechanisms [drive system with wheels 45], the cleaning device configured to travel adjacent to submerged or water-containing surfaces of the swimming pool [pool surfaces] or spa and to perform a cleaning operation [removing debris]." EX1010, ¶¶506-510.

7. Claim 4

Schnittman in view of Benzler would have rendered obvious claim 4. *Id.*, ¶¶511-513. A POSA would have recognized the advantages of implementing the Schnittman/Benzler pool cleaning robot 11 with Benzler's external camera 8 for similar reasons as explained in Section IV.C.4. For example, the combination would yield an advantageous arrangement for more accurate monitoring and control of the robot 11 due to the external camera's ability to provide an overhead, unobstructed view of the entire pool along with the robot's exact location, orientation, and trajectory. *Id.*

A POSA would have had a reasonable expectation of success in making this combination using routine, well-known techniques for connecting a robot to an external device. *Id.*, ¶¶511-513. In fact, Schnittman itself describes well-known wireless communication methods between the robot's bin 50 and a remote indicator 1202, such as "IEEE 801.11/WiFi, BlueTooth, Zigbee, wireless USB, a frequency modulated signal, an amplitude modulated signal, or the like." EX1008, [0213]. A POSA could have easily integrated external camera 8 with robot 11 using known communication methods.

Thus, Schnittman in view of Benzler renders obvious claim 4: "the one or more cameras [Benzler's camera 8] are mounted external to the swimming pool or spa." EX1010, ¶¶511-513.

8. Claim 5

Schnittman in view of Benzler would have rendered obvious claim 5. *Id.*, ¶514. Schnittman's "camera 1190 [is] disposed toward the forward portion of the robot 11":

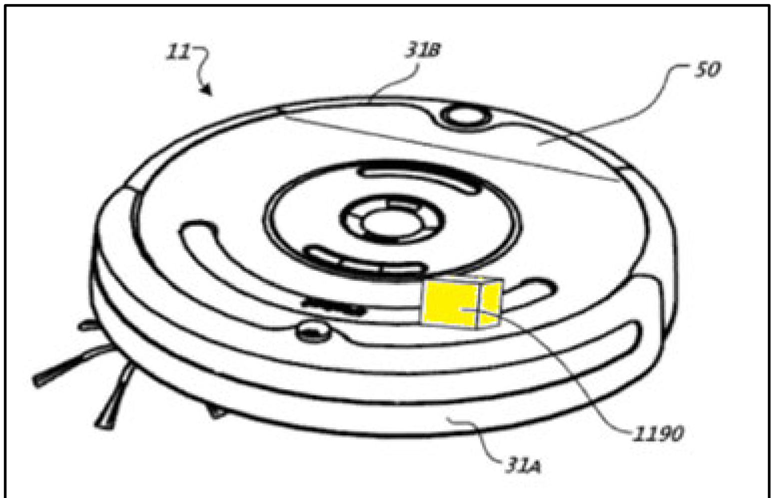


FIG. 11

EX1008, Fig. 11, ¶[0204]. Thus, Schnittman in view of Benzler renders obvious claim 5: "the one or more cameras [camera 1190] are mounted on the at least one piece of equipment [robotic cleaner 11]." EX1010, ¶514.

9. Claim 6

Schnittman in view of Benzler would have rendered obvious claim 6. *Id.*, ¶¶515-516. In a pool-cleaning embodiment of Schnittman in view of Benzler, the robotic cleaner 11 would operate underwater, so its onboard camera 1190 would be submerged. Section IV.D.3.

Thus, Schnittman in view of Benzler renders obvious claim 6: "the one or more cameras [camera 1190] are submergible or submerged within the swimming pool or spa." EX1010, ¶¶515-516.

10. Claim 7

Schnittman in view of Benzler would have rendered obvious claim 7. *Id.*, ¶¶517-519. As explained for element 2c, Schnittman's microprocessor 245 "can process the signal from the camera 1190 [*i.e.*, "visual data"] to recognize obstacles and/or debris in the vicinity of the robot 11," and maneuver the robot accordingly, for *e.g.*, drive toward the debris, or drive to avoid obstacles or debris larger than a threshold. Section IV.D.5.d.

Thus, Schnittman in view of Benlzer renders obvious "the controller is configured to detect a characteristic [presence of debris/obstacle] of the location based on the visual data and control the piece of equipment [maneuver the robotic cleaner 11 toward debris and to avoid obstacles or larger debris] based on the detected characteristic." EX1010, ¶¶517-519.

11. Claim 11

Schnittman in view of Benzler would have rendered obvious claim 11. *Id.*, ¶¶520-521. Schnittman discloses an onboard controller (microprocessor 245) in communication with the camera. Section IV.D.4.f-g. A POSA would have recognized the advantages of implementing the Schnittman/Benzler robot 11 with Benzler's external camera 8 (Section IV.D.7), making "the controller [onboard microprocessor 245] [] remote from the camera [Benzler's camera 8]" in the

Schnittman/Benzler robot 11.

Thus, Schnittman in view of Benzler renders obvious claim 11. EX1010, ¶¶520-521.

12. Claim 12

(a) Preamble

To the extent limiting, claim 12's preamble would have been obvious over Schnittman in view of Benzler. *Id.*, ¶¶522-524. A POSA would have been motivated to implement Schnittman's robotic cleaner 11, comprising an onboard camera 1190, as an underwater pool cleaner in view of Benzler. Section IV.D.3. Schnittman's microprocessor 245 processes signals received from camera 1190, *i.e.*, images, to recognize obstacles and/or debris, and maneuvers the robot accordingly. Section IV.D.5.d. This continuous processing of images to recognize debris/obstacles comprises a "method for monitoring a pool system."

Thus, Schnittman in view of Benzler renders obvious claim 12's preamble. EX1010, ¶¶522-524.

(b) Element 12a

Schnittman in view of Benzler would have rendered obvious element 12a. *Id.*, ¶¶525-526. Schnittman's microprocessor 245 receives signals from camera 1190, *i.e.*, images of the cleaning surface. Section IV.D.5.d. In a pool-cleaner implementation of Schnittman in view of Benzler, the cleaning surface would comprise a pool.

Section IV.D.3. Hence, camera 1190 would capture images of submerged pool surfaces.

Thus, Schnittman in view of Benzler renders obvious "receiving images of at least a portion of a location including a swimming pool [images of pool surfaces] or spa from one or more cameras [camera 1190]." EX1010, ¶¶525-526.

(c) Element 12b

Schnittman discloses element 12b. *Id.*, ¶¶527-528. Schnittman's robot 11 processes signals from camera 1190, *i.e.*, images of the cleaning surface, to "recognize obstacle and/or debris." EX1008 ¶¶[0204]-[0205]. The specific region of the cleaning surface captured in the images and assessed for obstacles/debris corresponds to the "target area." *See* Section IV.A.8.c.

Thus, Schnittman discloses "determining a target area [pictured region of the cleaning surface assessed for obstacles/debris] and detecting a characteristic [presence of obstacles/debris] of the target area based on the images." EX1010, ¶¶527-528.

(d) Element 12c

Schnittman discloses element 12c. *Id.*, ¶¶529-530. As explained for element 2c, based on the recognized obstacles/debris on the cleaning surface, microprocessor 245 maneuvers robot 11 toward debris, or away from obstacles or larger debris. Section IV.D.5.d.

Thus, Schnittman discloses "generating a control response [maneuver robot 11 toward debris, or away from obstacles/debris] based on the detected characteristic [presence of obstacles/debris] of the target area [pictured region of the cleaning surface assessed for obstacles/debris].” EX1010, ¶¶529-530.

Thus, Schnittman in view of Benzler renders obvious claim 12. *Id.*, ¶¶522-530.

13. Claim 13

Schnittman in view of Benzler would have rendered obvious claim 13. *Id.*, ¶¶531-532. In a pool-cleaner implementation of Schnittman in view of Benzler, the target area would comprise a portion of a pool surface. Section IV.D.3. As explained for element 12b, the target area is assessed for presence of debris. Section IV.D.12.c.

Thus, Schnittman in view of Benzler renders obvious claim 13: “the target area [pictured region of a pool surface assessed for obstacles/debris] comprises a portion of a surface of the swimming pool or spa, and wherein the characteristic [presence of debris] comprises a cleanliness characteristic of the portion of the surface of the swimming pool or spa.” EX1010, ¶¶531-532.

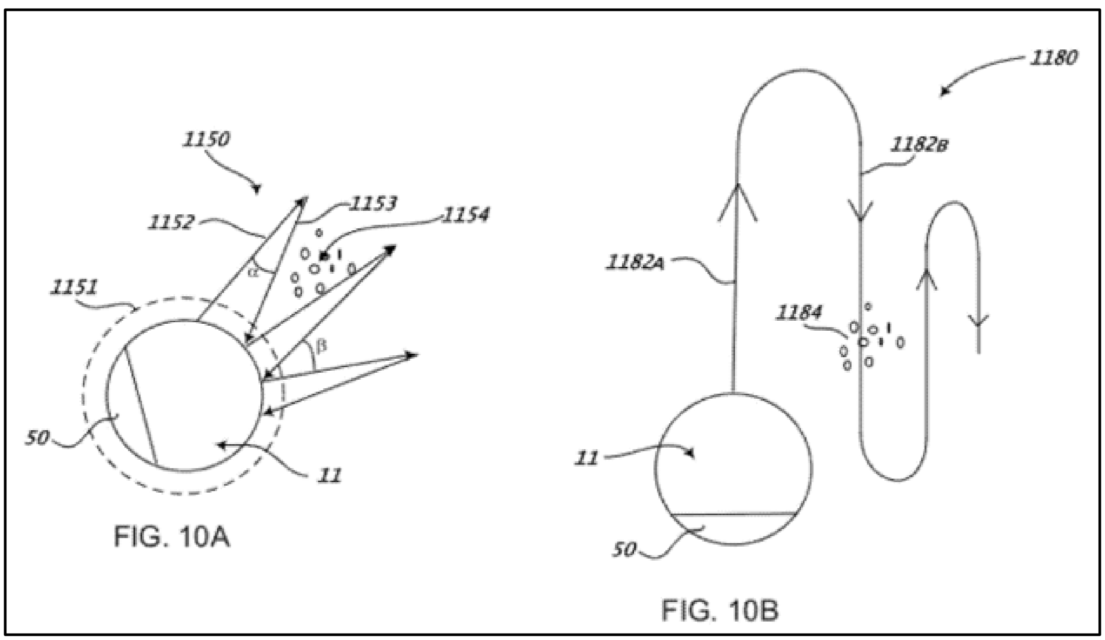
14. Claim 14

Schnittman in view of Benzler would have rendered obvious claim 14. *Id.*, ¶533. As explained for element 12c, based on the recognized debris on the cleaning surface, microprocessor 245 maneuvers robot 11 toward debris, or away from debris larger than a threshold. Section IV.D.12.d.

Thus, Schnittman in view of Benzler renders obvious claim 14: “generating the control response comprises controlling an operation of a piece of equipment of the swimming pool [maneuver robot 11 toward debris, or away from large debris] or spa." EX1010, ¶533.

15. Claim 19

Schnittman in view of Benzler would have rendered obvious claim 19. *Id.*, ¶¶534-536. As explained for claim 3, implementation of Schnittman's robotic cleaner 11 in view of Benzler renders obvious a "cleaning device" "configured to travel adjacent to submerged or water-containing surfaces of the swimming pool or spa and to perform a cleaning operation." Section IV.D.6. Further, microprocessor 245 causes robot 11 to move based on detected debris and/or in different cleaning patterns (*id.*, ¶¶[0177], [0191]-[0203]):



Id., Figs. 10A, 10B.

Accordingly, Schnittman in view of Benzler renders obvious claim 19: "generating the control response comprises controlling operation of a cleaning device [robotic cleaner 11] configured to travel adjacent to submerged or water-containing surfaces of the swimming pool [pool surfaces] or spa and to perform a cleaning operation, wherein controlling operation of the cleaning device comprises one or more of controlling a path or route of the cleaning device [maneuvering robot 11 based on detected debris or cleaning patterns], an aggressiveness of cleaning chemicals deployed, an aggressiveness of mechanical cleaning, or a speed of the cleaning device." EX1010, ¶¶534-536.

E. Ground 2b: Claim 8 Would Have Been Obvious Over Schnittman In View Of Benzler, In Further View Of Fu

Schnittman in view of Benzler further in view of Fu would have rendered obvious claim 8. *Id.*, ¶¶537-541. Schnittman in view of Benzler renders obvious the limitations added in claim 8 (*id.*, ¶538), but should the Board disagree, this limitation is nonetheless obvious over Schnittman and Benzler, in further view of Fu. A POSA would have been motivated to combine Fu with the Schnittman/Benzler pool-cleaning robot because Fu is also directed to an autonomous pool cleaner that uses images to guide its operations. Fu additionally compares images of the pool floor with a "pool cleanliness image threshold" to determine the "level of cleanliness" of the pictured area, and guides its robot accordingly. EX1007, ¶[0026]; Section IV.A.7. A POSA would have understood that implementing Fu's threshold-based cleanliness assessment in the Schnittman/Benzler combination would yield a pool cleaner capable of focusing cleaning efforts on dirty areas (*i.e.*, sub-threshold areas), while avoiding unnecessary cleaning of already-clean areas (*i.e.*, above-threshold areas), thus improving cleaning efficiency. EX1010, ¶¶537-541. As explained by Dr. Reinholtz, threshold-based cleaning was conventional at the time, and implementing Fu's threshold-based assessment in the Schnittman/Benzler combination would have required no more than routine software configurations to microprocessor 245, which already processes images from a camera to recognize debris and maneuver the robot accordingly. *See* Section IV.D.4.g. Thus, this combination would have been well within a POSA's skill. *Id*.

Thus, Schnittman in view of Benzler further in view of Fu renders obvious claim 8: "the characteristic comprises a cleanliness of a surface of the swimming pool [presence of debris], and wherein the controller is configured to control the piece of equipment based on the detected cleanliness being outside of a threshold [pool cleanliness image threshold]." *Id*.

V. CONCLUSION

Petitioner respectfully requests IPR of claims 1-8, 11-14, and 19 of the '207 Patent.

VI. MANDATORY NOTICES PURSUANT TO 37 C.F.R. § 42.8(a)(1)

Pursuant to 37 C.F.R. § 42.8(a)(1), the mandatory notices identified in 37 C.F.R. § 42.8(b) are provided below as part of this petition.

A. 37 C.F.R. § 42.8(b)(1): Real Parties-In-Interest

The real parties-in-interest are Wybotics Inc., Wybotics, Co. Ltd., and Tianjin Zhuhui Commercial, Tianjin Wangyuan Industry and Trade, and Ms. Fu Guilan.

B. 37 C.F.R. § 42.8(b)(2): Related Matters

Pursuant to 37 C.F.R. § 42.8(b)(2), Petitioner is aware of the following patent infringement lawsuit that involves the '207 Patent:

- *Zodiac Pool Systems LLC v. Wybotics, Co. Ltd. f/k/a Tianjin Wangyuan Environmental Protection and Technology Co.,* 2:25-cv-582-JRG-RSP (E. D. Tex. Filed May 23, 2025).
- *Wybotics Inc. v. Zodiac Pool Systems LLC*, 2:25-cv-08526 CAS (AGRx) (C.D. Cal. Filed Sept. 9, 2025).

Petitioner is also concurrently filing Petitions for *Inter Partes* Review of U.S. Patent Nos. 11,003,191 and 11,262,766, which are related to the '207 Patent challenged herein.

C. 37 C.F.R. § 42.8(b)(3), (4): Lead And Back-Up Counsel And Service Information

Petitioner provides the following designation of counsel:

Lead Counsel	Back-up Counsel
Matthew W. Johnson (Reg. No. 59,108) mwjohnson@jonesday.com JONES DAY 500 Grant Street, Suite 4500 Pittsburgh, PA 15219 T: 412-394-9524	Joshua R. Nightingale (Reg. No. 67,865) jrnightingale@jonesday.com JONES DAY 500 Grant Street, Suite 4500 Pittsburgh, PA 15219 T: 412-394-7950 Adam J. Cook (Reg. No. 83,160) acook@jonesday.com JONES DAY 500 Grant Street, Suite 4500 Pittsburgh, PA 15219 T: 412-394-7230

Pursuant to 37 C.F.R. § 42.10(b), a Power of Attorney for Petitioner accompanies this petition. Please address all correspondence to lead and back-up counsel at the addresses above. Petitioner also consents to electronic service by email at the email addresses listed above.

Dated: November 25, 2025

Respectfully submitted,

/Joshua R. Nightingale/

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that a copy of the foregoing petition for *Inter Partes* Review of U.S. Patent No. 11,880,207, including all exhibits, was served on November 25, 2025 via Express Mail delivery directed to the attorney of record for the patent at the following address:

John Pratt
Kilpatrick Townsend & Stockton LLP - East Coast
Mailstop: IP Docketing - 22
1100 Peachtree Street
Suite 2800
Atlanta, GA 30309

In addition, a courtesy copy of the foregoing petition for *Inter Partes* Review of U.S. Patent No. 11,880,207, including all exhibits, was served on litigation counsel for patent owner Zodiac Pool Systems LLC at the following address:

Steven D. Moore
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Date: November 25, 2025

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CERTIFICATE OF WORD COUNT UNDER 37 C.F.R. § 42.24(a)

I, the undersigned, do hereby certify that the attached petition contains 13,970 words, as measured by the Word Count function of Microsoft Word. This is less than the limit of 14,000 words as specified by 37 C.F.R. § 42.24(a)(1)(i).

Date: November 25, 2025

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