

**Identification of Material Omitted from Zodiac’s Comparison
of Wybotics Petition and Reinholtz Declaration (EX2011)**

Petition for IPR of ’207 Patent	Expert Declaration of Dr. Charles F. Reinholtz
<p>Section II.A.</p> <p>A. Summary Of The ’207 Patent</p> <p>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. <i>Id.</i>, claims 1-20.</p> <p>The ’207 Patent generally relates to “a robotic pool cleaner” comprising a vehicle 30 with propulsion mechanisms, a filter, a camera, and a controller. <i>Id.</i>, 2:67-3:3, 3:7-21, 3:31-43. Vehicle 30 uses propulsion mechanisms to move along submerged pool surfaces. <i>Id.</i>, 3:33-45. Using its filter, the pool cleaner draws water from the pool and retains any debris present in the water. <i>Id.</i>, 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.” <i>Id.</i>, 3:46-55, 4:46-48.</p>	<p>Section VII.C.</p> <p>C. ’207 Patent</p> <p>72. 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, three of which 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. <i>Id.</i>, claims 1-20. --- <u>Claim 1 recites a self-propelled pool cleaning system with (1) a vehicle body, (2) means for moving the body within the pool, (3) a filter for retaining debris collected from the pool, (4) at least one camera for capturing an image of a portion of the pool, and (5) a controller for processing the image and generating corresponding control signals for moving the body. <i>Id.</i>, claim 1. Independent claims 2 and 12 are broader than claim 1’s pool cleaning system, reciting a pool system and a method for monitoring a pool system respectively. <i>Id.</i>, claims 2-12. All three independent claims recite the use of an image to control the operation of a pool equipment, such as a pool cleaner, but do so at different levels of abstraction.</u></p> <p>73. The ’207 Patent generally relates to “a robotic pool cleaner” that comprises a vehicle 30 with one or more propulsion mechanisms, a filter, a camera, and a controller. <i>Id.</i>, 2:67-3:3, 3:4-19, 3:31-43. The vehicle 30 uses the propulsion mechanisms, such as “wheels, rollers, tracks, or other surface</p>

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	<p>contacting members powered by a motor,” to move along the submerged surfaces of the pool. <i>Id.</i>, 3:31-43. Using its filter, the pool cleaner draws water from the pool and retains any debris present in the water. <i>Id.</i>, 3:8-14. One or more cameras 32 “capture images of submerged surfaces ... of [the] pool,” and the images are used by the controller 42 “to generate control signals for steering vehicle 30 based upon signals received from cameras 32.” <i>Id.</i>, 3:51-53, 4:44-46.</p> <p><u>74. The '207 Patent was filed on Jan. 10, 2022 as U.S. Patent Application No. 17/572,388. <i>Id.</i>, (21), (22). The '207 Patent is the seventh in a series of continuation applications, and claims priority back to U.S. Patent Application No. 13/545,918 (now U.S. Patent No. 9,388,595), filed July 10, 2012. <i>Id.</i>, (63).</u></p> <p><u>75. I have reviewed the file history of the '207 Patent, and I understand that originally filed claims 1-19 were copies of the claims filed in a parent application in the series, U.S. Patent Application No. 16/416,840 (the “'840 application”). Compare EX1006 (file history of the '207 Patent), 18-20 with EX1009 (file history of the '840 application), 17-19. Prior to examination, the applicant filed a preliminary amendment, canceling claims 1-19 and adding a new claim 20. EX1006, 41. In response to the sole Office Action, the applicant also added new claims 21-39. <i>Id.</i>, 99-105. I also understand that the Examiner identified “controller (i) in electronic communication with the at least one camera and (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” as allegedly being inventive over the prior art. <i>Id.</i>, 146-150 (also identifying the “controller” limitation of claims 21 as allegedly inventive over prior art).</u></p>

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	<p><u>The Notice of Allowance also identified claim 31's "method for monitoring a pool system, the method comprising: receiving images of at least a portion of a location including the swimming pool or spa from one or more cameras; determining a target area and detecting a characteristic of the target area based on the images; and generating a control response based on the detected characteristic of the target area" as allegedly being inventive over prior art. <i>Id.</i> However, as I explain below, the purportedly inventive features asserted by the Examiner were very well known in the art. See <i>infra</i> Sections XIII.A.1.f-g., XIII.A.2.d., XIII.A.7.a-d.</u></p>
<p>Section IV.A.1.</p> <p>1. Summary Of Fu</p> <p>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. <i>Id.</i>, (10), (45). Fu is therefore prior art under at least pre-AIA 35 U.S.C. §§ 102(a) and (b).</p> <p>Fu describes a robot designed "for the underwater cleaning of swimming pool floors and walls." <i>Id.</i>, Abstract.</p>	<p>Section X.A.</p> <p>A. Fu</p> <p>90. Fu, entitled "Underwater Cleaning Robot," was filed on July 31, 2007 as Application No. 200710119800.5 in China. EX1007, (19), (21), (22). Fu issued as Grant Publication No. CN 101139007 B, and published on June 15, 2011. <i>Id.</i>, (10), (45). Fu is therefore prior art under at least pre-AIA 35 U.S.C. §§ 102(a) and (b).</p> <p>91. Fu describes a robot that is designed "for the underwater cleaning of swimming pool floors and walls." <i>Id.</i>, Abstract. An example of Fu's underwater cleaning robot is depicted in Figure 1:</p>

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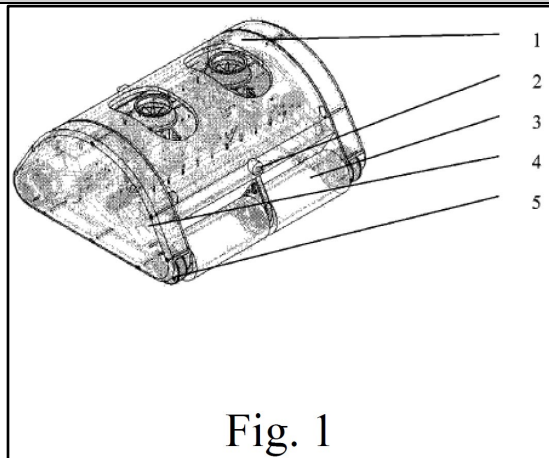


Fig. 1

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

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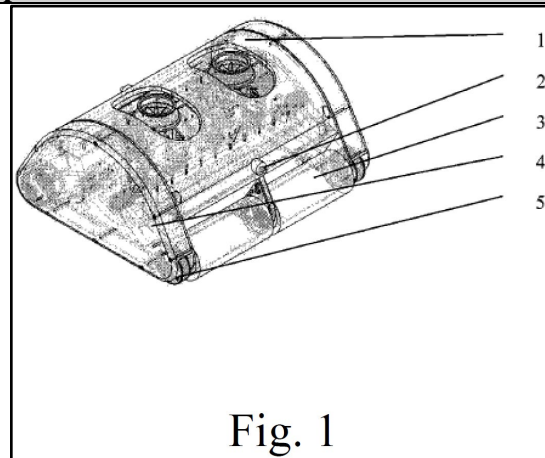


Fig. 1

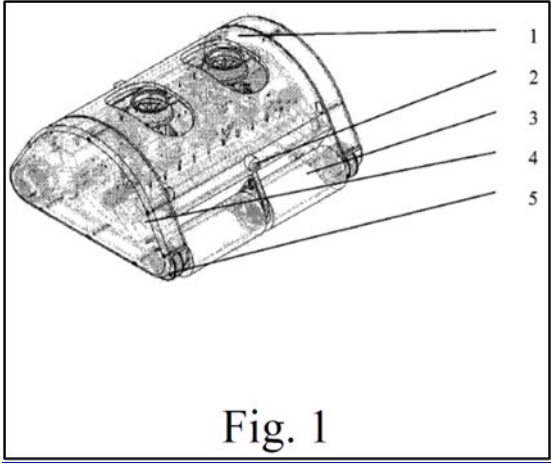
Id., Fig. 1.

92. Fu describes two operational modes for cleaning: manual and autonomous. *Id.*, ¶[0025]. In the manual mode, a control keypad is used to manually send control signals to the robot. *Id.* In the autonomous mode, the control system autonomously plans and controls the robot's movement and cleaning operations based on data received from sensors and cameras. *Id.*

93. The robot "comprises a drainage mechanism, a cleaning and mobility platform, and a control system." *Id.*, ¶[0024]. These three units work in coordination to "perform cleaning tasks autonomously or via remote control underwater on horizontal, vertical, and inclined surfaces." *Id.*, Abstract.

94. The drainage mechanism performs a cleaning function by drawing pool water into the robot, filtering it to remove any debris, and discharging the filtered water back into the pool. *Id.*,

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<p>cameras 2, that are installed on the robot's housing. <i>Id.</i></p>	<p>¶¶[0024]-[0026]. <u>— An example schematic of the drainage mechanism is illustrated in Figures 3 and 5:</u></p> <div data-bbox="1121 337 1835 623" data-label="Image"> </div> <p><u><i>Id.</i>, Fig. 3 (water discharger), Fig. 5 (side cross-sectional view of the robot).</u></p> <p>95. <u>The drainage mechanism “comprises a water discharger [Figure 3], a water flow channel 24 ..., a water flow filter screen 23, and a water inlet [26] with an anti-backflow device 25.” <i>Id.</i>, ¶[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.” <i>Id.</i>, ¶[0026]. This negative pressure “draws pool water from the bottom of the robot into the water flow channel 24 through the water inlet [26].” <i>Id.</i> Once in the flow channel 24, the “water passes through the water flow filter screen 23, which filters out debris, and the clean water is then discharged.” <i>Id.</i></u></p> <p>96. <u>The drainage mechanism “uses the cleaning and mobility platform as a carrier and coordinates its movement with the cleaning and mobility platform.” <i>Id.</i>, ¶[0024]. The cleaning and mobility platform, illustrated in Figure 1, comprises “a robot</u></p>

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	<p data-bbox="1060 235 1837 305"><u>housing body 1, cleaning driving wheels 3, synchronous belt gears 5, and a driving synchronous belt 4.” <i>Id.</i></u></p> <div data-bbox="1205 341 1751 802">  <p data-bbox="1423 743 1528 792">Fig. 1</p> </div> <p data-bbox="1060 846 1194 878"><u><i>Id.</i>, Fig. 1.</u></p> <p data-bbox="1060 922 1885 1284">97. <u>The “cleaning driving wheels 3 are controlled by their respective motor drivers ... By using different combinations of wheel speeds, the robot can perform tasks such as moving forward, backward, turning, and brush-cleaning.” <i>Id.</i>, ¶[0026]. The synchronous belt gears 5 and the driving synchronous belt 4 help drive the cleaning driving wheels 3 via a driving DC motor 7. <i>Id.</i>, ¶[0024].</u> --- In this way, the cleaning and mobility platform provides structural support and propulsion to the robot, while also performing “brush-cleaning” of the pool surface via the cleaning driving wheels 3. <i>Id.</i>, ¶[0024], [0026].</p> <p data-bbox="1060 1323 1843 1425">98. The control system autonomously controls the robot’s operation by generating control signals that drive the robot’s movement and cleaning. <i>Id.</i> --- <u>As shown in Figure 6, the</u></p>

control system comprises “a central processor, monitoring cameras, an image acquisition card, inertial navigation components, a remote control signal interface, motor drivers, a control system box 8, cleaning driving wheel DC motors 7, a water outlet driving servo 16, a drainage propeller high-speed DC motor 14, a driving and control sealed housing, and a control and power management system.” *Id.*, ¶[0024].

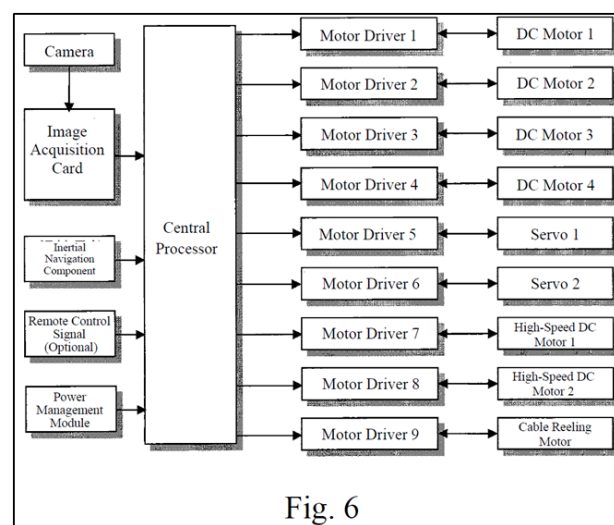


Fig. 6

Id., Fig. 6.

99. Fu’s monitoring cameras 2, installed on the main robot housing body 19, are in communication with the central processor via the image acquisition card. *Id.*, ¶[0024], Fig. 6. “The monitoring cameras 2 and the image acquisition card constitute the environmental perception layer,” which also “constitutes the input part of the control system.” *Id.*, ¶[0024]. The central processor receives an image from the environmental

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	<p><u>perception layer, i.e., monitoring cameras 2, and processes it to determine “the level of cleanliness” of the pool. <i>Id.</i>, ¶[0026]. Based on this determination, “control signals are generated by the central processor, which autonomously plans paths and actions ... to ... complete the underwater cleaning task.” <i>Id.</i>, ¶[0025]. The central processor sends these control signals to “the robot’s execution layer,” also known as the “output part of the control system,” which comprises “the motor drivers and the cleaning driving wheel DC motors 7.” <i>Id.</i>, ¶[0024]-[0025]. Based on the control signals, the respective motor drivers and the cleaning driving wheel DC motors 7 drive the cleaning driving wheels 3. <i>Id.</i>, ¶[0026]. For example, “the speed of each wheel 3 can be adjusted,” “cleaning actions of varying intensity can be achieved,” and “the robot can perform tasks such as moving forward, backward, turning, and brush-cleaning.” <i>Id.</i></u></p> <p><u>100. In this way, Fu’s drainage mechanism, cleaning and mobility platform, and control system work in concert to control the underwater cleaning robot’s movement and cleaning operations based on an image captured by the monitoring cameras 2.</u></p>
<p>Section IV.A.2.</p> <p>Claim 1</p> <p>(a) Preamble: “A self-propelled pool cleaning system for cleaning debris from a submerged surface of a swimming pool, comprising:”</p> <p>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</p>	<p>Section XIII.A.1</p> <p>Claim 1</p> <p>a. Preamble: “A self-propelled pool cleaning system for cleaning debris from a submerged surface of a swimming pool, comprising:”</p> <p>359. To the extent limiting, the preamble of claim 1 is disclosed by Fu. Fu discloses “an underwater cleaning robot” designed “for the underwater cleaning of swimming pool floors</p>

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floors and walls.” EX1007, Abstract.

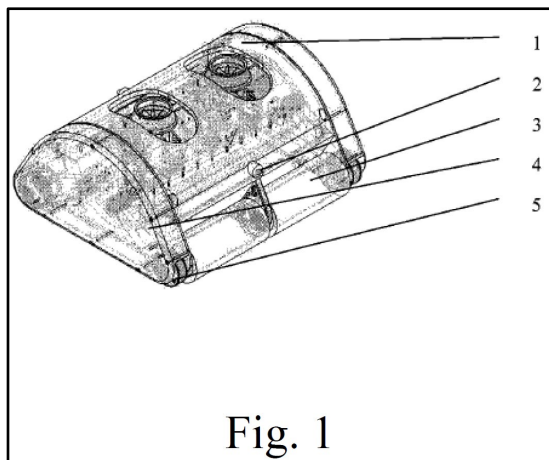


Fig. 1

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

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and walls.” EX1007, Abstract. An example of Fu’s underwater cleaning robot is depicted in Figure 1:

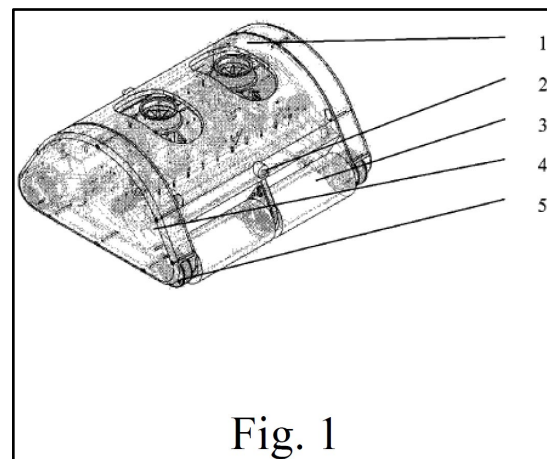


Fig. 1

Id., Fig. 1.

360. Fu’s robot includes, among other components, “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 underwater cleaning robot is “for cleaning debris from a submerged surface of a swimming pool.”

361. Fu further discloses that its robot is self-propelled. The robot’s cleaning and mobility platform comprises “four

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<p>processor, which autonomously plans paths and actions ... to drive the robot's execution layer and complete the underwater cleaning task." <i>Id.</i>, ¶[0025]. The execution layer comprises motor drivers and cleaning driving wheel DC motors 7, which drive cleaning driving wheels 3. <i>Id.</i>, ¶[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." <i>Id.</i>, ¶¶[0007], [0008], [0024], [0025].</p> <p>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."</p>	<p>independent cleaning driving wheels 3" that "are controlled by their respective motor drivers, allowing for independent movement." <i>Id.</i>, ¶[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." <i>Id.</i>, ¶[0025]. The execution layer comprises the motor drivers and the cleaning driving wheel DC motors 7, which drive the cleaning driving wheels 3. <i>Id.</i>, ¶[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." <i>Id.</i>, ¶¶[0007], [0008], [0024], [0025].</p> <p>362. As detailed below for elements 1a-1f, Fu's underwater cleaning robot discloses all the features recited in claim 1 ("vehicle body," "means for moving the vehicle body," "filter," "at least one camera," and "controller"), and thus discloses the "pool cleaning system" recited in the preamble.</p> <p><u>363. For at least these reasons, Fu discloses the claimed "self-propelled pool cleaning system [underwater cleaning robot] for cleaning debris from a submerged surface of a swimming pool."</u></p>
<p>Section IV.A.3.</p> <p>(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."</p>	<p>Section XIII.A.2.</p> <p>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."</p>

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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.

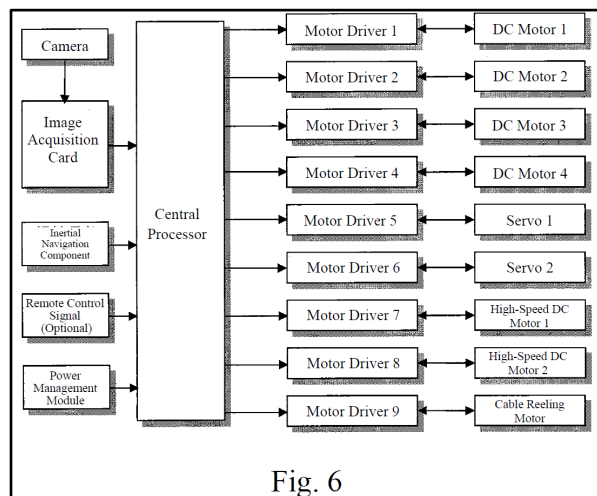


Fig. 6

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

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396. Fu discloses element 2c of claim 2. As explained above with respect to element 1e, Fu’s control system, comprising the central processor and motor drivers, teaches the claimed “controller.” EX1007, ¶[0024], Fig. 6.

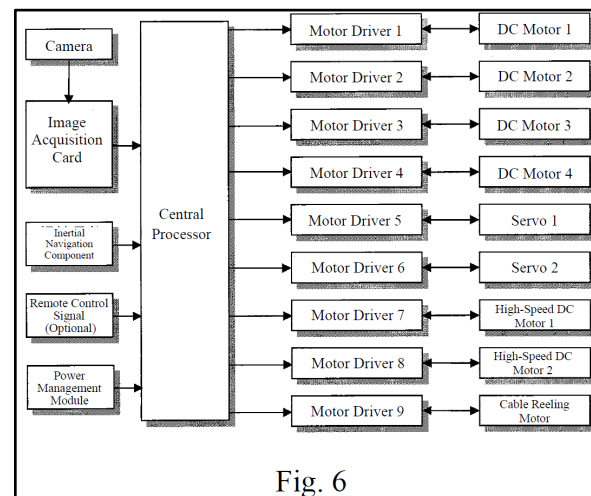


Fig. 6

Id., Fig. 6.

397. Fu further teaches that its control system is in communication with both the underwater cleaning robot as well as the monitoring cameras 2. Fu explains that the control system comprises “a central processor, monitoring cameras, an image acquisition card, ... motor drivers, a control system box 8, [and] cleaning driving wheel DC motors 7.” *Id.*, ¶[0024]. Figure 6 shows that “the monitoring cameras (2) are connected to the central processor via the image acquisition card.” EX1007, Fig. 6, claim 1. The image acquisition card serves as an electronic interface that transmits visual data, such as captured images, from the monitoring cameras 2 to the central processor of the

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<p>movements and adjusts the working state of the four cleaning driving wheels 3.” Section IV.A.2.g; EX1007, ¶[0026].</p> <p>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.”</p> <p>Fu anticipates claim 2. <i>Id.</i>, ¶¶389-403.</p>	<p><u>control system for processing, such that the controller is in communication with the one or more cameras as claimed. <i>Id.</i></u></p> <p>398. Fu also confirms that the controller is in communication with the underwater cleaning robot. Specifically, “[t]he underwater cleaning robot controls its actions according to control commands issued by the central processor,” which establishes communication between Fu’s control system and the underwater cleaning robot via control commands. <i>Id.</i>, ¶¶[0010], [0026].</p> <p><u>399. Fu further explains how the control commands are based on the visual data captured by the cameras. Fu states that “[t]he monitoring cameras 2 and the image acquisition card constitute the environmental perception layer of the control system.” EX1007, ¶[0024]. “[I]nformation from the environmental perception layer,” <i>i.e.</i>, visual data captured by the monitoring cameras 2, is expressly identified as the basis upon which “control signals are generated by the central processor ... to drive the robot[]” in the autonomous mode. <i>Id.</i>, ¶[0025].</u></p> <p><u>400. Fu further describes its control architecture in which the image acquisition card comprises the control system’s input, and the motor drivers that drive the cleaning driving wheels 3 comprise the output. <i>Id.</i>, ¶[0007]. As shown in Figure 6, the image acquisition card transmits the visual data captured by the cameras 2 to the central processor. <i>Id.</i>, Fig. 6, claim 1. Based on the visual data, “control signals are generated by the central processor, which autonomously plans paths and actions ... to drive the robot’s execution layer [<i>i.e.</i>, the motor drivers] and complete the underwater cleaning task.” <i>Id.</i>, ¶[0025]. In other words, the central processor receives the visual data from the</u></p>

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	<p><u>cameras 2 and generates control signals based on the visual data to instruct the motor drivers on how to move the robot.</u></p> <p><u>401. Fu describes in detail how its central processor uses the visual data to generate control signals for moving the robot:</u></p> <p style="padding-left: 40px;"><u>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.</u></p> <p><u>EX1007, ¶[0026].</u></p> <p><u>402. In sum, Fu describes a control system that receives visual data from the monitoring cameras 2, and uses that visual data to assess the “level of cleanliness” of the pictured region of the pool as compared against a “pool cleanliness image threshold.” <i>Id.</i> Based on that assessment, “control signals are generated by the central processor, which autonomously plans” the robot’s</u></p>

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	<p><u>“cleaning movements and adjusts the working state of the four cleaning driving wheels 3” to “perform tasks such as moving forward, backward, [and] turning.”</u> <i>Id.</i> 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.”</p> <p>403. Fu anticipates claim 2.</p>
<p>Section IV.A.4.</p> <p>4. Claim 3</p> <p>Fu discloses claim 3. <i>Id.</i>, ¶¶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 <i>e.g.</i>, 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,” <i>e.g.</i>, driving wheels 3 powered by cleaning driving wheel DC motors 7. Section IV.A.2.c.</p> <p>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.” <i>Id.</i>, ¶[0001], Abstract. The robot “can adhere to</p>	<p>Section XIII.A.3.</p> <p>3. Dependent Claim 3: “The pool system of claim 2, wherein the at least one piece of equipment comprises a cleaning device with one or more propulsion mechanisms, the cleaning device configured to travel adjacent to submerged or water-containing surfaces of the swimming pool or spa and to perform a cleaning operation.”</p> <p>404. Fu discloses the limitations added in dependent claim 3. As explained above with respect to element 2a, Fu’s underwater cleaning robot teaches the claimed “at least one piece of equipment.” Fu describes the robot as specifically designed for cleaning a swimming pool by performing operations such as filtering the pool water and brush-cleaning the pool surfaces. EX1007, Abstract, ¶¶[0010], [0024]-[0026]. Thus, the robot constitutes “a cleaning device.”</p>

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<p>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.” <i>Id.</i>, ¶¶[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. <i>Id.</i>, 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.</p> <p>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.</p>	<p>405. As explained above for element 1b, Fu discloses “means for moving the vehicle body within the swimming pool,” and also discloses that the robot includes “one or more propulsion mechanisms,” <i>e.g.</i>, driving wheels 3 powered by cleaning driving wheel DC motors 7.</p> <p><u>406. --- Fu also teaches that its robot is configured to travel adjacent to submerged or water containing surfaces of the swimming pool to perform a cleaning operation.</u> Fu states that its 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.” <i>Id.</i>, ¶[0001], Abstract. --- <u>Additionally, 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.”</u> For vertical wall-climbing movement, Fu explains that the robot adjusts the position and discharge direction of the water outlets 10 to generate a propulsive force to ensure that the robot can continue its upward movement. <i>Id.</i>, 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.”).</p>

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	<p>407. Because Fu’s robot travels underwater along the pool floor and/or vertical walls, it travels “adjacent to submerged or water containing surfaces of the swimming pool” just like the pool cleaning system 20 with vehicle 30 of the '207 Patent. ... <u>Additionally, Fu’s robot performs “a cleaning operation” such as filtering the pool water and brush-cleaning the pool surfaces through wheels 3, as explained above for the preamble of claim 1.</u></p> <p>408. In sum, Fu anticipates “[t]he pool system of claim 2, wherein 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 the pool water and brush-cleaning the pool surfaces].”</p>
<p>Section IV.A.7.</p> <p>7. Claims 7-8</p> <p>Fu discloses claims 7-8. EX1010, ¶¶412-415. As explained for element 2c, Fu’s central processor receives captured images (<i>i.e.</i>, “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>i.e.</i>, 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.” <i>Id.</i></p>	<p>Section XIII.A.6.</p> <p>6. Dependent Claim 7: “The pool system of claim 2, wherein the controller is configured to detect a characteristic of the location based on the visual data and control the piece of equipment based on the detected characteristic.” Dependent Claim 8: “The pool system of claim 7, wherein the characteristic comprises a cleanliness of a surface of the swimming pool, and wherein the controller is configured to control the piece of equipment based on the detected cleanliness being outside of a threshold.”</p> <p>412. Fu discloses dependent claims 7 and 8. As explained with respect to element 2c, Fu’s control system receives visual</p>

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<p>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].”</p>	<p>data, such as captured images of the pool floor, from the monitoring cameras 2. The control system compares that visual data against a “pool cleanliness image threshold” to determine the “level of cleanliness” of the pictured region of the pool, <i>i.e.</i>, whether the cleanliness level of the pictured region of the pool falls above or below the “pool cleanliness image threshold.” This “level of cleanliness” constitutes “a characteristic of the location” as recited in claim 7, and “a cleanliness of a surface of the swimming pool” as recited in claim 8.</p> <p>...</p> <p><u>413. Based on this “level of cleanliness” determination, the control system plans and adjusts the cleaning movements of the robot, such as moving forward, backward, turning, or adjusting wheel speeds. This adjustment of the robot’s cleaning movements and wheel speeds based on the “level of cleanliness” determination constitutes “control [of] the piece of equipment based on the detected characteristic” as recited in claim 7, and “control [of] the piece of equipment based on the detected cleanliness being outside of a threshold” as recited in claim 8.</u></p> <p>414. 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 the pictured region of the pool] 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.”</p> <p>415. Accordingly, Fu also anticipates claim 8: “[t]he pool system of claim 7, wherein the characteristic comprises a cleanliness of a surface of the swimming pool [level of</p>

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	cleanliness of the pictured region of the pool], 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].”
<p>Section IV.A.8.</p> <p>(c) Element 12b: “determining a target area and detecting a characteristic of the target area based on the images; and”</p> <p>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. <i>Id.</i> That region corresponds to the “target area” because it is the specific area identified, <i>i.e.</i>, “determine[ed]” for assessing the level of cleanliness. <i>Id.</i></p> <p>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.”</p>	<p>Section XIII.A.7.</p> <p>c. Element 12b: “determining a target area and detecting a characteristic of the target area based on the images; and”</p> <p>422. Fu discloses element 12b of claim 12. Fu’s underwater cleaning 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.” <i>Id.</i>, ¶[0026]. In Fu, the robot analyzes a specific region of the pool, the region pictured in the captured images, to determine whether that region meets the preset cleanliness threshold. The area of the pool floor that is captured in the images and subjected to this cleanliness analysis corresponds to the claimed “target area” because it is the specific area that is identified, <i>i.e.</i>, “determine[ed]” for evaluation.</p> <p><u>423. Once the “target area” of the pool is captured in images, Fu teaches that the images are compared “with the [pool cleanliness image] threshold to determine the level of cleanliness.” This “level of cleanliness” is a “characteristic of the target area” detected from the images captured by the monitoring cameras 2.</u></p> <p><u>424. Thus, Fu discloses “determining a target area [the pictured region of the pool floor that is evaluated] and detecting</u></p>

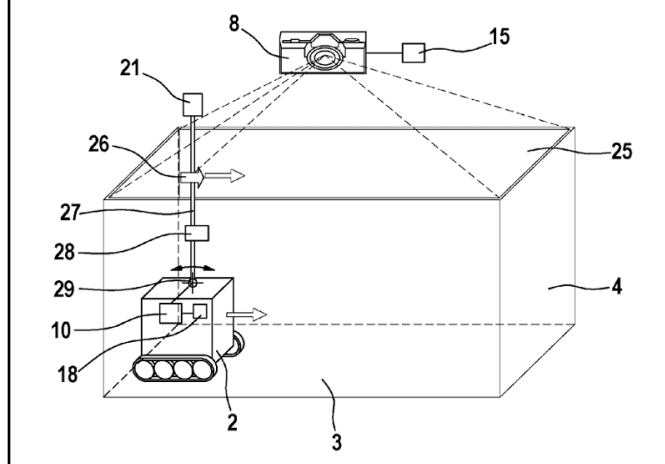
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	a characteristic of the target area [“level of cleanliness”] based on the images.”
<p>Section IV.B.1.</p> <p>1. Claim 1</p> <p>Fu anticipates claim 1. Section IV.A.2. However, to the extent the Board finds that Fu does not anticipate claim 1 for allegedly lacking at least one control signal that causes movement of the body “to, or away from, the first object,” Fu nevertheless would have rendered obvious this claim. EX1010, ¶¶437-440.</p> <p>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.</p> <p>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>i.e.</i>, relatively dirty) area. <i>Id.</i> A POSA would have been motivated to do so because moving the robot toward dirtier areas improves cleaning efficiency and task completion time. <i>Id.</i> Likewise, it</p>	<p>Section XIII.B.1.</p> <p>1. Claim 1</p> <p>437. Fu anticipates claim 1 of the '207 Patent. <i>See</i> Ground 1a above. However, should the Board find that Fu does not anticipate claim 1 because it allegedly lacks at least one control signal that causes movement of the body “to, or away from, the first object,” Fu nevertheless would have rendered obvious this claim.</p> <p>438. Fu already teaches acquiring images of submerged pool surfaces (EX1007, ¶[0026]), comparing these images to a cleanliness image threshold (<i>id.</i>), 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 (<i>id.</i>). 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.</p> <p>439. 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 subthreshold (<i>i.e.</i>, relatively dirty area). A POSA would have been motivated to do so because moving the robot toward dirtier areas improves cleaning efficiency and task completion time. Likewise, it</p>

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<p>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>i.e.</i>, relatively clean) area. <i>Id.</i> 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. <i>Id.</i> Such implementation would reflect routine, predictable applications of well-known control techniques, requiring no new hardware and instead leveraging Fu's disclosed central processor. <i>Id.</i> 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." <i>Id.</i></p> <p>Accordingly, Fu would have rendered obvious claim 1. <i>Id.</i></p>	<p>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 above-threshold (<i>i.e.</i>, relatively clean) photographed regions. Implementing such control behaviors in Fu would have required no more than routine software configuration within a POSA's skill. Such implementation would reflect only routine, predictable applications of well-known control techniques, requiring no new hardware and instead leveraging Fu's disclosed central processor. A POSA would have thus had a reasonable expectation of success in implementing Fu with the claimed "at least one control signal to cause movement of the body within the swimming pool to, or away from, the object."</p> <p>440. Accordingly, even if Fu were found not to anticipate, it would have rendered obvious claim 1 for at least these reasons.</p>
<p>Section IV.B.2.</p> <p>2. Claims 2, 3, 5-8, 12-14, And 19</p> <p>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 (<i>see</i> Ground 1a in Section IV.A), such that these dependent claims are likewise obvious over Fu. EX1010, ¶441.</p>	<p>Section XIII.B.2.</p> <p>2. Claims 2, 3, 5-8, 12-14, And 19</p> <p>441. Independent claims 2 and 12 recite limitations similar to those of claim 1 and are obvious over Fu for the reasons explained in the preceding section for claim 1. Fu also discloses the limitations added in dependent claims 3, 5-8, 13, 14, and 19 (<i>see</i> Section XIII.A.1.b above for Ground 1a), such that these dependent claims are likewise obvious over Fu.</p>
<p>Section IV.C.1.</p> <p>1. Summary Of Benzler</p> <p>Benzler, EX1013, entitled "Activation System for a Robotic Vehicle," was filed on May 16, 2008 as PCT/EP08/56016, and</p>	<p>Section X.C.</p> <p>C. Benzler</p> <p>114. Benzler, EX1013, entitled "Activation System for a Robotic Vehicle," was filed on May 16, 2008 as</p>

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<p>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).</p> <p>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. <i>Id.</i>, ¶[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).” <i>Id.</i>, 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. <i>Id.</i>, ¶¶[0044]-[0046].</p> <p>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.” <i>Id.</i>, ¶[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.” <i>Id.</i>, ¶[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 (<i>id.</i>, ¶¶[0036], [0051]-[0056]):</p>	<p>PCT/EP08/56016, and published on Nov. 25, 2010 as US Patent Pub. No. 20100299016. EX1013, (10), (22), (43), (86). Benzler is therefore prior art under at least pre-AIA 35 U.S.C. §§ 102(a), (b), and (e).</p> <p>115. Benzler describes “an activation system (1) for a robotic vehicle (2)” that uses image-based navigation to autonomously control movement of the vehicle (2) within a work area 3. <i>Id.</i>, ¶[0037]. 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).” <i>Id.</i>, Abstract.</p> <p>116. “The logic unit 10 calculates driving instructions for the robotic vehicle 2 based on the image data,” and the driving instructions are transmitted to the robotic vehicle 2 for execution. <i>Id.</i>, ¶¶[0044]-[0046]. <u>--- Benzler further describes that the “logic unit automatically calculates a trajectory for the robotic vehicle based on the image data” “in such a way that the entire work area or a ... pre-defined section of the work area is at least almost completely driven along.” <i>Id.</i>, ¶[0024]. In a “particularly advantageous” embodiment, “the logic unit detects differently conditioned sections 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[s] on one of those [differently conditioned] sections[.]” <i>Id.</i>, ¶[0016].</u></p> <p>117. Benzler describes several example embodiments of the activation system, such as “a snow cleaning vehicle, [a] leaf</p>

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Fig. 3



Id., Fig. 3.

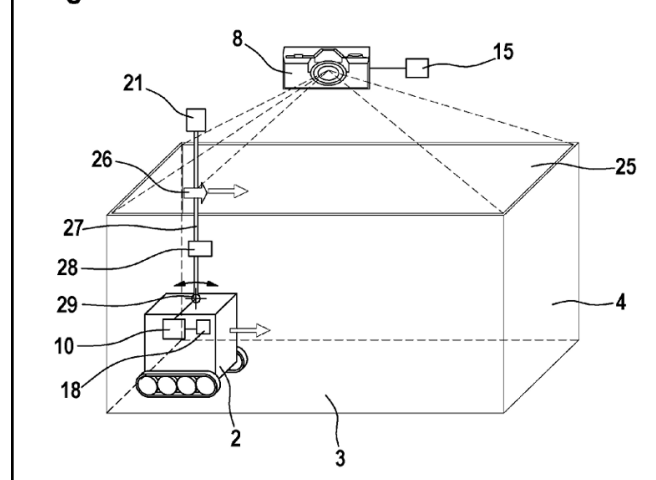
Camera 8 transmits data via logic unit 10 to “control unit 18, which controls the not shown drive means” for driving robotic vehicle 2. *Id.*, ¶[0054].

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collecting vehicle, [a] grass collecting vehicle, thatching vehicle, or [a] weeding vehicle ...[and] as a lawnmower.” *Id.*, ¶[0023].

118. In a “particularly preferred” embodiment, “the robotic vehicle is [constructed] 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 underwater embodiment, “[t]he external border 4 of the work area 3 is created by the surrounding pool walls.” Figure 3 illustrates a schematic of the activation system construed as a pool robotic vehicle 2 (*id.*, ¶[0036], [0051]-[0056]):

Fig. 3



Id., Fig. 3.

119. Benzler discloses a camera 8 for guiding the pool cleaning implementation of robotic vehicle 2. *Id.*, ¶[0053]. [The](#)

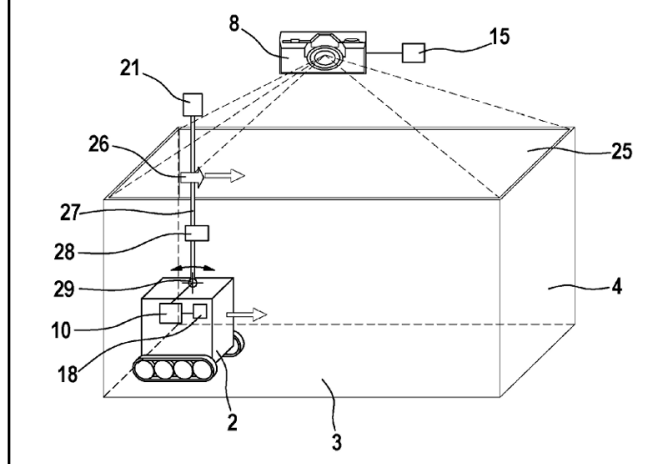
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	<p><u>camera 8 transmits data via the logic unit 10 to the control unit 18, “which controls the not shown drive means” for driving the pool cleaning vehicle 2. <i>Id.</i>, ¶[0054]. In the pool-cleaning context, the camera 8 may capture a “differently conditioned” portion of the submerged pool surface, such as a cleaned or not cleaned portion of the surface, and control the position of the vehicle 2 accordingly. <i>Id.</i>, ¶[0016].</u></p>
<p>Section IV.C.2.</p> <p>2. Motivation To Combine</p> <p>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.</p> <p>A POSA’s motivation for combining Fu and Benzler and further described below with respect to the claims.</p>	<p>Section XIII.C.1.</p> <p>1. Motivations To Combine</p> <p>442. The similar disclosures of Fu and Benzler would have motivated a POSA to consider these references together. As detailed in Section X.A above, Fu discloses capturing an image, comparing it to a cleanliness threshold to determine a level of cleanliness, and then planning movement and adjusting the working state of a robot’s drive wheels to complete a cleaning task. EX1007, ¶[0026]. Benzler, like Fu, describes an autonomous robotic cleaning system that makes movement and cleaning decisions based on an image of the cleaning surface or work area, including “differently conditioned” sections of the work area. EX1013, Abstract, ¶¶[0016], [0018], [0028], [0037], [0044]-[0046], [0053]. --- <u>In particular, Benzler describes an activation system for a robotic vehicle 2 that includes (i) a digital camera 8 for capturing an image of the work area, and (ii) a logic unit 10 that evaluates the image to generate driving instructions for the robotic vehicle 2. <i>Id.</i>, Abstract.</u></p> <p><u>443. In a “particularly preferred” embodiment, Benzler’s robotic vehicle is a “pool-robotic vehicle ... in particular as a filter vehicle and/or cleaning or purifying vehicle,” which drives on the bottom of a pool to perform its cleaning function. <i>Id.</i>,</u></p>

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	<p>¶[0028]. Benzler further explains that “the internal or external logic unit automatically calculates a trajectory for the robotic vehicle based on the image data that is in particular continuously determined by the external camera.” <i>Id.</i>, ¶[0024]. --- These disclosures confirm that Benzler, like Fu, is directed to an autonomous robotic cleaner that uses image-derived information to guide its movement and cleaning, and in particular, includes an embodiment where the cleaning is performed in a pool environment using camera-based navigation.</p>
<p>Section IV.C.3.</p> <p>3. Claim 1</p> <p>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.</p> <p>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.” <i>Id.</i>, ¶[0016]. Thus,</p>	<p>Section XIII.C.2.</p> <p>2. Claim 1</p> <p>444. To the extent that the Board determines that Fu alone does not anticipate or render obvious the claimed “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.</p> <p>445. A POSA would have been motivated to combine Fu and Benzler to yield the claimed control signal for causing movement “to, or away from” a portion of the submerged surface (i) captured by the camera, and (ii) containing the first object. --- Benzler describes embodiments in which its robotic vehicle is implemented as an autonomous lawnmower, a snow cleaning vehicle, a gas collecting vehicle, a thatching vehicle, a weeding vehicle, etc. <i>Id.</i>, ¶[0023]. In the autonomous lawnmower embodiment, for instance, “the logic unit ... is ... construed 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.” <i>Id.</i>, ¶¶[0018], [0045]. Benzler also</p>

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<p>Benzler uses an image to cause motion “only or preferably” toward target sections and away from non-target sections. <i>Id.</i>, ¶¶[0016], [0018], [0045].</p> <p>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. <i>Id.</i> 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. <i>Id.</i></p> <p>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. <i>Id.</i></p> <p>Claim 1 would have been obvious over Fu in view of Benzler.</p>	<p>discloses that 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.” <i>Id.</i>, ¶[0016]. Thus, Benzler uses image-based classification of differently conditioned sections to cause motion “only or preferably” toward target sections and away from non-target sections. <i>Id.</i>, ¶¶[0016], [0018], [0045].</p> <p>446. A POSA would have been motivated to incorporate Benzler’s 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 claimed 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. A POSA would also have had a reasonable expectation of success. The combination does not require new hardware or unconventional algorithms; Fu already discloses the 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.</p>

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<p><i>Id.</i>, ¶¶442-448.</p>	<p>447. In sum, even if Fu alone were deemed insufficient, the combination of Fu with Benzler renders obvious the “to, or away from” control-signal limitation of claim 1 by teaching and motivating the use of image-based region classification to control motion toward target (dirtier) regions and away from non-target (cleaner) regions, with a reasonable expectation of success.</p> <p>448. Claim 1 would have been obvious over Fu in view of Benzler.</p>
<p>Section IV.C.4.</p> <p>4. Claim 4</p> <p>Claim 4 would have been obvious over Fu in view of Benzler. <i>Id.</i>, ¶¶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>i.e.</i>, 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.”).</p>	<p>Section XIII.C.3.</p> <p>3. Dependent Claim 4: “The pool system of claim 2, wherein the one or more cameras are mounted external to the swimming pool or spa.”</p> <p>449. Claim 4 would have been obvious over Fu in view of Benzler. As explained with respect to claim 2, Fu discloses a pool system comprising an underwater cleaning robot with onboard cameras that are submerged in the pool. Benzler demonstrates that the use of off-board, external cameras for pool-cleaning was also well-known in the art, and a POSA would have been motivated to implemented Fu’s pool-cleaning system with external cameras like those taught in Benzler.</p> <p>450. <u>Specifically, a POSA would have recognized the advantages of implementing Fu with Benzler’s external camera 8. Benzler emphasizes that the external camera 8 is positioned above the pool so that it can capture a broad, global view of the entire pool. <i>Id.</i>, ¶[0010] . . .</u> (“The camera is preferably arranged above the work area, so that a section of the work area can be</p>

Fig. 3



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:

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."). 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. A POSA would therefore understand that the external camera thus facilitates a more accurate monitoring and control of the robot.

451. A POSA would also have had a reasonable expectation of success in making this combination because Fu already provides an existing communication infrastructure that is external to the pool. For instance, Figure 7 illustrates a "control and power management system" that is external to the pool, and includes components such as the signal relay and cable manager 28 and the signal and power cable 33:

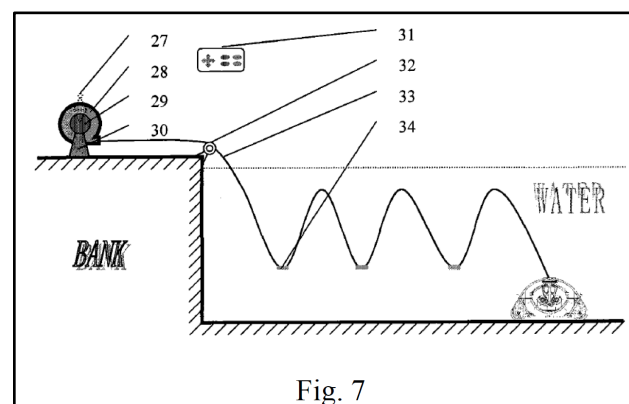
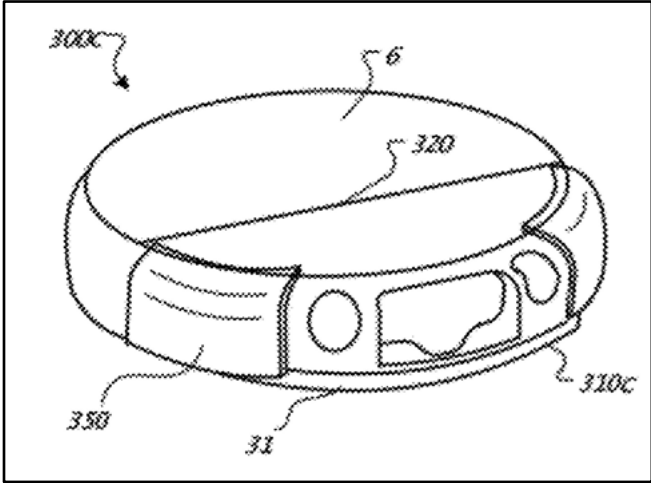
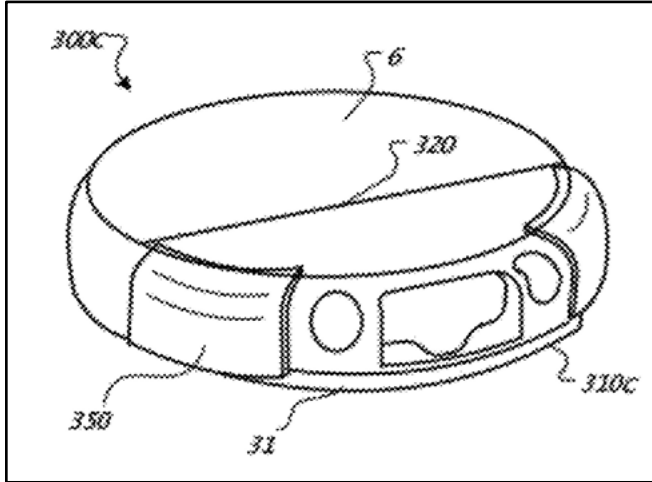


Fig. 7

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<div data-bbox="319 232 917 605" data-label="Image"> </div> <p><i>Id.</i>, Fig. 7. This system establishes a communication path for transmitting 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.</p> <p>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.” <i>Id.</i></p>	<p><i>Id.</i>, Fig. 7.</p> <p>452. This system already establishes a communication path that is utilized to transmit controls signals and power between the external hardware and the underwater robot. A POSA would readily 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 the camera 8, to the underwater robot. Fu’s architecture thus provides an existing communication infrastructure that could easily be used to integrate Benzler’s external camera 8. This would be a straightforward integration that is well within a POSA’s skill.</p> <p>453. Thus, Fu in view of Benzler renders obvious “[t]he pool system of claim 2, wherein the one or more cameras [Benzler’s camera 8] are mounted external to the swimming pool or spa.” Claim 4 would have been obvious over Fu in view of Benzler.</p>
<p>Section IV.C.5.</p> <p>5. Claim 11</p> <p>Claim 11 would have been obvious over Fu in view of Benzler. <i>Id.</i>, ¶¶454-455. Fu discloses an onboard controller (control system with central processor) in communication with the camera.</p>	<p>Section XIII.C.4.</p> <p>4. Dependent Claim 11: “The pool system of claim 2, wherein the controller is remote from the camera.”</p> <p>454. Claim 11 would have been obvious over Fu in view of Benzler. As explained above for claim 4, a POSA would have</p>

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<p>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.</p> <p>Thus, Fu in view of Benzler renders obvious claim 11. EX1010, ¶¶454-455.</p>	<p>recognized the advantages of implementing Fu with Benzler's external camera 8. Fu discloses an onboard controller (control system with the central processor) in communication with the camera to process the camera's images and guide the robot. A POSA would have been motivated to implement Benzler's external camera 8 with Fu's onboard controller, making "the controller [] remote from the camera" in Fu's underwater robot.</p> <p>455. Thus, Fu in view of Benzler renders claim 11.</p>
<p>Section IV.C.6.</p> <p>6. Claims 2, 3, 5-8, 12-14, And 19</p> <p>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 (<i>see</i> Section IV.A for Ground 1a), such that these dependent claims are likewise obvious over Fu in view of Benzler. EX1010, ¶456.</p>	<p>Section XIII.C.5.</p> <p>5. Claims 2, 3, 5-8, 12-14, And 19</p> <p>456. Independent claims 2 and 12 recite limitations similar to those of claim 1 and are obvious over Fu in view of Benzler for the reasons explained in Sections XIII.C.1-2 for claim 1. Fu also discloses the limitations added in dependent claims 3, 5-8, 13, 14, and 19 (<i>see</i> Section XIII.A above for Ground 1a), such that these dependent claims are likewise obvious over Fu in view of Benzler.</p>
<p>Section IV.D.1.</p> <p>1. Summary Of Schnittman</p> <p>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. <i>Id.</i>, (60). Schnittman is prior art under at least pre-AIA 35 U.S.C. §§ 102(a) and (e).</p> <p>Schnittman discloses an autonomous cleaning robot having a</p>	<p>Section X.B.</p> <p>B. Schnittman</p> <p>101. 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. <i>Id.</i>, (60). Schnittman is prior art under at least pre-AIA 35 U.S.C. §§ 102(a) and (e).</p>

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<p>debris monitoring system and onboard sensing for navigation and safety. <i>Id.</i>, Abstract, ¶¶[0002], [0004]-[0006].</p>  <p><i>Id.</i>, 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. <i>Id.</i>, Fig. 2; ¶¶[0113], [0118]-[0119], [0191]-[0203], [0216]-[0227].</p> <p>In embodiments, Schnittman's cleaning robot further includes a microprocessor 245 that executes routines and issues control signals to move the robot (<i>id.</i>, ¶¶[0118]-[0119]):</p>	<p>102. Schnittman discloses an autonomous cleaning robot having a debris monitoring system and onboard sensing for navigation and safety. <i>Id.</i>, Abstract, ¶¶[0002], [0004]-[0006]. An example of Schnittman's autonomous cleaning robots is depicted in Figure 3C:</p>  <p><i>Id.</i>, Fig. 3C.</p> <p>103. 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. <i>Id.</i>, Fig. 2; ¶¶[0113], [0118]-[0119], [0191]-[0203], [0113], [0216]-[0227].</p> <p>104. In embodiments, Schnittman's cleaning robot further includes a dedicated microprocessor 245 that executes routines</p>

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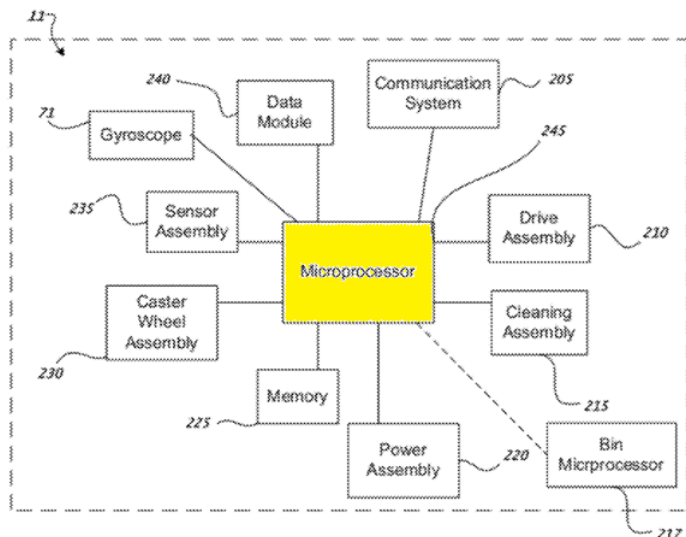


FIG. 2

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]):

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and issues control signals to move the robot (*id.*, ¶[0118]-[0119]):

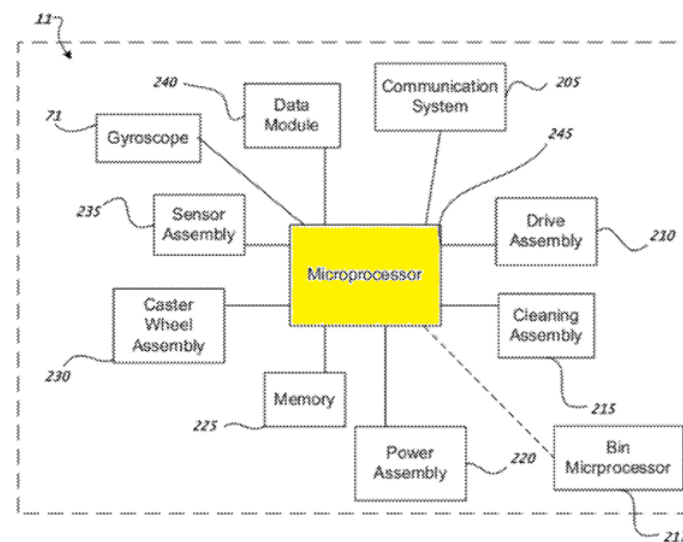


FIG. 2

Id., Fig. 2.

105. As seen above, the 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.*

106. Schnittman further discloses that “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]):

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<div data-bbox="283 253 930 662" data-label="Image"> </div> <p data-bbox="556 695 651 722">FIG. 11</p> <p data-bbox="201 784 1016 1036"><i>Id.</i>, Fig. 11; <i>see also id.</i>, ¶[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. <i>Id.</i>, ¶[0204].</p> <p data-bbox="201 1076 1016 1255">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; <i>see Airbus S.A.S. v. Firepass Corp.</i>, 941 F.3d 1374, 1379 (Fed. Cir. 2019).</p> <p data-bbox="201 1295 1016 1398"><i>First</i>, the '207 Patent and Schnittman are in the same field of endeavor: autonomous cleaning robots. <i>Compare</i> EX1005, 1:26-2:36 (automated, robotic cleaners for cleaning surfaces) <i>with</i></p>	<div data-bbox="1140 253 1787 662" data-label="Image"> </div> <p data-bbox="1413 695 1507 722">FIG. 11</p> <p data-bbox="1062 784 1213 812"><i>Id.</i>, Fig. 11.</p> <p data-bbox="1062 857 1877 1036">107. Further, “[i]n 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.” <i>Id.</i>, ¶[0045].</p> <p data-bbox="1062 1076 1877 1328"><u>108. The camera 1190 is “in communication with the microprocessor 245,” such that “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.” <i>Id.</i>, ¶[0204]. For example, “the 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.” <i>Id.</i></u></p>

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<p>EX1008, ¶¶[0002]-[0003] (“This application relates to robots, and more particularly to autonomous coverage robots” for “removing debris from a surface.”).</p> <p><i>Second</i>, 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.” <i>Airbus S.A.S.</i>, 941 F.3d at 1382.</p>	<p>109. Schnittman is analogous art to the challenged patents because (1) it is from the same field of endeavor as the challenged patents, and (2) it is reasonably pertinent to the problem faced by the inventors of the challenged patents. <i>First</i>, the challenged patents and Schnittman are in the same field of endeavor: autonomous cleaning robots. <i>Compare</i> EX1005, 1:26-2:36 (automated, robotic cleaners for cleaning surfaces) <i>with</i> EX1008, ¶¶[0002]-[0003] (“This application relates to robots, and more particularly to autonomous coverage robots” for “removing debris from a surface.”). <i>Second</i>, 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.</p>
<p>Section IV.D.3.</p> <p>3. Motivation To Combine</p> <p>A POSA would have been motivated to consider Schnittman and Benzler together because they describe similar technology (<i>e.g.</i>, 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</p>	<p>Section XIII.D.1.</p> <p>1. Motivations To Combine</p> <p>457. 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 X.B. The image may include “detection of debris and/or an obstacle by the camera 1190.” <i>Id.</i>, ¶[0204]. Schnittman explains that the camera 1190 is in communication with a microprocessor 245, such that movement</p>

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<p>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.</p> <p>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. <i>Id.</i> 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 (<i>e.g.</i>, robust, debris-responsive cleaning coverage) could be advantageously leveraged in a pool-cleaning context as taught by Benzler. <i>Id.</i>; EX1008, Figs. 10A-10B; ¶¶[0024], [0191]-[0203].</p> <p>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. <i>Id.</i> POSAs in the field of autonomous pool cleaners</p>	<p>of the robot 11 over the cleaning surface is based on this image, for <i>e.g.</i>, “to avoid obstacles and/or debris large than a specific size,” or “to recognize debris on the cleaning surface and maneuver the robot 11 toward the debris.” <i>Id.</i></p> <p>458. Importantly, Schnittman is not limited to any specific environment; its teachings apply generally to cleaning robots that navigate and make cleaning decisions based on an image of the surface being cleaned. This image-based control represented a state-of-the-art approach to autonomous cleaning at the time of the '207 Patent, and a POSA designing a pool-cleaning robot would have recognized that Schnittman's teachings and stated advantages (<i>e.g.</i>, robust, debris-responsive cleaning coverage) could be advantageously leveraged in a pool-cleaning context.</p> <p>459. The POSA designing a pool-cleaning robot at the time of the alleged invention would have also looked to pool-cleaning literature, like Benzler. --- Benzler, like Schnittman, describes an autonomous robotic cleaning system that makes movement and cleaning decisions based on an image of the cleaning surface or work area. Section X.C. --- In particular, Benzler describes an activation system for a robotic vehicle 2 that includes a digital camera 8 for capturing an image of the work area and a logic unit 10 that evaluates the image to generate driving instructions for the robotic vehicle 2. <i>Id.</i>, Abstract.</p> <p>460. In a “particularly preferred” embodiment, the robotic vehicle is a “pool-robotic vehicle ... in particular as a filter vehicle and/or cleaning or purifying vehicle,” which drives on the bottom of a pool to perform its cleaning function. <i>Id.</i>, ¶[0028]. Benzler further explains that “the internal or external logic unit automatically calculates a trajectory for the robotic</p>

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<p>were not working in isolation; they routinely drew on technologies from the broader field of autonomous cleaning. <i>Id.</i> 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.</p> <p>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 (<i>id.</i>, 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 (<i>id.</i>, ¶¶[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.</p> <p>A POSA would have had a reasonable expectation of success in making this combination. EX1010, ¶¶457-466. By the time of</p>	<p><u>vehicle based on the image data that is in particular continuously determined by the external camera." <i>Id.</i>, ¶[0024]. These disclosures confirm that Benzler, like Schnittman, is directed to an autonomous robotic cleaner that uses image-derived information to guide its movement and cleaning, and in particular, includes an embodiment where the cleaning is performed in a pool environment using camera-based navigation.</u></p> <p>461. A POSA would have been motivated to consider Schnittman and Benzler together because they describe similar technology (<i>e.g.</i>, 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. 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 core problem: how to use an image to enable a robot to perceive its cleaning surface, and execute cleaning operations autonomously. Both Schnittman and Benzler address that problem, and offer complementary, overlapping teachings that a POSA would have recognized as related.</p> <p>462. At the time of the alleged invention (July 2012), a POSA would have understood that the robotics principles underlying such image-based cleaners, like those developed by leading cleaning robot manufacturers such as iRobot (assignee of Schnittman), were readily adaptable to different environments and mediums. Robotics, like any other technology, develops by building on existing technology and adapting existing technology to new contexts. POSAs working in the field of</p>

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<p>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. <i>Id.</i> For example, in the same period, the use of cameras on underwater cleaning vehicles was well known. <i>See, e.g.</i>, 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 <i>e.g.</i>, literature from around that time described various normalization, filtering, and color-space methods that extract target information from underwater environments in real time. <i>See</i> 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.</p>	<p>autonomous pool cleaners were not working in isolation; they routinely drew on technologies from the broader field of autonomous cleaning robots. Indeed, Benzler itself confirms this: it describes the same image-driven framework as Schnittman, with Benzler applying this framework to both land and water environments.</p> <p>463. Benzler would have also reinforced a POSA's understanding that Schnittman's cleaning robot could be advantageously adapted for use in a pool-cleaning context. For example, Benzler's teaching of a "moisture-sealed housing" for the internal logic unit (<i>id.</i>, ¶[0011]) explicitly contemplates operation in wet environments, providing a practical implementation detail that a POSA would have readily incorporated when adapting Schnittman's camera-based cleaning robot for underwater use. Likewise, for instance, Benzler's teaching of "pool robotic vehicles [that] drive in particular on the bottom of a pool" using wheels powered by a drive motor (<i>id.</i>, ¶¶[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 robotic pool cleaner, would predictably yield an image-based underwater pool cleaner that is driven based on an image of the pool surface.</p> <p><u>464. Additionally, Benzler describes other embodiments in which the robotic vehicle is implemented as an autonomous lawnmower, a snow cleaning vehicle, a gas collecting vehicle, a thatching vehicle, a weeding vehicle, etc. <i>Id.</i>, ¶[0023]. In the autonomous lawnmower embodiment, for instance, "the logic unit ... is ... construed in such a way that differently conditioned</u></p>

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	<p><u>sections (mowed/not mowed) ... are detected and the driving instructions are calculated in such a way that preferably the mowed section ... is driven along.” <i>Id.</i>, ¶¶[0018], [0045]. Like the pool cleaning vehicle embodiment, this embodiment is based on the same image-driven activation system: the camera captures an image of the work area, and the logic unit interprets the captured image to determine how that area is “conditioned” and where to move next. <i>Id.</i>, ¶¶[0016], [0018], [0045]. 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 and mediums.</u></p> <p>465. Furthermore, a POSA would have had a reasonable expectation of success in making this combination. By the time of the '207 Patent, the necessary adaptations to render a system water-ready were straightforward and within a POSA's skill, with such adaptations including moisture-sealing or potting electronics, waterproofing housings, 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.</p> <p>466. For example, in the same period, the use of cameras on underwater vehicles was known (<i>see, e.g.</i>, EX1014, EX1015, EX1016), and researchers documented techniques to improve the effectiveness of underwater imaging. Literature from around the time of the '207 Patent described various normalization, filtering, and color-space methods that robustly extract target information from underwater environments in real time. <i>See</i> EX1017, 7. These developments would have reinforced a</p>

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	<p>skilled artisan's motivation and reasonable expectation of success in adapting Schnittman to Benzler's pool-cleaning context. Thus, a POSA seeking to develop an autonomous pool-cleaning robot would have been motivated 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.</p>
<p>Section IV.D.8.</p> <p>8. Claim 5</p> <p>Schnittman in view of Benzler would have rendered obvious claim 5. <i>Id.</i>, ¶514. Schnittman's "camera 1190 [is] disposed toward the forward portion of the robot 11":</p> <div data-bbox="268 781 963 1289" data-label="Image"> <p>FIG. 11</p> </div> <p>EX1008, Fig. 11, ¶[0204]. Thus, Schnittman in view of Benzler renders obvious claim 5: "the one or more cameras [camera 1190]</p>	<p>Section XIII.D.6.</p> <p>6. Dependent Claim 5: "The pool system of claim 2, wherein the one or more cameras are mounted on the at least one piece of equipment."</p> <p>514. Schnittman in view of Benzler would have rendered obvious claim 5. As explained above for element 1d, the Schnittman/Benzler pool-cleaning robot includes an onboard camera, <i>i.e.</i>, camera 1190 of Schnittman. Schnittman in view of Benzler thus renders obvious "wherein the one or more cameras are mounted on the at least one piece of equipment."</p>

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<p>are mounted on the at least one piece of equipment [robotic cleaner 11].” EX1010, ¶514.</p>	
<p>Section IV.D.15.</p> <p>15. Claim 19</p> <p>Schnittman in view of Benzler would have rendered obvious claim 19. <i>Id.</i>, ¶¶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 (<i>id.</i>, ¶¶[0177], [0191]-[0203]):</p> <div data-bbox="256 816 978 1230" data-label="Image"> </div> <p><i>Id.</i>, Figs. 10A, 10B.</p> <p>Accordingly, Schnittman in view of Benzler renders obvious claim 19: “generating the control response comprises controlling</p>	<p>Section XIII.D.13.</p> <p>13. Dependent Claim 19: “The method of claim 12, wherein generating the control response comprises controlling operation of 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, wherein controlling operation of the cleaning device comprises one or more of controlling a path or route of the cleaning device, an aggressiveness of cleaning chemicals deployed, an aggressiveness of mechanical cleaning, or a speed of the cleaning device.”</p> <p>534. Schnittman in view of Benzler would have rendered obvious claim 19. As explained above for claim 3, the combination of Schnittman and Benzler renders obvious controlling a pool-cleaning robot such that it “travel[s] adjacent to submerged or water-containing surfaces of the swimming pool or spa and [] perform[s] a cleaning action.” <i>See</i> Section XIII.D.4 above. Accordingly, Schnittman in view of Benzler renders obvious “wherein generating the control response comprises controlling operation of 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” of claim 19.</p> <p>535. Further, as explained above for claim 14, Schnittman in view of Benzler renders obvious generating control signals that cause the robot to move towards or away from debris, thus</p>

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<p>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.</p>	<p>“controlling a path or route of the cleaning device,” as claimed and as shown in Figures 10A and 10B of Schnittman:</p> <div data-bbox="1113 357 1837 755"> </div> <p><u>Id., Figs. 10A, 10B.</u></p> <p>536. Accordingly, Schnittman in view of Benzler renders obvious “wherein controlling operation of the cleaning device comprises one or more of controlling a path or route of the cleaning device, an aggressiveness of cleaning chemicals deployed, an aggressiveness of mechanical cleaning, or a speed of the cleaning device.”</p>