

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

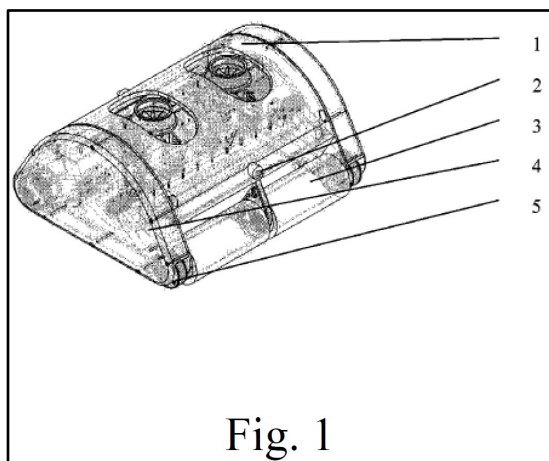
Petition for IPR of ’191 Patent	Expert Declaration of Dr. Charles F. Reinholtz
Section II.A. A. Summary Of The ’191 Patent The ’191 Patent, entitled “Pool Cleaning System and Method to Automatically Clean Surfaces of a Pool Using Images from a Camera,” issued with three total claims, each independent. EX1001, (54), claims 1-3. The claims are directed to a self-propelled swimming pool cleaner and are substantially similar despite minor differences in wording. <i>Id.</i>, claims 1-3. Each recites (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> The ’191 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 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 an image of submerged surfaces of the pool. <i>Id.</i>, 3:46-55. Controller 42 “generate[s] control signals for steering	Section VII.A. A. ’191 Patent 64. The ’191 Patent, entitled “Pool Cleaning System and Method to Automatically Clean Surfaces of a Pool Using Images from a Camera,” issued with three total claims, each independent. EX1001, (54), claims 1-3. The claims are directed to a self-propelled swimming pool cleaner and are substantially similar with only minor differences in wording. EX1001, claims 1-3. Each recites (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> I note that, while the specification describes embodiments where the camera is mounted remotely from the vehicle body, the claims of the ’191 patent all require the camera(s) to be positioned on or in the body. 65. The ’191 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 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

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vehicle 30 based upon signals received from cameras 32.” <i>Id.</i>, 3:51-53, 4:44-46.	“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. <u>66. The '191 Patent was filed on July 2, 2020 as U.S. Patent Application No. 16/919,750. <i>Id.</i>, (21), (22). The '191 Patent is the fifth 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> <u>67. I have reviewed the file history of the '191 Patent, and I understand that originally filed claims 1-19 were copies of the claims filed in the parent application, U.S. Patent Application No. 16/416,840 (the “'840 application”). Compare EX1002 (file history of the '191 Patent), 17-19 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 new claims 20-22, which have since issued as claims 1-3 of the '191 Patent. EX1002, 38-41. I also understand that the Examiner identified “a controller positioned on or in the body, in electronic communication with the at least one camera, and 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 portion of the submerged surface” as the reason for allowance. <i>Id.</i>, 133-135. However, as I explain below, the purportedly inventive feature asserted by the Examiner was very well known in the art. See <i>infra</i> Sections XI.A.1.f-h., XI.B-C.</u>
Section IV.A.1. 1. Summary Of Fu	Section X.A. A. Fu

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

Fu describes a robot that is designed “for the underwater cleaning of swimming pool floors and walls.” *Id.*, Abstract. An example of Fu’s underwater cleaning robot is depicted in Figure 1:

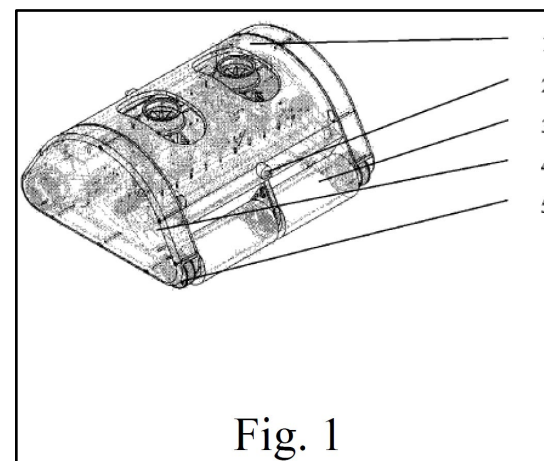


Id., Fig. 1. Fu describes two operational modes for cleaning: manual and autonomous. *Id.*, ¶[0025]. In the manual mode, a control keypad is used to manually send control signals to the robot. *Id.* In the autonomous mode, the control system autonomously plans and controls the robot’s movement and cleaning operations based on data received from sensors and

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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. *Id.*, (10), (45). Fu is therefore prior art under at least pre-AIA 35 U.S.C. §§ 102(a) and (b).

91. Fu describes a robot that is designed “for the underwater cleaning of swimming pool floors and walls.” *Id.*, Abstract. An example of Fu’s underwater cleaning robot is depicted in Figure 1:



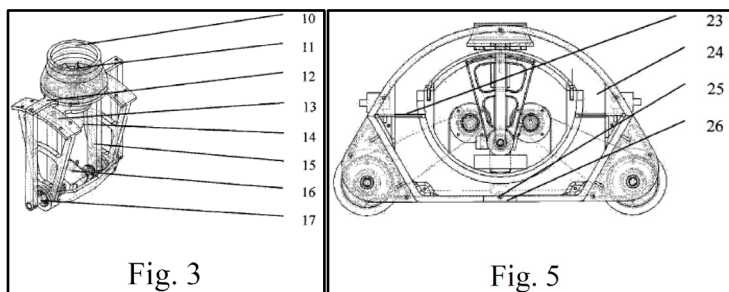
Id., Fig. 1.

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

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cameras. *Id.*

The robot “comprises a drainage mechanism, a cleaning and mobility platform, and a control system.” *Id.*, ¶[0024], Abstract. These three units work in coordination to “perform cleaning tasks autonomously or via remote control underwater on horizontal, vertical, and inclined surfaces.” *Id.*, Abstract. 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.*, ¶[0024]-[0026]. An example schematic of the drainage mechanism is illustrated in Figures 3 and 5:



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

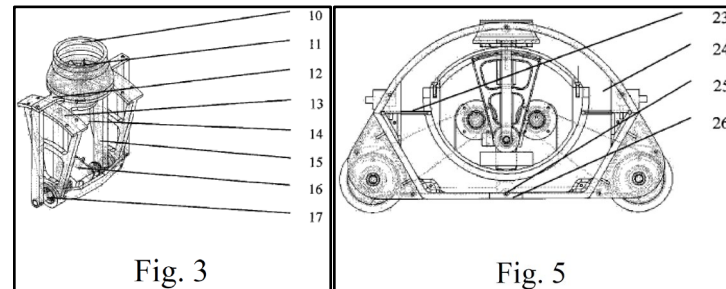
The drainage mechanism “comprises a water discharger [Figure 3], a water flow channel 24 ..., a water flow filter screen 23, and a water inlet [26] with an anti-backflow device 25.” *Id.*, ¶[0024]. During operation, “the drainage propeller high-speed DC motor 14 ... drives the drainage propeller 11 to rotate ... expel[ing] water from within the robot’s water flow channel 24, creating a high negative pressure inside.” *Id.*, ¶[0026]. This negative

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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.*, ¶[0024]-[0026]. An example schematic of the drainage mechanism is illustrated in Figures 3 and 5:



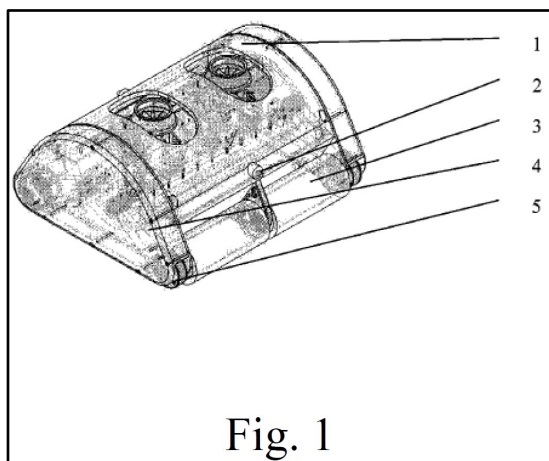
Id., Fig. 3 (water discharger), Fig. 5 (side cross-sectional view of the robot).

95. 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.” *Id.*, ¶[0024]. During operation, “the drainage propeller high-speed

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pressure “draws pool water from the bottom of the robot into the water flow channel 24 through the water inlet [26].” *Id.* 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.” *Id.*

The drainage mechanism “uses the cleaning and mobility platform as a carrier and coordinates its movement with the cleaning and mobility platform.” *Id.*, ¶[0024]. The cleaning and mobility platform, illustrated in Figure 1, comprises “a robot housing body 1, cleaning driving wheels 3, synchronous belt gears 5, and a driving synchronous belt 4.” *Id.*

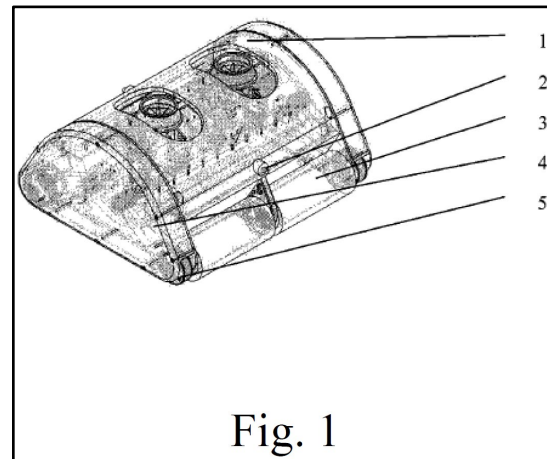


Id., Fig. 1. The “cleaning driving wheels 3 are controlled by their respective motor drivers ... By using different combinations of wheel speeds, the robot can perform tasks such as moving forward, backward, turning, and brush-cleaning.” *Id.*, ¶[0026]. The synchronous belt gears 5 and the driving synchronous belt 4 help drive the cleaning driving wheels 3 via a

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DC motor 14 ... drives the drainage propeller 11 to rotate ... expel[ling] water from within the robot’s water flow channel 24, creating a high negative pressure inside.” *Id.*, ¶[0026]. This negative pressure “draws pool water from the bottom of the robot into the water flow channel 24 through the water inlet [26].” *Id.* Once in 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.” *Id.*

96. The drainage mechanism “uses the cleaning and mobility platform as a carrier and coordinates its movement with the cleaning and mobility platform.” *Id.*, ¶[0024]. The cleaning and mobility platform, illustrated in Figure 1, comprises “a robot housing body 1, cleaning driving wheels 3, synchronous belt gears 5, and a driving synchronous belt 4.” *Id.*

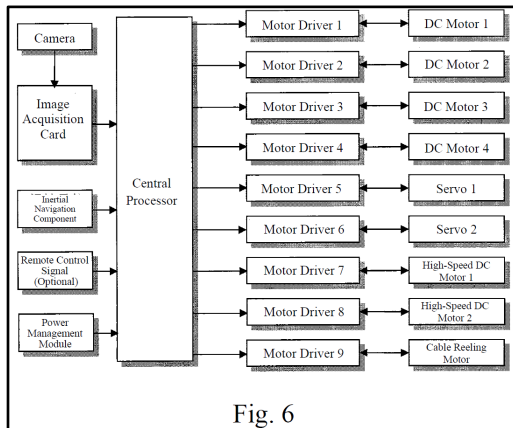


Id., Fig. 1.

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driving DC motor 7. *Id.*, ¶[0024]. 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. *Id.*, ¶[0024], [0026].

The control system autonomously controls the robot’s operation by generating control signals that drive the robot’s movement and cleaning. *Id.* As shown in Figure 6, the 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].



Id., Fig. 6.

Fu’s monitoring cameras 2, installed on the main robot housing body 19, are in communication with the central processor via the

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97. 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.” *Id.*, ¶[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. *Id.*, ¶[0024]. 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. *Id.*, ¶[0024], [0026].

98. The control system autonomously controls the robot’s operation by generating control signals that drive the robot’s movement and cleaning. *Id.* As shown in Figure 6, the 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].

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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 visual information from the environmental perception layer, *i.e.*, monitoring cameras 2, and processes it to determine “the level of cleanliness” of the pool. *Id.*, ¶[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.” *Id.*, ¶[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 “[t]he motor drivers and the cleaning driving wheel DC motors 7.” *Id.*, ¶[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. *Id.*, ¶[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.” *Id.*

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.

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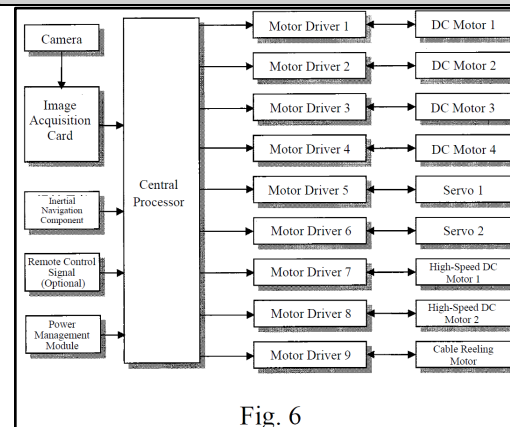


Fig. 6

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 perception layer, *i.e.*, monitoring cameras 2, and processes it to determine “the level of cleanliness” of the pool. *Id.*, ¶[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.” *Id.*, ¶[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.” *Id.*, ¶[0024]-[0025]. Based on the control signals, the respective motor drivers and the cleaning driving wheel DC motors 7 drive the cleaning

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	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> 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.
Section IV.A.2. 2. Claim 1 (a) Preamble: “A self-propelled pool cleaning system for cleaning debris from a submerged surface of a swimming pool, comprising:” To the extent limiting, the preamble of claim 1 is disclosed by Fu. EX1010, ¶¶127-130. Fu discloses “an underwater cleaning robot” designed “for the underwater cleaning of swimming pool floors and walls.” EX1007, Abstract. An example of Fu’s underwater cleaning robot is depicted in Figure 1:	Section XI.A.1 1. Independent Claim 1 a. Preamble: “A self-propelled pool cleaning system for cleaning debris from a submerged surface of a swimming pool, comprising:” 127. The preamble of claim 1 is disclosed by Fu. Fu discloses “an underwater cleaning robot” designed “for the underwater cleaning of swimming pool floors and walls.” EX1007, Abstract. An example of Fu’s underwater cleaning robot is depicted in Figure 1:

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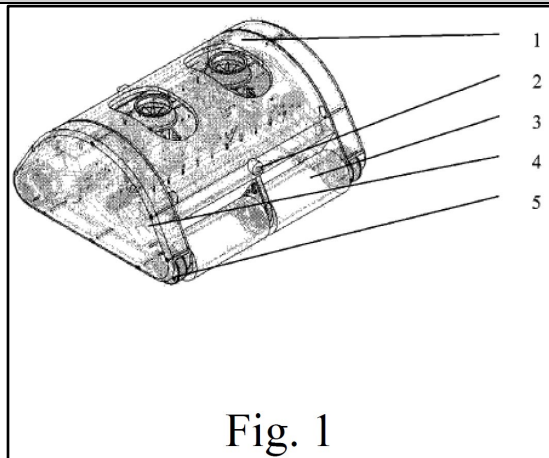


Fig. 1

Id., Fig. 1. 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 a “pool cleaner for cleaning debris from a submerged surface of a swimming pool.”

Fu further discloses that its robot is self-propelled. Fu’s cleaning and mobility platform comprises “four independent cleaning driving wheels 3” that “are controlled by their respective motor drivers, allowing for independent movement.” *Id.*, ¶[0026]. In the autonomous mode, “control signals are generated by the central processor, which autonomously plans paths and actions ... to drive the robot’s execution layer and complete the

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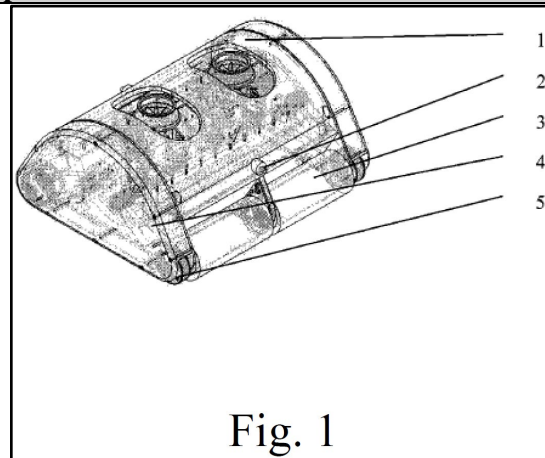


Fig. 1

Id., Fig. 1.

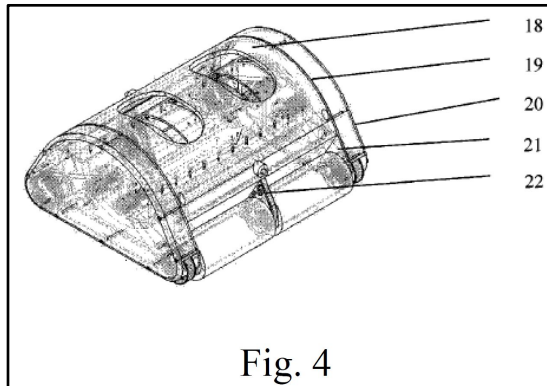
128. Fu’s robot includes, among other components, “a drainage mechanism [and] a cleaning and mobility platform.” *Id.*, ¶[0024]. The cleaning and mobility platform enables the robot to move around the pool and remove debris from its surfaces, *e.g.*, using brushes. *Id.*, ¶¶[0010], [0024]-[0026] (“brush-cleaning”). 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 a “pool cleaner for cleaning debris from a submerged surface of a swimming pool.”

129. Fu further discloses that its robot is self-propelled. Fu’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

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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]. For at least these reasons, Fu discloses the claimed “self-propelled pool cleaner [underwater cleaning robot] for cleaning debris from a submerged surface of a swimming pool.” (b) Element 1a: “a vehicle body;” Fu discloses element 1a of claim 1. EX1010, ¶[131-133]. As shown in Figure 1, Fu illustrates the “[o]verall schematic diagram of the underwater cleaning robot,” which includes “1 - robot housing body” (EX1007, ¶[0014]): Fig. 1	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]. 130. For at least these reasons, Fu discloses the claimed “self-propelled pool cleaner [<i>i.e.</i>, Fu’s underwater cleaning robot] for cleaning debris from a submerged surface of a swimming pool.” b. Element 1a: “a vehicle body;” 131. Fu discloses element 1a of claim 1. As shown in Figure 1, Fu illustrates the “[o]verall schematic diagram of the underwater cleaning robot,” which includes “1 - robot housing body” (EX1007, ¶[0014]):

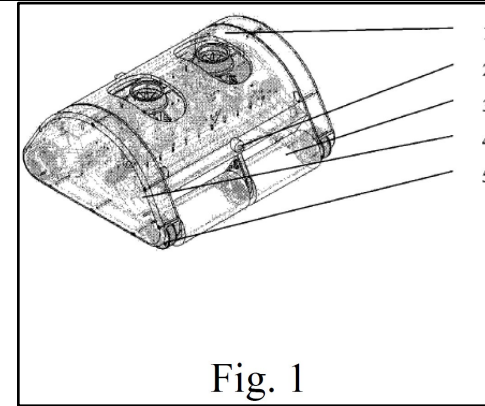
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Id., Fig. 1. Fu further specifies that the “housing body 1 comprises a robot top cover 18, robot side walls 20, and a robot main housing body 19.” *Id.*, ¶[0024].



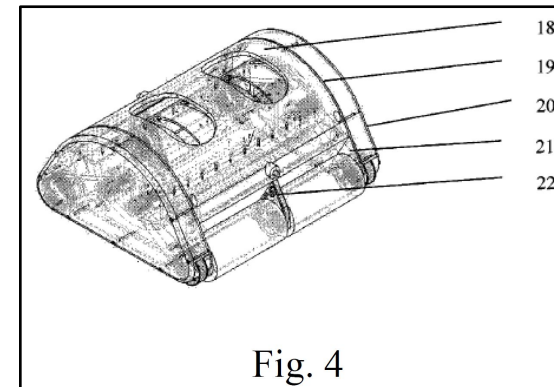
Id., Fig. 4. Accordingly, Fu discloses the claimed “vehicle body [robot housing body 1].”

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Id., Fig. 1.

132. Fu further specifies that the “housing body 1 comprises a robot top cover 18, robot side walls 20, and a robot main housing body 19.” *Id.*, ¶[0024].



Id., Fig. 4.

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Section IV.A.3. 3. Independent Claim 2 Claim 2 of the '191 Patent is anticipated by Fu for the reasons explained above for claim 1. <i>Id.</i>, ¶¶158-159. Claim 2 recites limitations of claim 1, but claim 2 is broader because it removes a restriction on the claimed “filter”: Whereas claim 1 requires the filter to be a part of a “self-propelled pool cleaner,” claim 2 “allows for the possibility of the debris filter being remote from the vehicle body, hence referring to a ‘system’ including both the cleaning vehicle and the debris filter” (EX1002, 42): Because Fu anticipates the narrower claim 1 requiring the filter to be part of the pool cleaner, Fu likewise anticipates the broader claim 2 eliminating this requirement. Further, as the applicant recognized during prosecution, claim 2 does not <i>require</i> the filter to be separate from the pool cleaner; it just encompasses this “<i>possibility</i>.” <i>Id.</i> Indeed, claim 2 includes no limitations forbidding the inclusion of the filter on the pool cleaner. Thus, Fu’s pool cleaner with the onboard filter anticipates the “system for cleaning debris” of claim 2.	133. Accordingly, Fu discloses the claimed “vehicle body [<i>i.e.</i>, Fu’s robot housing body 1].” Section XI.A.2. 2. Independent Claim 2 158. Claim 2 of the '191 Patent is anticipated by Fu for the reasons explained above for claim 1. Claim 2 recites limitations of claim 1, but claim 2 is broader because it removes a restriction on the claimed “filter”: Whereas claim 1 requires the filter to be a part of a “self-propelled pool cleaner,” claim 2 “allows for the possibility of the debris filter being remote from the vehicle body, hence referring to a ‘system’ including both the cleaning vehicle and the debris filter” (EX1002, 42): 159. Because Fu anticipates the narrower claim 1 requiring the filter to be part of the pool cleaner, Fu likewise anticipates the broader claim 2 eliminating this requirement. Further, I understand that during prosecution, Applicant recognized that claim 2 does not <i>require</i> the filter to be separate from the pool cleaner; it just encompasses this “<i>possibility</i>.” <i>Id.</i> Indeed, claim 2 includes no limitations forbidding the inclusion of the filter on the pool cleaner. Thus, Fu’s pool cleaner with onboard filter anticipates the “system for cleaning debris” of claim 2.
Section IV.A.4. 4. Independent Claim 3 Claim 3 of the '191 Patent is anticipated by Fu for the reasons explained above for claim 1. EX1010, ¶¶160-161. Claim 3 recites limitations of claim 1, but claim 3 is broader because it removes the requirement that the claimed “controller” be	Section XI.A.3. 3. Independent Claim 3 160. Claim 3 of the '191 Patent is anticipated by Fu for the reasons explained above for claim 1. Claim 3 recites limitations of claim 1, but claim 3 is broader because it removes the

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“positioned on or in the body” of the self-propelled pool cleaner: Because Fu anticipates the narrower claim 1 requiring the controller to be positioned on or in the body of the pool cleaner, Fu likewise anticipates the broader claim 3 eliminating this requirement. Further, as the applicant recognized during prosecution, claim 3 does not <i>require</i> the controller to be separate from the body of the pool cleaner, but it encompasses this <i>possibility</i>. EX1002, 42-43 (claim 3 “referenc[es] a ‘system’ including both the cleaning vehicle and a controller that could be remote from the vehicle body”). Claim 3 includes no limitations forbidding the controller from being positioned on or in the body of the pool cleaner. Thus, Fu’s pool cleaner with the onboard controller anticipates the “system for cleaning debris” of claim 3.	requirement that the claimed “controller” be “positioned on or in the body” of the self-propelled pool cleaner: 161. Because Fu anticipates the narrower claim 1 requiring the controller to be positioned on or in the body of the pool cleaner, Fu likewise anticipates the broader claim 3 eliminating this requirement. Further, as Applicant recognized during prosecution, claim 3 does not <i>require</i> the controller to be separate from the body of the pool cleaner, but it encompasses this <i>possibility</i>. EX1002, 42-43 (claim 3 “referenc[es] a ‘system’ including both the cleaning vehicle and a controller that could be remote from the vehicle body”). Claim 3 includes no limitations forbidding the controller from being positioned on or in the body of the pool cleaner. Thus, Fu’s pool cleaner with onboard controller anticipates the “system for cleaning debris” of claim 3.
Section IV.B. B. Ground 1b: Claims 1-3 Would Have Been Obvious Over Fu Fu anticipates claims 1-3 of the '191 Patent. <i>See</i> Ground 1a. However, should the Board find that Fu does not anticipate claims 1-3 because it allegedly lacks a control signal that causes movement of the vehicle body “to, or away from, the first portion of the submerged surface,” Fu nevertheless would have rendered obvious these claims. EX1010, ¶¶162-167. A POSA would have been motivated to implement Fu’s pool-cleaning robot such that it moves toward dirtier (sub-threshold) regions and away from cleaner (above-threshold) regions because this would improve cleaning efficiency and task	Section XI.B. B. Ground 1b: Claims 1-3 Would Have Been Obvious Over Fu <u>162. In my opinion, as set forth below, claims 1-3 of the '191 patent are unpatentable as obvious over Fu.</u> 163. Fu anticipates claims 1-3 of the '191 patent. <i>See</i> Ground 1a above. However, should the Board find that Fu does not anticipate claims 1-3 because it allegedly lacks a control signal that causes movement of the vehicle body “to, or away from, the first portion of the submerged surface,” Fu nevertheless would have rendered obvious these claims.

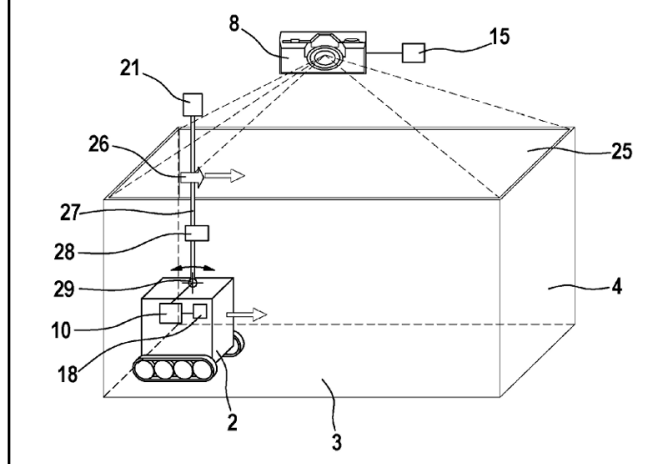
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completion time. <i>Id.</i>, ¶166. The resulting behavior—spending more time in dirtier areas and less in cleaner areas—would have been the expected and desirable outcome of applying Fu’s thresholded cleanliness information to motion control. <i>Id.</i> And as explained by Dr. Reinholtz, implementing this control behavior in Fu would have required no more than routine software configuration within a POSA’s skill. <i>Id.</i> 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. <i>Id.</i> 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 first portion of the submerged surface.” <i>Id.</i> Accordingly, even if Fu were found not to anticipate, it would have rendered obvious claims 1-3 for at least these reasons. <i>Id.</i>, ¶¶162-167.	<u>164. A POSA would have found it obvious to implement motion control in Fu to direct the cleaning robot toward image-identified dirty regions (i.e., regions below Fu’s cleanliness threshold) and away from clean regions (i.e., regions above the threshold).</u> <u>165. Fu already teaches acquiring an image of submerged pool surfaces (EX1007, ¶[0026]), comparing the image to a cleanliness image threshold (id.), 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 (id.). Once Fu’s system distinguishes areas as sub-threshold versus above-threshold, using that information to guide the robot’s movement towards dirtier areas and away from cleaner areas would have been a routine, predictable application that would have been obvious to a POSA.</u> 166. A POSA would have been motivated to implement Fu’s pool-cleaning robot such that it moves toward dirtier (sub-threshold) regions and away from cleaner (above-threshold) regions because this would improve cleaning efficiency and task completion time. The resulting behavior—spending more time in dirtier areas and less in cleaner areas—would have been the expected and desirable outcome of applying Fu’s thresholded cleanliness information to motion control. Implementing this control behavior in Fu would have required no more than common sense and routine changes to the 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

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	claimed “at least one control signal to cause movement of the body within the swimming pool to, or away from, the first portion of the submerged surface.” 167. Accordingly, even if Fu were found not to anticipate, it would have rendered obvious claims 1-3 for at least these reasons.
Section IV.C.1. 1. Summary Of Benzler Benzler, EX1013, entitled “Activation System for a Robotic Vehicle,” was filed on May 16, 2008 as PCT/EP08/56016, and published on Nov. 25, 2010 as US Patent Pub. No. 2010/0299016. EX1013, (10), (22), (43), (86). Benzler is therefore prior art under at least pre-AIA 35 U.S.C. §§ 102(a), (b), and (e). Benzler describes “an activation system (1) for a robotic vehicle (2)” that uses image-based navigation to autonomously control movement of the vehicle 2 within a work area 3. <i>Id.</i>, Abstract, ¶¶[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. “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]. 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	Section X.C. C. Benzler 114. Benzler, EX1013, entitled “Activation System for a Robotic Vehicle,” was filed on May 16, 2008 as PCT/EP08/56016, and published on Nov. 25, 2010 as 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). 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. 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]. Benzler further describes that the “logic unit automatically calculates a trajectory for the

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... 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]. 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 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 (<i>id.</i>, ¶¶[0036], [0051]-[0056]):	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]. 117. 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]. 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.” <i>Id.</i>, ¶[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 (<i>id.</i>, ¶¶[0036], [0051]-[0056]):

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Fig. 3



Id., Fig. 3.

Benzler discloses a camera 8 for guiding the pool cleaning implementation of the robotic vehicle 2. *Id.*, ¶[0053]. The 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. *Id.*, ¶[0054]. 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. *Id.*, ¶[0016].

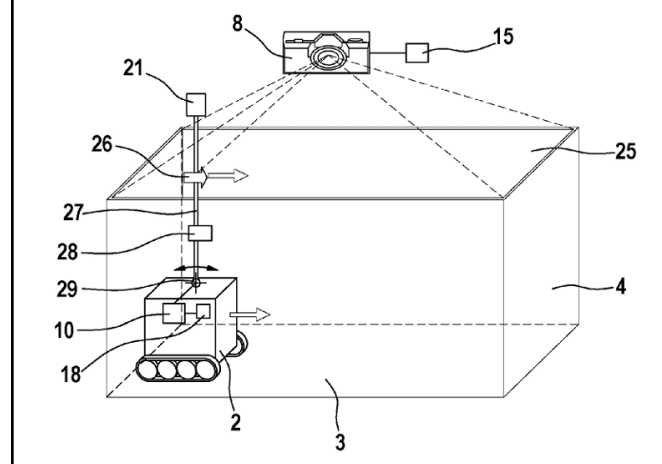
Section IV.C.2.

2. Obviousness Of The “To, Or Away From” Limitation Over Fu In View Of Benzler

If the Board determines that Fu alone does not anticipate or render

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Fig. 3



Id., Fig. 3.

119. Benzler discloses a camera 8 for guiding the pool cleaning implementation of robotic vehicle 2. *Id.*, ¶[0053]. The 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. *Id.*, ¶[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. *Id.*, ¶[0016].

Section XI.C.

C. Ground 1c: Claims 1-3 Would Have Been Obvious Over Fu In View of Benzler

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obvious the claimed “at least one control signal to cause movement of the body within the swimming pool to, or away from, the first portion of the submerged surface,” claims 1-3 are nonetheless obvious over Fu in combination with Benzler. EX1010, ¶¶168-176. 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 captured by the camera. <i>Id.</i>, ¶¶170-175. As detailed in Section IV.A.2.h above, Fu discloses capturing images, comparing them 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]. 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. 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>, ¶[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	<u>168. In my opinion, as set forth below, claims 1-3 of the '191 patent are unpatentable as obvious over Fu in view of Benzler.</u> 169. If 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 portion of the submerged surface,” claims 1-3 are nonetheless obvious over Fu in combination with Benzler. 170. 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 captured by the camera. As detailed in Section XI.A.1.h above, Fu discloses capturing an image, comparing them 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]. In particular, Benzler describes an activation system for a robotic vehicle 2 that includes (i) a digital camera 8 for capturing image data of the work area, and (ii) a logic unit 10 that evaluates the image data to generate driving instructions for the robotic vehicle 2. <i>Id.</i>, Abstract.

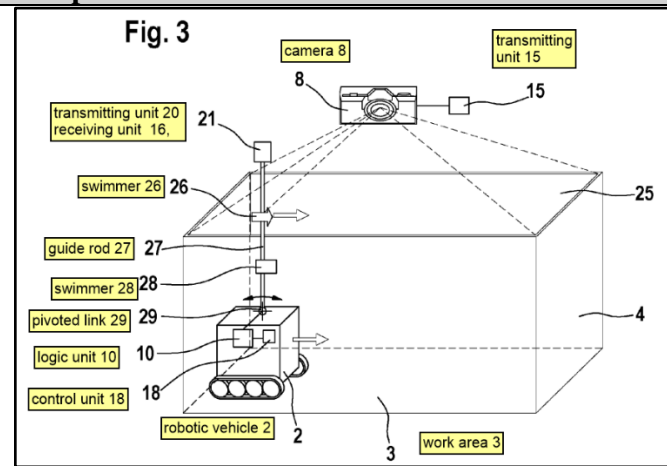
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that Benzler, like Fu, is directed to an autonomous robotic cleaner that uses an image to guide its movement and cleaning, and in particular, includes an embodiment where the cleaning is performed in a pool environment using camera-based navigation. The similar disclosures of Fu and Benzler would have motivated a POSA to consider these references together.

Benzler further describes 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. *Id.*, ¶[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.” *Id.*, ¶[0018], [0045]. Benzler also 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.” *Id.*, ¶[0016]. Thus, Benzler uses an image to cause motion “only or preferably” toward target sections and away from non-target sections. *Id.*, ¶[0016], [0018], [0045].

A POSA would have been motivated to incorporate Benzler’s 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,

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Id., Fig. 3 (annotated).

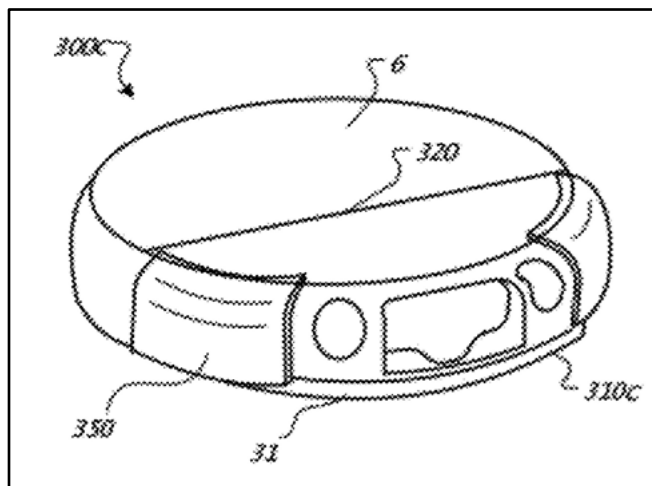
171. In a “particularly preferred” embodiment, Benzler’s robotic vehicle is a “pool-robotic vehicle ... in particular as a filter vehicle and/or cleaning or purifying vehicle,” which drives on the bottom of a pool to perform its cleaning function. *Id.*, ¶[0028]. Benzler further explains that “the internal 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.” *Id.*, ¶[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. The similar disclosures of Fu and Benzler would have motivated a POSA to consider these references together.

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predictable set of control options once regions are classified with respect to a threshold. EX1010, ¶174. 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. <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 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. <i>Id.</i>, ¶175. 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 claims 1-3 by teaching and motivating the use of an image to control motion toward target (dirtier) regions and away from non-target (cleaner) regions, with a reasonable expectation of success. <i>Id.</i>, ¶176.	172. Benzler further describes 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 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]. 173. Benzler also 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]. 174. 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. 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

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	submerged surface captured by the camera, with the robot moving toward sub-threshold (dirtier) regions and away from above-threshold (cleaner) regions. 175. 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 software modifications that would have been within a POSA’s skill. 176. 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 claims 1-3 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.
Section IV.D.1. 1. Summary Of Schnittman Schnittman, EX1008, entitled “Debris Monitoring,” was filed December 30, 2011, and published July 5, 2012. EX1008, (22), (43). Schnittman incorporates by reference and claims priority to U.S. Provisional Application No. 61/428,808 (the “’808 provisional”), filed December 30, 2010. <i>Id.</i>, (60). Schnittman is prior art under at least pre-AIA 35 U.S.C. §§ 102(a) and (e). Schnittman discloses an autonomous cleaning robot having a debris monitoring system and onboard sensing for navigation and	Section X.B. B. Schnittman 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).

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safety. *Id.*, Abstract, ¶¶[0002], [0004]-[0006]. An example of Schnittman's autonomous cleaning robot is depicted in Figure 3C:

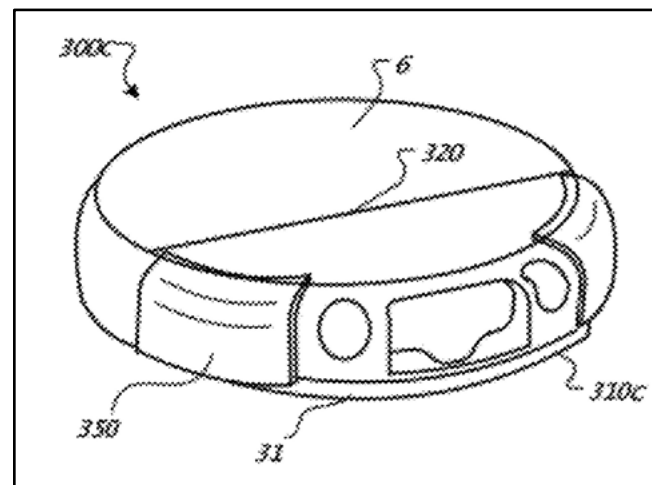


Id., Fig. 3C. Embodiments of Schnittman's cleaning robot include a drive assembly, cleaning assemblies, and a sensor suite, enabling behaviors such as debris-dependent spot cleaning, edge/cliff avoidance, and autonomous return to a maintenance/charging station. *Id.*, Fig. 2; ¶¶[0113], [0118]-[0119],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

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

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102. Schnittman discloses an autonomous cleaning robot having a debris monitoring system and onboard sensing for navigation and safety. *Id.*, Abstract, ¶¶[0002], [0004]-[0006]. An example of Schnittman's autonomous cleaning robots is depicted in Figure 3C:



Id., Fig. 3C.

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. *Id.*, Fig. 2; ¶¶[0113], [0118]-[0119], [0191]-[0203], [0113], [0216]-[0227].

104. In embodiments, Schnittman's cleaning robot further includes a dedicated microprocessor 245 that executes routines

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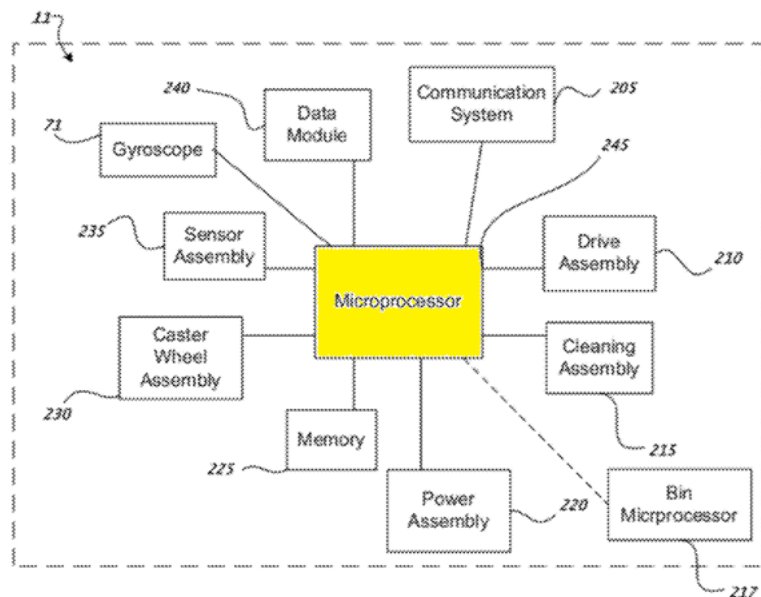


FIG. 2

Id., Fig. 2. 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.*

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

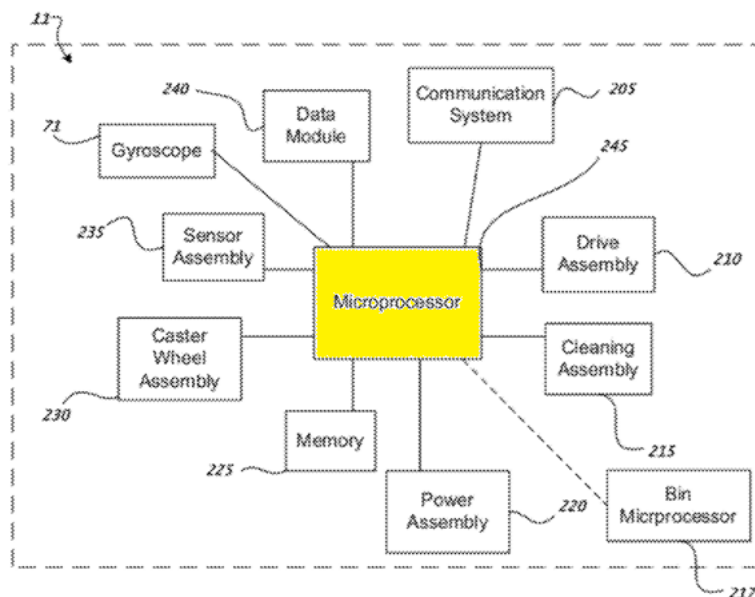


FIG. 2

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

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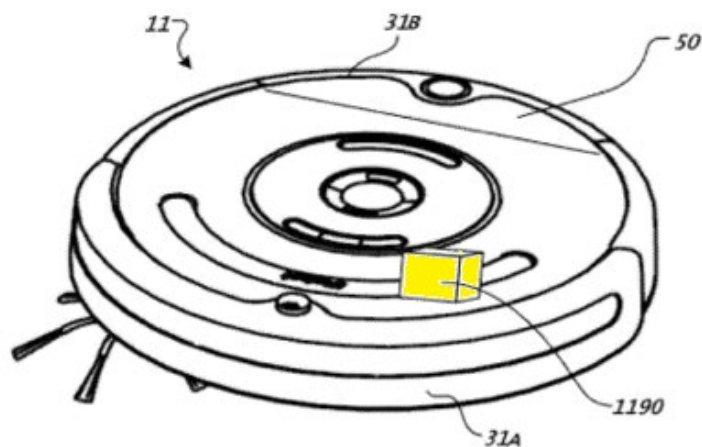


FIG. 11

Id., Fig. 11; *see also id.*, ¶[0045] (“In some implementations, the debris sensor includes a camera directed substantially forward of the cleaning apparatus. In certain implementations, the camera is movable to scan an area substantially forward of the cleaning apparatus.”).

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.” *Id.*, ¶[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.” *Id.*

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toward the forward portion of the robot 11, with a field of view beyond the perimeter of the robot 11” (*id.*, ¶[0204]):

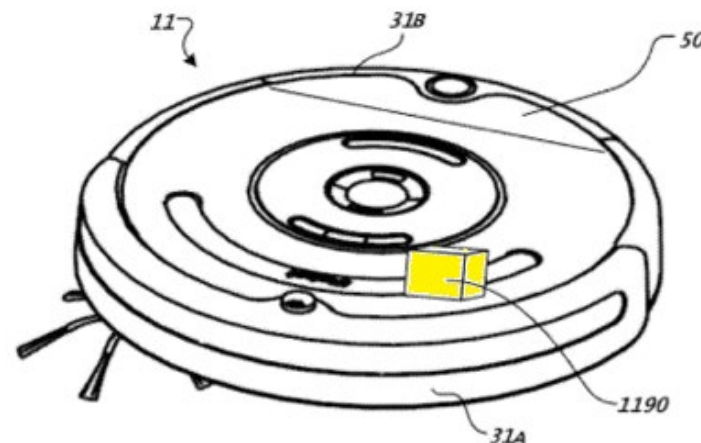


FIG. 11

Id., Fig. 11.

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.”} *Id.*, ¶[0045].

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.” *Id.*, ¶[0204]. For example, “the microprocessor 245 can process the signal

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	from the camera 1190 to recognize debris on the cleaning surface and maneuver the robot 11 toward the debris.” <i>Id.</i>
Section IV.D.4. 4. Independent Claim 1 Thus, Schnittman’s autonomous robotic cleaners disclose a “self-propelled ... cleaner for cleaning debris from a ... surface,” and as explained above, a POSA would have been motivated to apply Schnittman’s teachings in the pool-cleaning context for cleaning submerged surfaces in view of Benzler. Section IV.D.3. Therefore, Schnittman in view of Benzler renders obvious the “self-propelled pool cleaner for cleaning debris from a submerged surface of a swimming pool” recited in the preamble of claim 1. EX1010, ¶¶194-197. Schnittman discloses element 1a of claim 1. <i>Id.</i>, ¶¶198-200. Schnittman states that embodiments of its autonomous robotic cleaners include “a robot body 31 (<i>e.g.</i>, a chassis and/or housing) which carries an outer shell 6 connected to a bumper 5” (EX1008, ¶[0111]):	Section XI.D.3. 3. Independent Claim 1 197. Thus, Schnittman’s autonomous robotic cleaners disclose a “self-propelled ... cleaner for cleaning debris from a ... surface,” and as explained above, a POSA would have been motivated to apply Schnittman’s teachings in the pool-cleaning context for cleaning submerged surfaces in view of Benzler. Section XI.D.2. Therefore, Schnittman in view of Benzler renders obvious the “self-propelled pool cleaner for cleaning debris from a submerged surface of a swimming pool” recited in the preamble of claim 1. 198. Schnittman discloses element 1a of claim 1. Schnittman states that embodiments of its autonomous robotic cleaners include “a robot body 31 (<i>e.g.</i>, a chassis and/or housing) which carries an outer shell 6 connected to a bumper 5” (EX1008, ¶[0111]):

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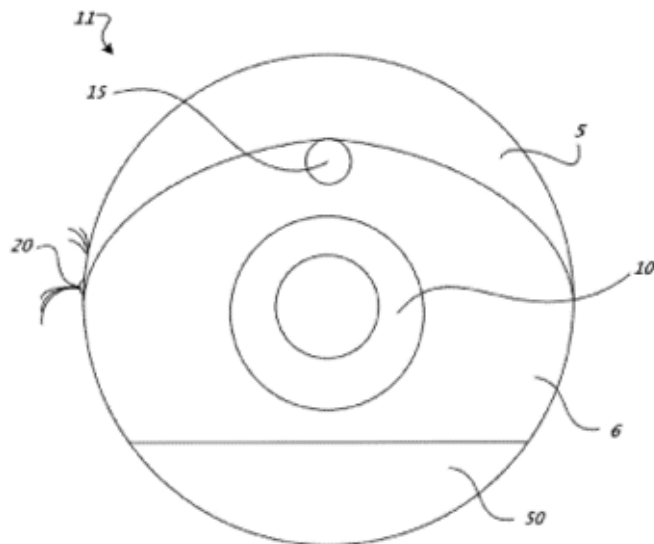


FIG. 1A

Id., Fig. 1A. In embodiments, the robot body 31 “carries a control panel 10 and an omnidirectional receiver 15, which has a 360 degree line of vision for detection of signals emitted towards the robot 11 from substantially all directions.” *Id.*, ¶[0111].

Schnittman’s robot body 31 discloses the claimed “vehicle body.” EX1010, ¶¶198-200.

Schnittman in view of Benzler would have rendered obvious element 1b of claim 1. *Id.*, ¶¶201-204. As explained in Section II.C.1 above, “means for moving the vehicle body within the swimming pool” is an MPF term, and the corresponding structures disclosed in the '191 Patent include “wheels, rollers, tracks or other surface contacting members powered by a motor and the like.” EX1001, 3:31-43.

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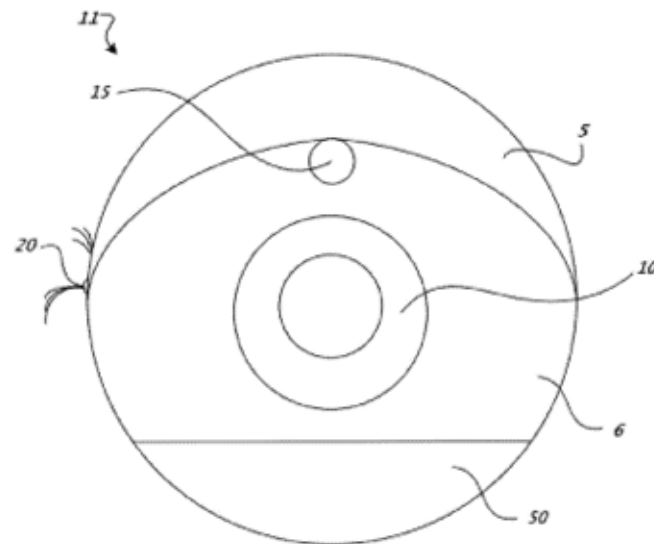


FIG. 1A

Id., Fig. 1A.

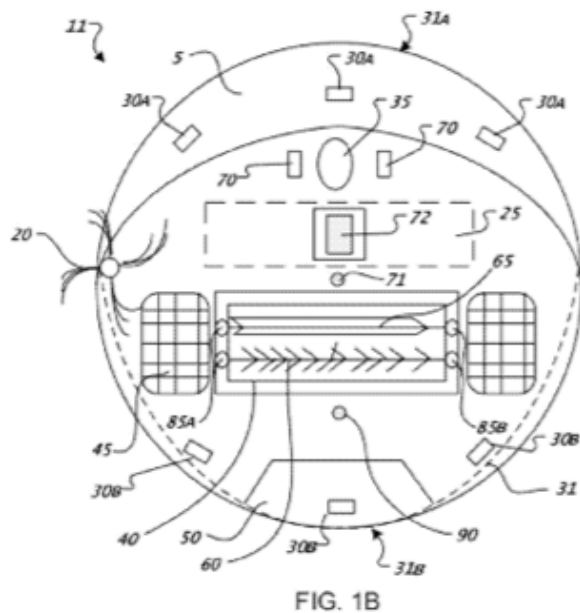
199. In embodiments, the robot body 31 “carries a control panel 10 and an omnidirectional receiver 15, which has a 360 degree line of vision for detection of signals emitted towards the robot 11 from substantially all directions.” *Id.*, ¶[0111].

200. Schnittman’s robot body 31 discloses the claimed “vehicle body.”

201. Schnittman in view of Benzler discloses or would have rendered obvious element 1b of claim 1. As explained in VIII above, “means for moving the vehicle body within the swimming pool” is an MPF term, and the corresponding structures disclosed in the '191 Patent include “wheels, rollers,

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Schnittman discloses “moving the vehicle body” and a corresponding structure described in the '191 Patent. As explained above for the preamble of claim 1, Schnittman’s autonomous robotic cleaners include an onboard drive system (also referred to as a “drive assembly”) for moving the robot, including its body. EX1008, ¶¶[0005], [0040], [0044], [0119], [0177]. The drive system “includes right and left differentially driven wheels 45, right and left wheel motors, and wheel encoders” in embodiments (*id.*, ¶[0119]):



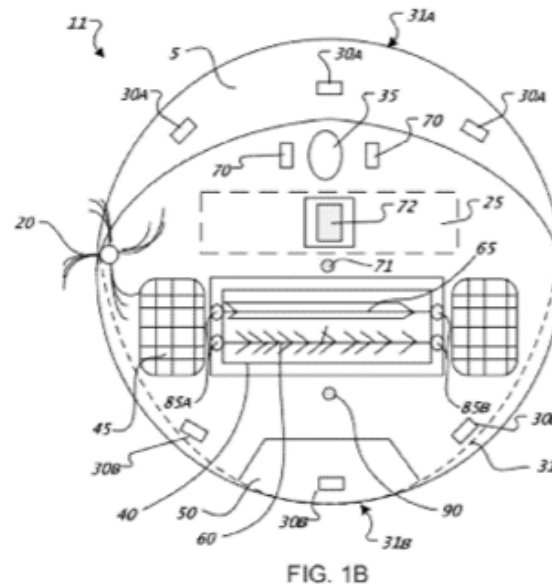
Id., Fig. 1B.

Schnittman’s “drive system is coupled to the [robot’s] housing

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tracks or other surface contacting members powered by a motor and the like.” EX1001, 3:31-43.

202. Schnittman discloses “moving the vehicle body” and a corresponding structure described in the '191 Patent. As explained above for the preamble of claim 1, Schnittman’s autonomous robotic cleaners include an onboard drive system (also referred to as a “drive assembly”) for moving the robot, including its body. EX1008, ¶¶[0005], [0040], [0044], [0119], [0177]. The drive system “includes right and left differentially driven wheels 45, right and left wheel motors, and wheel encoders” in embodiments (*id.*, ¶[0119]):



Id., Fig. 1B.

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and configured to maneuver the robot across a cleaning surface.” <i>Id.</i>, ¶[0005]. Further, the drive system is “operable to receive commands from the microprocessor 245” for controlling the movement of the robot. <i>Id.</i>, ¶[0119], [0177]. Schnittman thus discloses the claimed function (“moving the vehicle body”), and Schnittman’s wheels 45 powered by right and left wheel motors disclose a corresponding structure described in the ’191 Patent for performing this function. EX1010, ¶203. While Schnittman does not disclose moving its autonomous cleaning robots “within [a] swimming pool” specifically, as explained above, a POSA would have been motivated to apply Schnittman’s teachings in the pool-cleaning context in view of Benzler. Section IV.D.3. 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 (Ex. 1013, ¶[0028], [0051], Fig. 3) provides a drive system similar to that of Schnittman, reinforcing that Schnittman’s similar motor-powered wheels 45 could be readily adapted for underwater use. Therefore, Schnittman in view of Benzler renders obvious the “means for moving the vehicle body within the swimming pool (drive system).” EX1010, ¶[201-204]. Schnittman in view of Benzler would have rendered obvious element 1c of claim 1. <i>Id.</i>, ¶[205-206]. Schnittman discloses that embodiments of its autonomous robotic cleaners include an “internal filter 54” (EX1008, ¶[0117]):	203. Schnittman’s “drive system is coupled to the [robot’s] housing and configured to maneuver the robot across a cleaning surface.” <i>Id.</i>, ¶[0005]. Further, the drive system is “operable to receive commands from the microprocessor 245” for controlling the movement of the robot. <i>Id.</i>, ¶[0119], [0177]. Schnittman thus discloses the claimed function (“moving the vehicle body”), and Schnittman’s wheels 45 powered by right and left wheel motors disclose a corresponding structure described in the ’191 Patent for performing this function. 204. While Schnittman does not disclose moving its autonomous cleaning robots “within [a] swimming pool” specifically, as explained above, a POSA would have been motivated to apply Schnittman’s teachings in the pool-cleaning context in view of Benzler. Section XI.D.2. 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) provides a drive system similar to that of Schnittman, reinforcing that Schnittman’s similar motor-powered wheels 45 could be readily adapted for underwater use. Therefore, Schnittman in view of Benzler renders obvious the “means for moving the vehicle body within the swimming pool (drive system).” 205. Schnittman in view of Benzler discloses or would have rendered obvious element 1c of claim 1. Schnittman discloses that embodiments of its autonomous robotic cleaners include an “internal filter 54” (EX1008, ¶[0117]):

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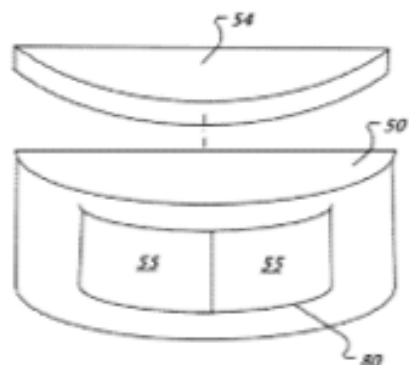


FIG. 1C

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

Schnittman's internal filter 54 is configured to retain debris collected from a cleaning surface, such as a "submerged surface" in a pool-cleaner implementation of Schnittman's robotic cleaner in view of Benzler. EX1010, ¶206. In embodiments, the internal filter 54 is part of the robot's cleaning bin 50, with the internal filter 54 retaining collected debris. *Id.*; EX1008, ¶¶[0117], [0121], [0123]-[0124] (internal filter must be cleaned to remove collected debris), [0129], [0242], [0248].

Schnittman in view of Benzler would have rendered obvious element 1d of claim 1. *Id.*, ¶¶207-210. Schnittman discloses that embodiments of its autonomous robotic cleaners include a camera, such as the exemplary camera 1190 of Figure 11:

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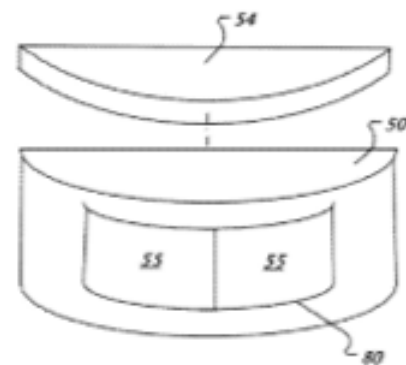


FIG. 1C

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

206. Schnittman's internal filter 54 is configured to retain debris collected from a cleaning surface, such as a "submerged surface" in a pool-cleaner implementation of Schnittman's robotic cleaner in view of Benzler. In embodiments, the internal filter 54 is part of the robot's cleaning bin 50, with the internal filter 54 retaining collected debris. EX1008, ¶¶[0117], [0121], [0123]-[0124] (internal filter must be cleaned to remove collected debris), [0129], [0242], [0248]. [Schnittman describes the operation of the filter in terms of filtering a "fluid" and uses debris carried in air as an example: "During use, a fluid stream 819 \(e.g., debris carried in air \) is drawn into the bin 50 ' by negative pressure created by rotation of the impeller 817 driven by the motor 815. EX1008, ¶\[0247\]. A pool-cleaner implementation of Schnittman would include a filter like that described in Schnittman, with the filter retaining debris collected by the robot while passing fluid \(filtered, clean water\) back into the swimming pool. Such on-board filters for pool-cleaning robots were well-known at the time of the alleged invention, and](#)

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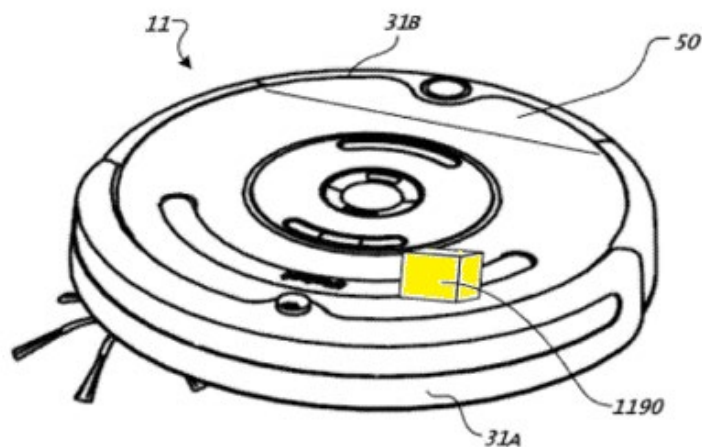


FIG. 11

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

As seen above, Schnittman's camera is positioned on or in the body of the robot. *Id.*, ¶[0204] ("Referring to FIG. 11, 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."). The camera captures an image of at least a first portion of a cleaning surface. EX1010, ¶208. Specifically, the camera "scan[s] an area substantially forward of the [robot]" as the "robot [moves] over the cleaning surface." EX1008, ¶¶[0045], [0204]. The camera is "in communication with [a] microprocessor 245," and the "microprocessor 245 ... process[es] [a] signal from the camera ... to recognize debris on the cleaning surface and maneuver the robot 11 toward the debris." *Id.*, ¶[0204]. As explained by Dr. Reinholtz, a POSA would have thus understood that Schnittman's

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a POSA would have understood how to modify or replace Schnittman's filter for use in Benzler's pool-cleaning context. I note that the same mechanical elements are commonly used to filter both water and air. These elements include a motor-driven impeller to move the fluid and a filter to retain the debris. In common wet/dry vacuum cleaners, these elements can handle either water or air as the fluid. A POSA's motivation for making such modifications is explained above in Section XI.D.2. Therefore, Schnittman in view of Benzler renders obvious "a filter [i.e., Schnittman's internal filter 54] configured to retain debris collected from the submerged surface."

207. Schnittman in view of Benzler discloses or would have rendered obvious element 1d of claim 1. Schnittman discloses that embodiments of its autonomous robotic cleaners include a camera, such as the exemplary camera 1190 of Figure 11:

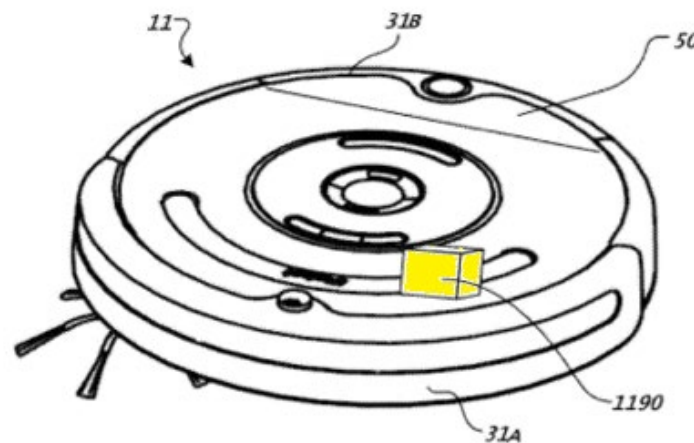


FIG. 11

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camera captures an image of at least a portion of the cleaning surface: The microprocessor could not “recognize debris on the cleaning surface” absent an image of the cleaning surface captured by the camera. EX1010, ¶208. While Schnittman does not disclose capturing an image of a “submerged [underwater] surface” specifically, a pool-cleaner implementation of Schnittman in view of Benzler would capture such an image, and a POSA would have been motivated to pursue such an implementation for the reasons in Section IV.D.3 above. <i>Id.</i>, ¶¶179-192, 210. Accordingly, Schnittman in view of Benzler renders obvious the claimed “at least one camera [camera 1190] positioned on or in the body for capturing an image of at least a first portion of the submerged surface.” <i>Id.</i>, ¶¶207-210.	EX1008, Fig. 11; <i>see also id.</i>, ¶¶[0045], [0204]-[0205]. 208. As seen above, Schnittman’s camera is positioned on or in the body of the robot. <i>Id.</i>, ¶[0204] (“Referring to FIG. 11, 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.”). The camera captures an image of at least a first portion of a cleaning surface. Specifically, the camera “scan[s] an area substantially forward of the [robot]” as the “robot [moves] over the cleaning surface.” EX1008, ¶¶[0045], [0204]. The camera is “in communication with [a] microprocessor 245,” and the “microprocessor 245 ... process[es] [a] signal from the camera ... to recognize debris on the cleaning surface and maneuver the robot 11 toward the debris.” <i>Id.</i>, ¶[0204]. A POSA would have thus understood that Schnittman’s camera captures an image of at least a portion of the cleaning surface: The microprocessor could not “recognize debris on the cleaning surface” absent an image of the cleaning surface captured by the camera. <u>209. By the July 10, 2012 priority date of the ‘191 patent, the use of cameras in underwater environments was commonplace, as evidenced by the previously cited chapter “Computer Vision Applications In the Navigation of Unmanned Underwater Vehicles” in the 2009 monograph “Underwater Vehicles” (EX1026) and by the common use of underwater cameras and computer vision systems in student competitions as evidenced by the RoboSub SubjuGator paper. See EX1017. The team I advised at the 2011 RoboSub competition used two GoPro HERO HD cameras for vision. EX1028. Each camera provided a 170 degree horizontal and 127 degree vertical field of view.</u>

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	<u><i>Id.</i> Each camera was mounted in a waterproof GoPro HERO Stereo vision case that was tethered to the main computer and electronics box via USB cables. <i>Id.</i> The vision system was able to reliably detect different colored objects in tests conducted in the university swimming pool. <i>Id.</i></u> 210. While Schnittman does not disclose capturing an image of a “submerged [<i>i.e.</i>, underwater] surface,” specifically, a pool-cleaner implementation of Schnittman in view of Benzler would capture such an image, and a POSA would have been motivated to pursue such an implementation for the reasons in Section XI.D.2 above. Accordingly, Schnittman in view of Benzler renders obvious the claimed “at least one camera [<i>i.e.</i>, Schnittman’s camera 1190] positioned on or in the body for capturing an image of at least a first portion of the submerged surface.”
Section IV.D.5. 5. Independent Claim 2 Claim 2 of the '191 Patent is unpatentable over Schnittman in view of Benzler for the reasons explained above for claim 1. <i>See also</i> Section IV.A.3.	Section XI.D.4. 4. Independent Claim 2 221. Claim 2 of the '191 Patent is unpatentable over Schnittman in view of Benzler for the reasons explained above for claim 1. <i>See also</i> Section XI.A.2.
Section IV.D.6. 6. Independent Claim 3 Claim 3 of the '191 Patent is unpatentable over Schnittman in view of Benzler for the reasons explained above for claim 1. <i>See also</i> Section IV.A.4.	Section XI.D.5. 5. Independent Claim 3 222. Claim 3 of the '191 Patent is unpatentable over Schnittman in view of Benzler for the reasons explained above for claim 1. <i>See also</i> Section XI.A.3.