

Petition ¹	Declaration
IV. INVALIDITY GROUNDS A. Ground 1A: Claims 1-5 Unpatentable over Durvasula with Fu-007 1. Durvasula Durvasula (EX1014) is U.S. Patent Application Publication No. US20140015959A1 of Patent Owner's '918 Application published on January 16, 2014. Durvasula is prior art under AIA 35 U.S.C. §102(a)(1) and pre-AIA 35 U.S.C. §102(b). Durvasula discloses a pool cleaning system and contains technical features that are identical or similar to those of the '766 Patent and is analogous art. Janét, ¶¶97-98. 2. Fu-007 Fu-007 (EX1007) is prior art under AIA 35 U.S.C. §102(a)(1) and pre-AIA 35 U.S.C. §102(b). Janét, ¶99.	IV. INVALIDITY GROUNDS A. Ground 1: Claims 1-5 Are Unpatentable under AIA 35 U.S.C. §103 over Durvasula with Fu-007. 1. Durvasula 97. Durvasula (EX1014) is U.S. Patent Application Publication No. US20140015959A1 of Patent Owner's '918 Application that was published on January 16, 2014. Durvasula is prior art under AIA 35 U.S.C. §102(a)(1) and is not subject to exceptions under AIA 35 U.S.C. §102(b)(1) because it was published more than one year before its effective filing date which is no earlier than July 11, 2016. See §VI.C, <i>supra</i>. Additionally, Durvasula is also prior art under pre-AIA 35 U.S.C. §102(b). 98. Durvasula discloses a pool cleaning system and contains technical features that, in my opinion, are identical or similar to those of the '766 Patent and is analogous art with respect to Claims 1-5 of the '766 Patent. 2. Fu-007 99. Fu-007 (EX1007) is Chinese Patent Application Publication No. CN 101139007A published on March 12, 2008 and is prior art under AIA 35 U.S.C. §102(a)(1) and is not subject to exceptions under AIA 35 U.S.C. §102(b)(1) because it was published more than one year before its effective filing date which is no earlier than July 11, 2016. See §VI.C, <i>supra</i>. In

¹ The background section on the Patent and the Priority date were also identical but they are not included in this exhibit, only the substantive arguments are.

Fu-007 discloses an underwater cleaning robot for swimming pools using camera-based control. Fu-007, Abstract, pp.8-103, 14-16, Claims 1, 4. Fu-007 is analogous art. Janét, ¶100. Fu-007's robot includes a control system with a central processing unit housed in control system enclosure 8, which housed within a sealed drive control enclosure, which is "installed on...the interior of the robot main shell 19...to sealingly enclose the control system components" and "has waterproof properties." Fu-007, pp.8-9, 12-14, Claim 4, FIGS. 1-2, 4 (annotated below). [image omitted] Fu-007's robot also includes monitoring camera 2 connected to the central processing unit. Fu-007, pp.8-9, 12-14, Claim 4, FIGS. 1, 6 (annotated below). [image omitted]	addition, Fu-007 is also prior art under pre-AIA 35 U.S.C. §102(b). 100. Fu-007 discloses an underwater cleaning robot for swimming pools using camera-based control. Fu-007, Abstract, pp.8-103, 14-16, Claims 1, 4. In my opinion, Fu-007 is analogue art with respect to the subject matter of Claims 1-5 of the '766 Patent. 101. Fu-007's robot includes a control system with a central processing unit (controller) housed in control system enclosure 8. Fu-007, pp.8-9, 12-14, Claim 4, FIGS. 1-2 (annotated below). [image omitted] 102. Control system enclosure 8 is housed within a sealed drive control enclosure, which is "installed on and fixed to the interior of the robot main shell 19...to sealingly enclose the control system components" and "has waterproof properties." Fu-007, pp.8-9, 12-14, Claim 4, FIG. 4 (annotated below). [image omitted] 103. Fu-007's robot also includes monitoring camera 2 "installed on two front panels of the robot main shell 19" and connected to the central processing unit via image acquisition card. Fu-007, pp.8-9, 12-14, Claim 4, FIGS. 1, 4, 6 (annotated). [image omitted] 104. Fu-007's control system enclosure 8 is "provided with both a power input interface and a rechargeable battery box, allowing
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3. Motivation to Combine Both Durvasula and Fu-007 disclose underwater cleaning robots for pools using camera-based control, and both sought to improve autonomous pool cleaning. Janet, ¶105. Durvasula describes vehicle 30 as “an automated powered device” that autonomously cleans pool surfaces. Durvasula, [0014]. Fu-007 similarly describes an underwater cleaning robot that can “help and even replace humans to autonomously complete underwater cleaning work.” Fu-007, p.11. POSITAs would have been motivated to combine the complementary teachings of Durvasula and Fu-007 to improve autonomous pool cleaning. Janet, ¶¶105-111. POSITAs would have recognized that both address similar technical issues in the same pool cleaning field with similar solutions. Janet, ¶¶105-106. Both teach using a controller to generate control signals based on captured images to move the pool cleaner. <i>Compare</i> Durvasula, [0020], [0022]-[0023], with Fu-007, pp.10, 14-16, Claims 4, 7. Accordingly, POSITAs would have looked to both for guidance when designing pool cleaning systems. Janet, ¶¶105-106.	the robot to be powered either externally or by the battery box.” Fu-007, pp.8-9, 12-14, Claim 4. During autonomous cleaning, Fu-007’s central processing unit generates control signals based on images from monitoring camera 2—the robot “determines a cleanliness level of the bottom of the swimming pool by comparing the image(s) with the threshold, and plans a cleaning movement...to complete the cleaning task.” Fu-007, p.10, 14-16, Claim 7. Fu-007’s robot may operate “powered by the battery box,” enabling untethered operation. Fu-007, pp.8-10, 12-14, Claims 4-5. 3. Reasons for Combining Durvasula and Fu-007 105. Both Durvasula and Fu-007 disclose underwater cleaning robots for swimming pools using camera-based control, and both sought to improve autonomous pool cleaning operations. Durvasula describes vehicle 30 as “an automated powered device” that autonomously cleans pool surfaces. Durvasula, [0014]. Fu-007 similarly describes an underwater cleaning robot that can “help and even replace humans to autonomously complete underwater cleaning work.” Fu-007, p.11. A POSITA would have been motivated to combine the complementary teachings of Durvasula and Fu-007 to achieve improved autonomous pool cleaning operations. 106. A POSITA would have recognized that the teachings in Durvasula and Fu-007 are directed to the same pool cleaning technical field, are based on recognition of the same or similar technical issues in pool cleaning, and provide similar technical solutions to address those issues. Specifically, both references use a controller to generate, in response to captured images, control signals to cause movement of the pool cleaning body within the swimming pool. <i>Compare</i> Durvasula, [0020], [0022]-
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Fu-007 places its controller within the vehicle. Fu-007, pp.8-9, 12-14, Claim 4; Janét, ¶107. Hence, Fu-007 differs from Durvasula's placement of the controller outside the pool in a tethered configuration, or a remote server or portable electronic device (PED) (Durvasula, [0013]-[0039], [0045]-[0046], FIGS. 1-5, 9, Claims 2-4, 10). Janét, ¶107.

POSITAs would have been motivated to modify Durvasula by substituting Durvasula's external controller with Fu-007's onboard controller for various reasons. Janét, ¶¶107-111. For example, Durvasula relies on an external controller and tether, which constrains autonomy by limiting range and requiring human intervention to manage cable entanglements, but Fu-007 moves the architecture onboard—specifically positioning the controller, camera connection, and power source within the body—allows the robot to operate autonomously. Fu-007, p.11; Janét, ¶108. POSITAs would have recognized that integrating Fu-007's onboard controller would have enhanced autonomous operations by generating control signals onboard to plan paths and complete cleaning tasks, allowing the vehicle to navigate freely without cable constraints or human interventions. Janét, ¶108.

[0023], with Fu-007, pp.10, 14-16, Claims 4, 7. Accordingly, a POSITA would have investigated the technical teachings in both Durvasula and Fu-007 to seek guidance when designing a pool cleaning system for specific pool cleaning considerations and applications.

107. Durvasula teaches placing the controller in a dry station outside the pool in a tethered configuration, or a remote server or portable electronic device (PED) in a wireless configuration (Durvasula, [0013]-[0039], [0045]-[0046], FIGS. 1-5, 9, Claims 2-4, 10). Fu-007 teaches placing its controller within the cleaning and moving platform as part of a sealed drive control enclosure suitable for underwater operation. Fu-007, pp.8-9, 12-14, Claim 4. A POSITA would have been motivated to modify Durvasula by substituting Durvasula's external controller with Fu-007's onboard controller structure for at least two reasons.

108. First, a POSITA would have been guided by Durvasula and Fu-007 to make such a combination to advance Durvasula's goal of autonomous pool cleaning by eliminating physical dependencies on external infrastructure. Durvasula's reliance on an external controller and tether constrains autonomy by limiting range and often requiring human intervention to manage cable entanglements. Fu-007 explicitly teaches that moving the architecture onboard—specifically positioning the controller, camera connection, and power source within the body—allows the robot to operate autonomously. Fu-007, p.11. A POSITA would have recognized that by integrating Fu-007's onboard controller, the modified system would have enhanced autonomous operations—generating control signals onboard to plan paths and complete cleaning tasks without requiring human supervision or corresponding transmission of data (e.g., images, control signals) between the underwater cleaner and an external

As another example, POSITAs would have been motivated to make this modification to further improve the safety of Durvasula's system. Janét, ¶¶109-110. Durvasula discloses a tethered configuration that transmits power to the vehicle through a cable. Durvasula, [0025] ("provid[ing] electrical power to vehicle 30 in a wired fashion"), [0029], [0045], FIG.9; Janét, ¶109. Fu-007 teaches a safer architecture including a "sealed drive control enclosure" with "waterproof properties" and a "rechargeable battery box" that allows operation "without using the signal relay and cable manager 28 and the signal and power cable 33." Fu-007, pp.8-9, 12-14, Claim 4; Janét, ¶110. POSITAs would have been motivated to replace Durvasula's tethered controller configuration with Fu-007's onboard, sealed, battery-powered architecture, because this modification would have eliminated the need for the power cable—thereby removing the potential electrical leakage and enhancing the overall safety. Janét, ¶¶109-111.

controller located outside the water (in a dry station, a remote server, or a portable electronic device (Durvasula, [0013]-[0039], [0045]-[0046], FIGS. 1-5, 9, Claims 2-4, 10)). Additionally, removing the external tether would allow the vehicle to navigate freely without cable management constraints. Durvasula's cable can become tangled with pool features such as ladders, drains, and return fittings during cleaning operations, potentially interrupting the cleaning cycle and requiring user intervention. Fu-007's tetherless design avoids these complications, allowing the robot to navigate complex pool geometries without obstruction. Fu-007, pp.9-10, 14. Even if a power tether were retained, relocating the controller onboard would eliminate or reduce the need for signal transmission through the tether, reducing its diameter and mass and resulting in less hydrodynamic drag and impedance to movement.

109. Second, a POSITA would have been motivated to adopt this modification to further improve the safety of Durvasula's system. Durvasula discloses a tethered configuration that transmits both control signals and power to the vehicle through an external cable. Durvasula, [0045], FIG.9. See also id., [0025] ("dry station 46 further provides electrical power to vehicle 30 in a wired fashion"), [0029] ("dry station 246 further provides part of vehicle 30 across a wired cable or wired connection"). A POSITA would have recognized that tethered systems introduce safety risks by requiring a physical electrical connection between shoreside components and the submerged cleaner, creating potential pathways for electrical leakage into the swimming pool environment if cable insulation wears down or connections become compromised. A POSITA would have further recognized that this risk is exacerbated in swimming pool environments, where dissolved chemicals (e.g., chlorine,

POSITAs would have reasonably expected success, because positioning the controller in the vehicle body was a well-known design choice in autonomous pool cleaning robots, as shown by the teachings in Fu-007. Fu-007, pp.8-10; Knoll, [0007], [0027]-[0028], FIG.1; §§IV.D.1-IV.D.2; Renaud (EX1017), [0008]-[0009], [0029]-[0030]; §§IV.G.1-IV.G.2; Janét, ¶111. Additionally, Fu-007's onboard controller is already configured to execute image-based cleaning tasks similar to Durvasula's—	calcium, pH balancers, algacides) increase water conductivity and thus the potential for electrical current to reach pool users. 110. Fu-007 teaches a safer architecture that eliminates the external tether, including the power cable. Fu-007 discloses a “sealed drive control enclosure” with “waterproof properties” that houses the controller entirely inside the robot, and a “rechargeable battery box” that allows the robot to operate “without using the signal relay and cable manager 28 and the signal and power cable 33.” Fu-007, pp.8–9, 12–14, Claim 4. A POSITA would have been motivated to replace Durvasula's tethered controller configuration with Fu-007's onboard, sealed, battery-powered architecture, because this modification would have eliminated the need for external cables entering the water—including power cables—thereby removing the primary pathway for electrical leakage and enhancing the overall safety profile of the device for pool users. 111. A POSITA would have had a reasonable expectation of success in making this combination because positioning the controller on the vehicle body was a well-known design choice in autonomous pool cleaning robots, as shown by the teachings in Fu-007. <i>See, e.g.</i>, Fu-007, pp.8–10. <i>See also</i> Knoll, [0007], [0027]-[0028], FIG.1 (showing control unit 11 inside the vehicle that receives images from camera 6, processes the images, and controls the drive means 12 accordingly, as explained in §§VII.D.1-VII.D.2); Renaud (EX1017), [0008], [0009], [0029]-[0030] (disclosing a processing device/microprocessor inside the cleaner that receives images from a vision system, processes the images to identify debris, and actuates the motor to direct the cleaner to the debris, as explained in §§VII.G.1-VII.G.2). Additionally, Fu-007's onboard controller is already configured to execute image based cleaning tasks similar to Durvasula's—
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analyzing images and generating drive signals to move the vehicle (Fu-007, pp.8-10, 14-16) so POSITAs would have reasonably expected that Fu-007's controller would implement Durvasula's control logic (e.g., processing images to steer toward missed portions; Durvasula, [0020], [0022]-[0023]), thereby yielding predictable results. Janet, ¶111.

4. Claim 1 Unpatentable over Durvasula and Fu-007

Durvasula and Fu-007 render claim 1 obvious. Janet, ¶¶112-136.

a. 1[pre]

Durvasula discloses or suggests 1[pre]. Janet, ¶¶113-116.

Durvasula discloses a “self-propelled pool cleaner for cleaning debris from a submerged surface of a swimming pool.” Durvasula, FIGS. 1-10 and [0002]-[0012], [0014], [0031], [0045]-[0046], Claims 1, 17, FIGS. 1, 9 (annotated below); Janet, ¶¶114-116.

[image omitted]

analyzing captured images and generating drive signals to control the vehicle's movement. Fu-007, pp.8-10, 14-16. A POSITA would have reasonably expected that Fu-007's controller could implement Durvasula's specific control logic (e.g., processing images to steer toward missed portions; Durvasula, [0020], [0022]-[0023]), thereby yielding predictable results.

4. Claim 1 Unpatentable over Durvasula and Fu-007

112. In my opinion, Durvasula and Fu-007 render independent claim 1 obvious.

a. 1[pre] “A self-propelled pool cleaner for cleaning debris from a submerged surface of a swimming pool, comprising”

113. In my opinion, Durvasula discloses or suggests 1[pre].

114. Durvasula discloses a “pool cleaner” by disclosing a pool cleaning vehicle as part of a pool cleaning system. Durvasula, FIGS. 1-10 and [0002]-[0012]. Durvasula describes “[v]ehicle 30 comprises an automated powered device configured to travel adjacent to submerged or water containing surfaces of pool 20...while cleaning such surfaces” and “[v]ehicle 830 comprises a robotic or automated pool cleaning device...to systematically clean surfaces of pool 22.” Durvasula, [0014], [0046], FIGS. 1, 9 (annotated below). See also Durvasula, 0031] (“wherein controller 42 generates control signals for steering the pool cleaning vehicle 30 of system 320”), [0045] (“Pool cleaning system 820 is similar to pool cleaning system 520 except the pool cleaning system 820 located controller 42 in dry station 246 and includes pool cleaning vehicle 830, a specific

b. 1[a]	example of vehicle 30”), Abstract (“A pool cleaning system utilizes a powered robotic surface cleaning vehicle”), Claims 1, 17. [image omitted] 115. Durvasula discloses its pool cleaning vehicle as a “self-propelled” pool cleaner: “[v]ehicle 30 comprises an automated powered device,” “includes one or more propulsion mechanisms” to “move along the submerged surfaces of pool 22,” and “[c]ontroller 42 is configured to generate control signals for steering vehicle 30.” Durvasula, [0014], [0016], [0022], FIG. 1 (annotated above); <i>see also id.</i>, [0023], [0026], [0030]-[0031], [0034], FIGS. 2-10. 116. Durvasula discloses its pool cleaning vehicle 30 as a pool cleaner “cleaning debris from a submerged surface of a swimming pool” throughout its description, including, e.g., “vehicle 30 may include vacuum or suction devices, a liquid circulation system and a filter to draw debris, such as bacterial growth or plant growth, from such pool surfaces, wherein the drawn liquid containing such residue or foreign matter is filtered to collect the debris.” (Durvasula, [0014]; <i>see also id.</i> [0015]-[0016]); “[v]ehicle 830 comprises a robotic or automated pool cleaning device...to systematically clean surfaces of pool 22” and “[v]ehicle 830 comprises rotating brushes 902 to loosen waterline buildup and breakdown large debris” (Durvasula, [0046], FIGS. 9-10 (annotated below)). [image omitted] b. 1[a] “a. a vehicle body”
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Durvasula discloses vehicle 30/830 as a vehicle body. Durvasula, [0014]-[0015], [0046], Claims 1, 17, FIGS. 1 (annotated below), 2-5, 9 (annotated below), 10; Janet, ¶¶117-118. [image omitted] c. 1[b] Limitation 1[b] invokes §112¶6/§112(f); the function is “moving the vehicle body within the swimming pool,” and the corresponding structure includes “wheels, rollers, tracks...powered by a motor.” <i>See</i> §III.E. Durvasula discloses this function and structure by describing moving the vehicle using “wheels, rollers, [or] tracks.” Durvasula, [0014], [0016], [0046], Claims 1, 17, FIGS. 9-10 (annotated below); Janet, ¶¶119-121. [image omitted]	117. In my opinion, Durvasula discloses or suggests 1[a]. 118. Durvasula discloses vehicle 30/830 as a vehicle body. Durvasula, [0014]-[0015], [0046], Claims 1, 17, FIGS. 1 (annotated below), 2-5, 9 (annotated below), 10. A POSITA would have understood vehicle 30/830 that travels within the pool is the claimed “vehicle body.” [image omitted] c. 1[b] “b. means for moving the vehicle bod within the swimming pool” 119. In my opinion, Durvasula discloses or suggests 1[b]. 120. In my opinion, the format and content of 1[b] invoke claim interpretation under pre-AIA 35 U.S.C. §112 ¶6, or 35 U.S.C. §112(f). As explained in §VI.D, the recited function for the claimed “means for” is “moving the vehicle body within the swimming pool,” and the corresponding structure in the description of the ’766 Patent is “wheels, rollers, tracks, or other surface contacting members powered by a motor.” EX1001, 3:31-43, 10:12-14, FIGS. 9-10. 121. In my opinion, Durvasula discloses identical function and corresponding structure disclosed in the ’766 Patent. Function: <i>see, e.g.,</i> Durvasula, [0014] (“[v]ehicle 30 comprises an automated powered device configured to travel adjacent to submerged or water containing surfaces of pool 20”); <i>see also id.</i>, Abstract, [0016], [0023], Claims 1, 17, FIGS. 9-10. Structure: <i>see, e.g., id.</i>, [0016] (“vehicle 30 is propelled along the submerged pool surfaces using wheels, rollers, tracks or
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d. 1[c] Durvasula discloses 1[c]: “vehicle 30 may include...a filter to draw debris” and an “internally housed filter bag” through which “loosened dirt and debris” passes. <i>Id.</i>, [0014], [0046]; Janet, ¶122. e. 1[d] Durvasula discloses cameras 32 that are “configured to capture images of submerged surfaces 26, 28 of pool 22,” and “cameras 32 may...be mounted to vehicle 30.” Durvasula, [0013]-[0014], [0017]; Janét, ¶123. f. 1[e][i] The Durvasula-Fu-007 combination discloses or suggests the claimed controller in 1[e][i]. Janét, ¶¶124-128. Durvasula describes controller 42 that “is in communication with vehicle 30 and cameras 32” and “is configured to generate control signals for steering vehicle 30.” Durvasula, [0020],	other surface contacting members powered by a motor”); <i>see also id.</i>, [0046], FIGS. 9-10 (annotated below). [image omitted] d. 1[c] “c. a filter configured to retain debris collected from the submerged surface;” 122. In my opinion, Durvasula discloses “a filter configured to retain debris” because Durvasula describes “vehicle 30 may include...a filter to draw debris” and an “internally housed filter bag” through which “loosened dirt and debris” passes. <i>Id.</i>, [0014], [0046]. e. 1[d] “d. at least one camera mounted directly or indirectly to the body for capturing an image of at least a first portion of the submerged surface; and” 123. In my opinion, Durvasula discloses cameras 32 that are “configured to capture images of submerged surfaces 26, 28 of pool 22,” and “cameras 32 may...be mounted to vehicle 30.” Durvasula, [0013]-[0014], [0017]. f.1[e][i] “e. a controller (i) positioned on or in the body” 124. It is my opinion that the Durvasula-Fu-007 combination discloses or suggests 1[e][i]. 125. Durvasula discloses a controller. Specifically, Durvasula describes controller 42 that “is in communication with vehicle 30 and cameras 32” and “is configured to generate control
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[0022]. Controller 42 “utilizes signals from camera 32 to steer vehicle 30” to “cover such missed portions” and “to re-clean such portions until such portions have been satisfactorily cleaned.” Durvasula, [0023].

As explained in §III.C.1, Durvasula fails to disclose that its controller is “positioned on or in the body.” Janét, ¶¶81-86, 125-126.

Like Durvasula, Fu-007 discloses an underwater cleaning robot for swimming pools using camera-based control. §IV.A.2.

Fu-007’s system includes monitoring camera 2, image acquisition card, central processing unit (controller) **housed in control system enclosure 8**, and cleaning and moving platform with cleaning drive wheels 3. Fu-007, pp.12-14, Claims 1, 3, FIGS.1-2 (annotated below); Janét, ¶¶97-106, 127.

[image omitted]

Similar to Durvasula, Fu-007 teaches using cleaning drive wheels, belt gears, and drive belts as part of a cleaning and moving platform to control the movement of the platform during the pool cleaning operation. Fu-007, pp.8-9, 12-14, Claims 1, 3. Janét, ¶¶95-106, 127.

For the reasons explained in §IV.A.3, POSITAs would have been motivated to modify Durvasula by substituting Durvasula’s external controller with Fu-007’s onboard controller structure housed in Fu-007’s “sealed drive control enclosure” inside

signals for steering vehicle 30.” Durvasula, [0020], [0022]. Durvasula further describes that controller 42 “utilizes signals from camera 32 to steer vehicle 30” to “cover such missed portions” and “to re-clean such portions until such portions have been satisfactorily cleaned.” Durvasula, [0023].

126. As explained in §VI.C.1 regarding the relationship between the ’918 Application and the ’766 Patent in connection with the claimed priority to the ’918 Application, Durvasula, the patent publication of the ’918 Application, fails to disclose that its controller is “positioned on or in the body.”

127. Like Durvasula, Fu-007 discloses an underwater cleaning robot for swimming pools using camera-based control. *See* §VII.A.2. **Like Durvasula, Fu-007 uses a controller to generate, in response to the captured image, at least one control signal to cause movement of the pool cleaning body within the swimming pool.** Specifically, Fu-007’s system includes monitoring camera 2, image acquisition card, central processing unit (controller) housed in control system enclosure 8, and cleaning and moving platform with independently controllable cleaning drive wheels 3 and drainage devices. **Fu-007, pp.12-14, Claims 1, 3, FIGS.1-2 (annotated below).** Similar to the teaching in Durvasula for moving the pool cleaning vehicle, Fu-007 teaches the use of cleaning drive wheels, synchronous belt gears, and synchronous drive belts as part of a cleaning and moving platform to cause and control the movement of the platform during the pool cleaning operation. Fu-007, pp.8-9, 12-14, Claims 1, 3.

128. For the reasons explained in §VII.A.3, a POSITA would have been motivated to modify Durvasula by substituting Durvasula’s external controller with Fu-007’s onboard controller structure. The modified system incorporates Fu-007’s central

Durvasula's vehicle. Janét, ¶¶105-111, 128. Additionally, Fu-007's onboard controller would be in electronic communication with Durvasula's camera via onboard connection (per Fu-007's image acquisition card; pp.12-14), powered by an onboard power source (per Fu-007's rechargeable battery box; pp.12-14), and generates control signals for steering the vehicle based on camera-captured images to clean or re-clean portions of the pool (per Durvasula's control logic). Janét, ¶¶105-111, 128.

g. 1[e][ii]

Durvasula-Fu-007 combination discloses or suggests 1[e][ii]. Janét, ¶¶129-131.

Durvasula describes controller 42 "communicates with...cameras 32...across a wired connection," "across a wireless connection," or "using a combination of both wired and wireless communication connections," and "utilizes signals from camera 32 to steer vehicle 30." Durvasula, [0020]-[0021], [0023].

As explained in §§IV.A.3&IV.A.4.f (1[e][i]), POSITAs would have been motivated, and reasonably expected success, to modify Durvasula to replace Durvasula's external controller with Fu-007's onboard controller structure, where the onboard controller is in electronic communication with Durvasula's camera via Fu-007's internal connection architecture (the camera connects to the controller via an "image acquisition card"). Fu-007, pp.12-14, Claim 4, FIGS. 1, 4, 6; Janét, ¶¶105-111, 124-131.

processing unit (controller), which is housed in the "sealed drive control enclosure" inside Durvasula's vehicle. In such modified system, Fu-007's onboard controller within the cleaning and moving platform would be in electronic communication with Durvasula's camera mounted to the vehicle body via onboard connection (per Fu-007's image acquisition card; pp.12-14), powered by an onboard power source (per Fu-007's rechargeable battery box; pp.12-14), and generates control signals for steering the vehicle based on camera-captured images to clean or re-clean portions of the pool (per Durvasula's control logic).

g. 1[e][ii] "(ii) in electronic communication with the at least one camera, and"

129. It is my opinion that Durvasula-Fu-007 combination discloses or suggests 1[e][ii].

130. Durvasula describes controller 42 "communicates with...cameras 32...across a wired connection," "across a wireless connection," or "using a combination of both wired and wireless communication connections," and "utilizes signals from camera 32 to steer vehicle 30." Durvasula, [0020]-[0021], [0023].

131. As explained in §VII.A.3, §VII.A.4.f (1[e][i]), with a reasonable expectation of success, a POSITA would have been motivated to modify Durvasula's system by substituting Durvasula's external controller with an onboard controller structure taught by Fu-007, where the onboard controller is in electronic communication with the camera (mounted to the vehicle body) via Fu-007's internal connection architecture (specifically, the camera connects to the central processing unit

h. 1[e][iii]

Durvasula's controller 42 generates control signals "in response to the captured image," because controller 42 identifies a portion requiring cleaning or re-cleaning based on "signals from camera 32," and steers vehicle 30 accordingly. Durvasula, [0022]-[0023]; Janét, ¶133. Durvasula discloses generating control signals to cause movement "to...the first portion of the submerged surface," because Durvasula's controller 42 steers vehicle 30 to "cover such missed portions" and to "re-clean such portions." Durvasula, [0023], [0026], [0044]. Janét, ¶133.

As explained in §§IV.A.3&IV.A.4.f (1[e][i]), POSITAs would have been motivated, and reasonably expected success, to modify Durvasula's system to use Fu-007's onboard controller structure to execute Durvasula's control logic, including generating control signals to cause the body movement "to...the first portion of the submerged surface" in response to the captured image described above. Janét, ¶134.

via an "image acquisition card"). Fu-007, pp.12-14, Claim 4, FIGS. 1, 4, 6.

h. 1[e][iii] "(iii) 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."

132. In my opinion, the Durvasula-Fu-007 combination discloses or suggests 1[e][iii].

133. Specifically, Durvasula's controller 42 generates control signals "in response to the captured image" because controller 42 identifies a portion requiring cleaning or re-cleaning based on "signals from camera 32," and steers vehicle 30 accordingly. Durvasula, [0022]-[0023]. Durvasula further discloses generating control signals to cause movement "to...the first portion of the submerged surface" because Durvasula's controller 42 steers vehicle 30 to "cover such missed portions" and to "re-clean such portions until such portions have been satisfactorily cleaned"—i.e., to the first portion identified from the captured image. Durvasula, [0023]; *see also id.*, [0026], [0044].

134. As explained in §VII.A.3, §VII.A.4.f (1[e][i]), with a reasonable expectation of success, a POSITA would have been motivated to modify Durvasula's system to use Fu-007's onboard controller structure configured to execute Durvasula's control logic, including generating control signals to cause the body movement "to...the first portion of the submerged surface" in response to the captured image described above.

Thus, because the Durvasula-Fu-007 combination teaches control signals that cause movement “to” the first object, the Durvasula-Fu-007 combination discloses or suggests this limitation. Janét, ¶¶134-135.

5. Claim 2 Unpatentable over Durvasula and Fu-007

Durvasula and Fu-007 render independent Claim 2 obvious. Janét, ¶¶137-141.

a. 2[pre], 2[a]-2[c], 2[e][i]-[iii]

Limitations 2[pre], 2[a]-2[c], and 2[e][i]-2[e][iii] are identical to 1[pre], 1[a]-1[c], and 1[e][i]-1[e][iii], respectively. For the reasons in §§IV.A.4.a-IV.A.4.d (1[pre], 1[a]-1[c]), Durvasula discloses or suggests 2[pre] and 2[a]-2[c]. Additionally, for the reasons in §§IV.A.4.f-h (1[e][i]-[iii]), the Durvasula-Fu-007 combination discloses or suggests 2[e][i]-2[e][iii]. Janet, ¶138.

b. 2[d]

Limitations 2[d] and 1[d] only differ in:

135. The claim limitation uses the disjunctive “or” between “to” and “away from,” meaning the limitation is satisfied by teaching either alternative. Because the Durvasula-Fu-007 combination teaches control signals that cause movement “to” the first object, the Durvasula-Fu-007 combination discloses or suggests this element.

136. Therefore, it is my opinion that Durvasula, in view of Fu-007, renders Claim 1 obvious.

5. Claim 2 Unpatentable over Durvasula and Fu-007

137. In my opinion, Durvasula and Fu-007 render independent Claim 2 obvious.

a. 2[pre], 2[a]-2[c], 2[e]

138. Limitations 2[pre], 2[a]-2[c], and 2[e][i]-2[e][iii] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e][i]-1[e][iii], respectively. It is my opinion that, for at least the same reasons explained above in §§VII.A.4.a-VII.A.4.d (1[pre], 1[a]-1[c]), Durvasula discloses or suggests 2[pre] and 2[a]-2[c]. Additionally, it is my opinion that, for at least the same reasons explained above in §§VII.A.4.f-h (1[e][i]-[iii]), the Durvasula-Fu-007 combination discloses or suggests limitations 2[e][i]-2[e][iii].

b. 2[d]

139. Limitation 2[d] is substantially the same as limitation 1[d], with the only difference being that Limitation 2[d] recites “at least one camera **carried by the body**,” whereas limitation 1[d]

1[d]	"camera"	"mounted directly/or indirectly to"	"the body"
2[d]		"carried by"	

Durvasula discloses 2[d], because a camera "mounted directly...to the body" (§IV.A.4.e (1[d])) is also "carried by the body." Janet, ¶¶139-140.

6. Claim 3 Unpatentable over Durvasula and Fu-007

Durvasula and Fu-007 render Claim 3 obvious. Janet, ¶¶142-159.

a. 3[pre], 3[a]-3[c], 3[e][i]

Limitations 3[pre], 3[a]-3[c], and 3[e][i] are identical to 1[pre], 1[a]-1[c], and 1[e][i], respectively. For the reasons in §§IV.A.4.a-d (1[pre], 1[a]-1[c]), Durvasula discloses or suggests 3[pre] and 3[a]-3[c]. Additionally, for the reasons in §IV.A.4.f (1[e][i]), the Durvasula-Fu-007 combination discloses or suggests 3[e][i]. Janet, ¶143.

b. 3[d]

Limitations 3[d] and 1[d] only differ in:

recites "at least one camera **mounted directly or indirectly to the body.**"

140. It is my opinion that, as explained above in §VII.A.4.e (1[d]), Durvasula discloses "at least one camera mounted directly...to the body." Thus, Durvasula also discloses limitation 2[d], because a camera that is "mounted directly...to the body" is also "carried by the body."

141. Therefore, it is my opinion that Durvasula, in view of Fu-007, renders Claim 2 obvious.

6. Claim 3 Unpatentable over Durvasula and Fu-007

142. In my opinion, Durvasula and Fu-007 render independent Claim 3 obvious.

a. 3[pre], 3[a]-3[c], 3[e][i]

143. Limitations 3[pre], 3[a]-3[c], and 3[e][i] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e][i], respectively. For at least the same reasons explained above in §§VII.A.4.a-d (1[pre], 1[a]-1[c]), Durvasula discloses or suggests 3[pre] and 3[a]-3[c]. Additionally, for at least the same reasons explained above in §VII.A.4.f (1[e][i]), the Durvasula-Fu-007 combination discloses or suggests limitation 3[e][i].

b.3[d] "d. at least one camera positioned on or in, or carried by, the body for capturing an image of at least a first portion of the submerged surface; and"

1[d]	"camera"	"mounted directly or indirectly to"	"the body"
3[d]		"positioned on or in, or carried by,"	

Durvasula discloses 3[d], because a camera "mounted directly...to the body" (§IV.A.4.e (1[d])) is also "positioned on or in, or carried by, the body." Janét, ¶144.

c. 3[e][ii]

As explained in §IV.A.4.g (1[e][ii]), the controller in the Durvasula-Fu-007 combination is "in electronic communication with the at least one **camera**."

Durvasula also discloses a **portable electronic device** ("PED") **464** including an input to "facilitate[] entry of inputs or commands by a person to cause **controller 42** to generate control signals varying the control of vehicle 30." Durvasula, [0032]-[0034], [0045], FIGS. 4-5, 9 (annotated below).

[images omitted]

144. Limitation 3[d] recites substantially the same features as limitation 1[d], with the only difference being that limitation 3[d] recites "at least one camera **positioned on or in, or carried by, the body**," whereas limitation 1[d] recites "at least one camera **mounted directly or indirectly to the body**." As explained above in §VII.A.4.e (1[d]), Durvasula discloses "at least one camera mounted directly...to the body." Thus, Durvasula also discloses limitation 3[d], because a camera that is "mounted directly...to the body" is also "positioned on or in, or carried by, the body."

c.3[e][ii] "(ii) in electronic communication with the at least one camera and a portable electronic device, and"

145. In my opinion, the Durvasula-Fu-007 combination discloses or suggests 3[e][ii].

146. As explained in §VII.A.4.g (1[e][ii]), the controller in the Durvasula-Fu-007 combination is "in electronic communication with the at least one **camera**."

147. Durvasula also discloses a **portable electronic device 464** that includes an input to "facilitate[] entry of inputs or commands by a person to cause **controller 42** to generate control signals varying the control of vehicle 30." Durvasula, [0032]-[0034], [0045], FIGS. 4-5, 9 (annotated below).

[images omitted]

148. Fu-007 also discloses that its onboard controller communicates with control keyboard 31 as a portable electronic device that is outside its cleaning and moving platform and pool,

Fu-007 discloses that its robot operates in a “remote control” mode where its central processing unit (controller) receives commands from a remote control keyboard 31 (PED) through a “remote control signal interface.” Fu-007, pp.8-9, Claim 4, FIGS.6, 8 (annotated below). To receive signals while submerged, the robot uses a control signal buoyant antenna 27 that “floats on a water surface to wirelessly communicate with the control keyboard 31” and is “configured to directly communicate with the remote control signal interface of the robot via the control signal buoyant antenna cable (35).” Fu-007, pp.8-9, 12-14, FIG. 8. [image omitted] POSITAs would have understood the “control keyboard 31” is a PED because it is a handle device (Fu-007, FIG. 8) distinct from the vehicle and designed to “wirelessly communicate” with the antenna. Fu-007, pp.12-14, FIG. 8; Janét, ¶150. As explained in §IV.A.4.f (1[e][i]), POSITAs would have been motivated to replace Durvasula’s controller with Fu-007’s onboard controller. POSITAs would have been further motivated to establish electronic communication between Fu-007’s	and is operated by a user. <i>See</i> Fu-007, pp.13-14, FIGS.7-8. The control keyboard 31 is operated to have wirelessly communications with the underwater platform via control signal buoyant antenna 27 that is installed on and connected to an antenna interface of the signal relay and cable manager 28. <i>Id.</i> [image omitted] 149. Specifically, Fu-007 discloses that its robot operates in a “remote control” mode where its central processing unit (controller) receives commands from a remote control keyboard 31 (portable electronic device) through a “remote control signal interface.” Fu-007, pp.8-9, Claim 4, FIGS.6, 8 (annotated below). To receive signals while submerged, the robot uses a control signal buoyant antenna 27 that “floats on a water surface to wirelessly communicate with the control keyboard 31” and is “configured to directly communicate with the remote control signal interface of the robot via the control signal buoyant antenna cable (35).” [images omitted] 150. Fu-007 describes a “control keyboard 31” used for “manual operation” to send control signals. Fu-007, pp.12-14. A POSITA would have understood that Fu-007’s “control keyboard 31” is a portable electronic device because it is distinct from the vehicle and designed to “wirelessly communicate” with the antenna floating on the water surface. <i>See</i> Fu-007, pp.12-14, FIG. 8. 151. As explained in §VII.A.4.f (1[e][i]), a POSITA would have been motivated to replace Durvasula’s controller with Fu-007’s onboard controller. A POSITA would have been further motivated to establish electronic communication between Fu-
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onboard controller and Durvasula's PED using Fu-007's wireless communication mechanism. Janét, ¶151. Specifically, the combined system utilizes Fu-007's onboard wireless infrastructure (the remote control signal interface, antenna 27, and antenna cable 35) to receive signals transmitted by Durvasula's PED. Durvasula, [0033], FIGS. 4-5, 9; Fu-007, pp.12-14, FIG. 8; Janét, ¶151. POSITAs would have been motivated to make such combination. First, as discussed in §IV.A.4.f (1[e][i]), POSITAs would be motivated to remove Durvasula's tether to eliminate entanglement risks and electrical leakage hazards. To preserve the user's ability to manually operate the vehicle (Durvasula, [0034]), POSITAs would be motivated to utilize Fu-007's antenna-communication system, which would allow the manual control without reintroducing the safety risks of a shore-to-robot power cable. Durvasula, [0033], FIGS. 4-5, 9; Fu-007, pp.12-14, FIG. 8; Janét, ¶153. Second, POSITAs would have recognized that using Fu-007's buoyant antenna, the user could reliably drive the robot to the wall for removal using the PED, instead of, e.g., pulling a cord or waiting for the robot to surface. Durvasula, [0033], FIGS. 4-5, 9; Fu-007, pp.12-14, FIG. 8; Janét, ¶154. POSITAs would have reasonably expected success, because Fu-007 teaches a working implementation where its onboard controller is already configured with a "remote control signal"	007's onboard controller and Durvasula's PED using Fu-007's wireless communication mechanism. Specifically, the combined system utilizes Fu-007's onboard wireless infrastructure (the remote control signal interface, antenna 27, and antenna cable 35) to receive signals transmitted by Durvasula's PED. Durvasula, [0033], FIGS. 4-5, 9; Fu-007, pp.12-14, FIG. 8. This configuration would replace Durvasula's original wired communication path with Fu-007's wireless communication link 152. A POSITA would have been motivated to make such a combination at least for the following reasons. 153. First, as discussed in §VII.A.4.f (1[e][i]), a POSITA would be motivated to remove Durvasula's tether to eliminate entanglement risks and electrical leakage hazards. To preserve the user's ability to manually operate the vehicle (Durvasula, [0034]), a POSITA would be motivated to utilize Fu-007's antenna-communication system, which would allow the manual control without reintroducing the safety risks of a shore-to-robot power cable. Durvasula, [0033], FIGS. 4-5, 9; Fu-007, pp.12-14, FIG. 8. 154. Second, a POSITA would have motivated to make such a combination, because using Fu-007's buoyant antenna (which stays on the surface for clear signal reception), the user could reliably drive the robot to the wall for removal using the PED, eliminating the need to physically pull a cord or wait for the robot to surface randomly. Durvasula, [0033], FIGS. 4-5, 9; Fu-007, pp.12-14, FIG. 8. 155. A POSITA would have had a reasonable expectation of success. Specifically, Fu-007 teaches a working implementation
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interface and “buoyant antenna” designed to communicate with a remote keyboard, and configuring this existing wireless interface with Durvasula’s PED would have been a routine integration yielding predictable results. Fu-007, pp.12-14, FIG. 8; Janét, ¶155.

d. 3[e][iii]

As explained in §IV.A.3, IV.A.4.f-h (1[e][i]-[iii]), POSITAs would have been motivated, and reasonably expected success, to modify Durvasula’s system to use Fu-007’s onboard controller to generate control signals “in response to...the **captured image**” to steer the vehicle “to...the first portion of the submerged surface” (e.g., to re-clean missed portions). Durvasula, [0022]-[0023], [0026], [0044]; Fu-007, Abstract, pp.8-9, 14-16, Claims 1, 4; Janét, ¶157. Thus, the Durvasula-Fu-007 combination satisfies this limitation through the “captured image” prong alone. *Id.*

where its onboard controller is already configured with a “Remote control signal” interface and a “buoyant antenna” specifically designed to communicate with a remote control keyboard. *See* Fu-007, pp.12-14, FIG. 8. Configuring this existing, wireless interface to accept signals from Durvasula’s PED would have been a routine integration of compatible electronic components yielding predictable results.

d. 3[e][iii] “(iii) configured to generate, in response to at least one of the captured image or information from the portable electronic device, 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.”

156. In my opinion, the Durvasula-Fu-007 combination discloses or suggests 3[e][iii].

157. The limitation requires the controller to generate signals in response to **one of** the captured image **or** the PED. As explained in §§VII.A.4.f-VII.A.4.h (1[e][i]-[iii]), with a reasonable expectation of success, a POSITA would have been motivated to modify Durvasula’s system to use Fu-007’s onboard controller configured to generate control signals “in response to...the **captured image**” to steer the vehicle “to...the first portion of the submerged surface” (e.g., to re-clean missed portions). *See, e.g.,* Durvasula, [0022]-[0023], [0026], [0044]; Fu-007, Abstract, pp.8-9, 14-16, Claims 1, 4. Thus, the Durvasula-Fu-007 combination satisfies this limitation through the “captured image” prong alone. *Id.*

158. Additionally, Durvasula describes a user may “enter commands or selections” through PED 464 to “adjust the

Additionally, for reasons in §§IV.A.4.f&IV.B.5.c (1[e][i], 3[e][ii]), POSITAs would have been motivated, and reasonably expected success, to configure Fu-007's onboard controller to process control signals from Durvasula's PED and generate drive signals that cause the robot to move "to" a specific target area selected by the user (i.e., the "first portion of the submerged surface") for cleaning. Fu-007, pp.8-9, 14-16, Claim 7; Durvasula, [0033], [0036]; Janét, ¶158.

7. Claim 4 Unpatentable over Durvasula and Fu-007

Durvasula and Fu-007 render independent Claim 4 obvious. Janét, ¶¶160-162.

a. 4[pre], 4[a]-4[c], 4[e]

Limitations 4[pre], 4[a]-4[c], and 4[e] are identical to 1[pre], 1[a]-1[c], and 1[e], respectively. For the reasons in §§IV.A.4.a-d (1[pre], 1[a]-1[c]) and §§IV.A.4.f-h (1[e][i]-[iii]), Durvasula discloses or suggests 4[pre] and 4[a]-4[c] and the Durvasula-Fu-007 combination discloses or suggests 4[e][i]-[iii]. Janét, ¶161.

steering of vehicle 30" or change "the path or route of vehicle 30." Durvasula, [0036]. A POSITA would have understood that controller 42 generates control signals to steer vehicle 30 "to" identified portions in response to user commands entered through PED 464. Fu-007 similarly teaches that its controller receives remote signals to "control the movement of the robot."

Fu-007, Claim 7. At least for the same reasons explained in §§VII.A.4.f and VII.B.5.c (1[e][i], 3[e][ii]), a POSITA would have been motivated, with reasonable expectation of success, to configure Fu-007's onboard controller to process control signals from Durvasula's PED and generate drive signals that cause the robot to move "to" a specific target area selected by the user (i.e., the "first portion of the submerged surface") for cleaning. See Fu-007, pp.8-9, 14-16; Durvasula, [0033], [0036].

159. Therefore, it is my opinion that Durvasula, in view of Fu-007, renders Claim 3 obvious.

7. Claim 4 Unpatentable over Durvasula and Fu-007

160. In my opinion, Durvasula and Fu-007 render independent Claim 4 obvious.

a. 4[pre], 4[a]-4[c], 4[e]

161. Limitations 4[pre], 4[a]-4[c], and 4[e] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e], respectively. It is my opinion that, for at least the same reasons explained above in §§VII.A.4.a-VII.A.4.d (1[pre], 1[a]-1[c]) and §§VII.A.4.f-VII.A.4.h (1[e][i]-[iii]), Durvasula discloses or suggests 4[pre] and 4[a]-4[c] and the Durvasula-Fu-007 combination discloses or suggests limitations 4[e][i]-[iii].

b. 4[d] Limitation 4[d] is nearly identical to 1[d], differing only in that 4[d] omits the requirement that the camera be “mounted directly or indirectly to the body.” For the reasons in §IV.A.4.e (1[d]), Durvasula discloses 4[d]. Janet, ¶162. 8. Claim 5 Unpatentable over Durvasula and Fu-007 Durvasula and Fu-007 render independent claim 5 obvious. Janet, ¶¶163-168. a. 5[pre], 5[a]-5[c] Durvasula discloses or suggests limitations 5[pre] and 5[a]-5[c] for the reasons in §§IV.A.4.a-d (1[pre]-1[c]), because they are identical to 1[pre] and 1[a]-1[c]. Janét, ¶164. b. 5[d] Durvasula discloses or suggests 5[d] because it teaches “vehicle 30 may include a chemical dispenser to closely apply pool cleaning chemicals to the pool surfaces as the vehicle 30 traverses such surfaces.” Durvasula, [0015]; Janét, ¶165.	b.4[d] “at least one camera for capturing an image of at least a first portion of the submerged surface; and” 162. Limitation 4[d] recites substantially the same features as limitation 1[d], with the only difference being that 4[d] omits the feature that the camera be “mounted directly or indirectly to the body.” Thus, it is my opinion that, for at least the reasons explained above in §VII.A.4.e (1[d]), Durvasula discloses limitation 4[d]. 8. Claim 5 Unpatentable over Durvasula and Fu-007 163. In my opinion, Durvasula and Fu-007 render independent Claim 5 obvious. a. 5[pre], 5[a]-5[c] 164. Limitations 5[pre] and 5[a]-5[c] are exactly the same as limitations 1[pre] and 1[a]-1[c], respectively. It is my opinion that, for at least the same reasons explained above in §§VII.A.4.a-VII.A.4.d (1[pre], 1[a]-1[c]), Durvasula discloses or suggests 5[pre] and 5[a]-5[c]. b. 5[d] “d. a chemical dispenser on, in, or carried by the vehicle body;” 165. In my opinion, Durvasula discloses or suggests 5[d] because Durvasula describes “vehicle 30 may include a chemical dispenser to closely apply pool cleaning chemicals to the pool surfaces as the vehicle 30 traverses such surfaces.” Durvasula, [0015]. c. 5[e] “e. at least one camera on, in, or carried by
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c. 5[e]

Limitations 5[e] and 1[d] only differ in:

1[d]	“camera”	“mounted directly or indirectly to”	“the body”
5[e]		“on, in, or carried by”	“the vehicle body”

Durvasula discloses 5[e], because a camera “mounted directly...to the body” (§IV.A.4.e (1[d])) is also “on, in, or carried by the vehicle body.” Janét, ¶166.

d. 5[f][i]

Limitations 5[f][i] and 1[e][i] only differ in:

1[e][i]	“controller”	“positioned on or in”	“the body”
5[f][i]		“on, in, or carried by”	“the vehicle body”

The Durvasula-Fu-007 combination discloses or suggests 5[f][i], because a controller “positioned on or in the body” (§IV.A.4.f (1[e][i])) is also “on, in, or carried by the vehicle body.” Janét, ¶167.

e. 5[f][ii]-5[f][iii]

The Durvasula-Fu-007 combination discloses or suggests limitations 5[f][ii] and 5[f][iii] for the reasons in §§IV.A.4.f-h

the vehicle body, for capturing an image of at least a first portion of the submerged surface; and”

166. Limitation 5[e] recites substantially the same features as limitation 1[d], with the only difference being that limitation 5[e] recites “at least one camera on, in, or carried by the vehicle body,” whereas limitation 1[d] recites “at least one camera mounted directly or indirectly to the body.” As explained above in §VII.A.4.e (1[d]), Durvasula discloses “at least one camera mounted directly...to the body.” Thus, it is my opinion that Durvasula also discloses limitation 5[e], because a camera that is “mounted directly...to the body” is also “on, in, or carried by the vehicle body.”

d. 5[f][i] “f. a controller (i) on, in, or carried by the vehicle body”

167. Limitation 5[f][i] is substantially the same as limitation 1[e][i], with the only difference being that 5[f][i] recites a controller “on, in, or carried by the vehicle body,” whereas 1[e][i] recites a controller “positioned on or in the body.” As explained above in §VII.A.4.f (1[e][i]), the Durvasula-Fu-007 combination discloses or suggests a controller “positioned on...the body.” Thus, it is my opinion that Durvasula also discloses 5[f][i], because a controller that is “positioned on...the body” is also “on, in, or carried by the vehicle body.”

e. 5[f][ii]-5[f][iii]

168. Limitations 5[f][ii] and 5[f][iii] are exactly the same as limitations 1[e][ii] and 1[e][iii], respectively. It is my opinion

(1[e][ii]-[iii]), because they are identical to 1[e][ii] and 1[e][iii]. Janét, ¶168.	that, for at least the same reasons explained above in §§VII.A.4.f-VII.A.4.h (1[e][ii]-1[e][iii]), the Durvasula-Fu-007 combination discloses or suggests 5[f][ii] and 5[f][iii].
B. Ground 2A: Claims 1-4 Are Unpatentable over Cui with Fu-007 1. Cui Cui (EX1005) is prior art under AIA 35 U.S.C. §102(a)(1) and pre-AIA 35 U.S.C. §102(b). Janét, ¶169. Cui discloses a pool cleaner with debris detection capability for use in swimming pools. Cui, Title, Abstract. A CCD camera is used to capture images of pool surfaces, compare them with pre-stored standard images of clean surfaces, and control the cleaner's operation based on detected debris levels/distributions. <i>Id.</i>, Abstract, pp.5-7.4 Cui is analogous art. Janét, ¶170. Cui's pool cleaner comprises a housing 4 containing various components including a water pump motor 2, an infrared distance sensor 3, a camera 5, a filter bag 6, a computer 7, track-type crawling mechanisms 10, roller brushes 11, and hybrid stepper motors 15. Cui, Claim 1, pp.5-6, FIGS. 1-2 (annotated below).	B. Ground 2A: Claims 1-4 Are Unpatentable under AIA 35 U.S.C. §103 and Pre-AIA AIA 35 U.S.C. §103 over Cui with Fu-007 1. Cui 169. Cui (EX1005) is Chinese Patent Application Publication No. CN1540119A published on October 27, 2004 and is prior art under AIA 35 U.S.C. §102(a)(1) and is not subject to exceptions under AIA 35 U.S.C. §102(b)(1) because it was published more than one year before its effective filing date which is no earlier than July 11, 2016. <i>See</i> §VI.C, <i>supra</i>. In addition, Cui is also prior art under pre-AIA 35 U.S.C. §102(b). 170. Cui discloses a pool cleaner with debris detection capability for use in swimming pools. <i>See</i> Cui, Title, Abstract. Cui's pool cleaner uses a CCD camera to continuously capture images of pool surfaces, compares them with pre-stored standard images of clean surfaces, and controls the cleaner's operation based on detected debris levels/distributions. <i>Id.</i>, Abstract, pp.5-7.4 Cui is analogous art with respect to Claims 1-5 of the '766 Patent. 171. As illustrated in FIGS. 1-2 (annotated below), Cui's pool cleaner comprises a housing 4 containing various components including a brushless DC water pump motor 2, an infrared distance sensor 3, a CCD camera 5, a filter bag 6, an industrial control computer 7 with related software, sensors 8, 9, tracktype crawling mechanisms 10, roller brushes 11, and hybrid stepper motors 15. Cui, Claim 1, pp.5-6, FIGS. 1-3.

[images omitted]

Cui's computer 7 processes images from **camera 5** to detect debris levels/distributions, and generates control signals that adjust speed of **motors 15**, controlling crawling speed and cleaning force. Cui, pp.4-7, FIGS. 5-6 (annotated below).

[images omitted]

2. Motivation to Combine

Both Cui and Fu-007 disclose underwater cleaning robots for swimming pools using camera-based control, and both sought to improve autonomous pool cleaning operations. Cui describes a pool cleaner using "intelligent adaptive technology with computer control" to autonomously adjust cleaning force based on debris distribution. Cui, p.5. Fu-007 similarly describes an underwater cleaning robot that can "help and even replace humans to autonomously complete underwater cleaning work." Fu-007, p.11; §IV.A.2. POSITAs would have been motivated to

[images omitted]

172. Cui's computer 7 is connected to **camera 5** through **image acquisition card 21** and processes the captured images to generate control signals that adjust the crawling speed based on detected debris levels/distributions. Cui, pp.4-7, FIGS. 5-6 (annotated below). Camera 5 captures images that undergo A/D conversion and comparison with stored standard images. *Id.* Greater sediment/debris produce larger grayscale differences, causing computer 7 to adjust speed of **motors 15** via **relay board 20, controlling crawling speed and cleaning force. Id.**

[images omitted]

173. Human-machine interface 16 of computer 7 displays pool area with different colors to indicate cleaned areas and areas to be cleaned, sensor values, and control switches. Cui, p.6, FIG. 4.

[image omitted]

2. Reasons to Combine Cui and Fu-007

174. Both Cui and Fu-007 disclose underwater cleaning robots for swimming pools using camera-based control, and both sought to improve autonomous pool cleaning operations. Cui describes a pool cleaner using "intelligent adaptive technology with computer control" to autonomously adjust cleaning force based on debris distribution. Cui, p.5. Fu-007 similarly describes an underwater cleaning robot that can "help and even replace humans to autonomously complete underwater cleaning work." Fu-007, p.11. A POSITA would have been motivated to

combine the complementary teachings of Cui and Fu-007 to improve autonomous pool cleaning. Janét, ¶174. POSITAs would have recognized that the teachings in Cui and Fu-007 are directed to the same pool cleaning technical field, based on recognition of t similar technical issues in pool cleaning, and provide similar technical solutions to address those issues. Janét, ¶175. Specifically, both use a controller to generate, in response to captured images, control signals to cause movement of the pool cleaning body within the swimming pool. <i>Compare</i> Cui, pp.5-7, FIGS. 5-7, <i>with</i> Fu-007, pp.10, 14-16, Claims 4, 7. Additionally, both teach motorized drive echanisms to cause and control movement of the pool cleaner during operation. <i>Compare</i> Cui, pp.5-6, Claim 1, FIGS. 1-3, <i>with</i> Fu-007, pp.8-9, 12-14, Claims 1, 3. Accordingly, POSITAs would have investigated the technical teachings in both to seek guidance when designing a pool cleaning system for specific pool cleaning considerations and applications. Janét, ¶175. Different from Cui's placement of the controller (computer 7) outside the pool and separate from the vehicle in a tethered configuration via cable assembly 12, Fu-007's controller is within the vehicle. Fu-007, pp.8-9, 12-14, Claim 4. The use of an external controller separated from the pool cleaner in Cui and the use of an onboard controller in Fu-007 had been two known design options. Janét, ¶176. POSITAs would have been motivated to modify Cui by substituting Cui's external computer 7 with Fu-007's onboard controller structure for at least two reasons. <i>Id.</i>	combine the complementary teachings of Cui and Fu-007 to achieve improved autonomous pool cleaning operations. 175. A POSITA would have recognized that the teachings in Cui and Fu-007 are directed to the same pool cleaning technical field, are based on recognition of the same or similar technical issues in pool cleaning, and provide similar technical solutions to address those issues. Specifically, both references use a controller to generate, in response to captured images, control signals to cause movement of the pool cleaning body within the swimming pool. <i>Compare</i> Cui, pp.5-7, FIGS. 5-7, <i>with</i> Fu-007, pp.10, 14-16, Claims 4, 7. Additionally, both references teach motorized drive mechanisms to cause and control movement of the pool cleaner during operation. <i>Compare</i> Cui, pp.5-6, Claim 1, FIGS. 1-3, <i>with</i> Fu-007, pp.8-9, 12-14, Claims 1, 3. Accordingly, a POSITA would have investigated the technical teachings in both Cui and Fu-007 to seek guidance when designing a pool cleaning system for specific pool cleaning considerations and applications. 176. Cui and Fu-007, however, differ in their technical implementations of certain common features. Different from Cui's placement of the controller (industrial control computer 7) outside the pool and separate from the pool cleaning vehicle in a tethered configuration via cable assembly 12, Fu-007 places its controller within the cleaning and moving platform as part of a sealed drive control enclosure suitable for underwater operation. Fu-007, pp.8-9, 12-14, Claim 4. The use of an external controller separated from the pool cleaner in Cui and the use of an onboard controller in Fu-007 had been two known design options. A POSITA would have been motivated to modify Cui by substituting Cui's external computer 7 with Fu-007's onboard controller structure for at least two reasons.
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First, Cui relies on an external computer and cable assembly, which constrains autonomy by limiting range and requiring human intervention to manage cable entanglements, but Fu-007 teaches that moving the architecture onboard—specifically positioning the controller, camera connection, and power source within the body—allows the robot to operate autonomously. Fu-007, p.11; Janét, ¶177. POSITAs would have recognized that integrating Fu-007’s onboard controller into Cui would have enhanced autonomous operations by generating control signals onboard to perform cleaning tasks, allowing the vehicle to navigate without cable constraints or human supervision. Janét, ¶177.

177. First, a POSITA would have been guided by Cui and Fu-007 to make such a combination to advance Cui’s goal of autonomous pool cleaning by eliminating physical dependencies on external infrastructure. Cui’s reliance on an external computer and cable assembly constrains autonomy by limiting range and requiring human intervention to manage cable entanglements. Fu-007 explicitly teaches that moving the architecture onboard—specifically positioning the controller, camera connection, and power source within the body—allows the robot to operate autonomously. Fu-007, p.11. A POSITA would have recognized that by integrating Fu-007’s onboard controller architecture into Cui, the modified system would have enhanced Cui’s autonomous operation by liberating the robot from shore-side constraints—generating control signals onboard to plan paths and complete cleaning tasks without requiring human supervision or corresponding transmission of data (e.g., images, control signals) between the underwater cleaner and an external controller located outside the water (in a dry station, a remote server, or a portable electronic device (Durvasula, [0013]-[0039], [0045]-[0046], FIGS. 1-5, 9, Claims 2-4, 10)). Additionally, removing the external tether would allow the vehicle to navigate freely without cable management constraints. Cui’s cable assembly 12 can become tangled with pool features such as ladders, drains, and return fittings during cleaning operations, potentially interrupting the cleaning cycle and requiring user intervention. Fu-007’s tetherless design avoids these complications, allowing the robot to navigate complex pool geometries without obstruction. Fu-007, pp.9-10, 14. Even if a power tether were retained, relocating the controller onboard would eliminate or reduce the need for signal transmission through the tether, reducing its diameter and mass and resulting in less hydrodynamic drag and impedance to movement.

Second, Cui discloses a tethered configuration connecting industrial control computer 7 via an external “cable assembly 12” (Cui, pp.5-6, Claim 1, FIGS. 1-2), which POSITAs would have recognized introduces safety risks of electrical leakage. Janét, ¶178. POSITAs would have been motivated to make this modification to further improve the safety of Cui’s system by removing the cable. *Id.*; §IV.A.3 (explaining Fu-007’s teaching of a safer system).

POSITAs would have had a reasonable expectation of success because positioning the controller on the vehicle body was a well-known design choice. Fu-007, pp.8-10, 12-14; Knoll, [0007], [0027]-[0028], FIG.1; §§IV.D.1-IV.D.2; Renaud (EX1017), [0008]-[0009], [0029]-[0030]; §§IV.G.1-IV.G.2; Janét, ¶180.

178. Second, a POSITA would have been motivated to adopt this modification to further improve the safety of Cui’s system. Cui discloses a tethered configuration where industrial control computer 7 is connected to the cleaner via an external “cable assembly 12.” Cui, pp.5-6, Claim 1, FIGS. 1–2. A POSITA would have recognized that tethered systems introduce safety risks by requiring a physical electrical connection between shore-side electronics and the submerged cleaner, creating potential pathways for electrical leakage into the swimming pool environment if cable insulation wears down or connections become compromised. A POSITA would have further recognized that this risk is exacerbated in swimming pool environments, where dissolved chemicals (e.g., chlorine, calcium, pH balancers, algacides) increase water conductivity and thus the potential for electrical current to reach pool users.

179. As explained in §VII.A.3, Fu-007 teaches a safer architecture that eliminates the external tether, including the power cable. A POSITA would have been motivated to replace Cui’s tethered computer arrangement with Fu-007’s onboard, sealed, battery-powered architecture, because this modification would have eliminated the need for any external cables entering the water—including power cables—thereby removing the primary pathway for electrical leakage and enhancing the overall safety profile of the device for pool users.

180. A POSITA would have had a reasonable expectation of success in making this combination because positioning the controller on the vehicle body was a well-known design choice in autonomous pool cleaning robots, as shown by the teachings in Fu-007. *See, e.g.*, Fu-007, pp.8–10, 12–14. *See also* Knoll, [0007], [0027]-[0028], FIG.1 (showing control unit 11 inside the

Additionally, Fu-007's onboard controller is already configured to execute image-based cleaning tasks similar to Cui's—analyzing captured images and generating drive signals (Fu-007, pp.8-10, 14-16)—so POSITAs would have reasonably expected it would implement Cui's specific control logic (e.g., processing images to control crawling speed based on debris levels; Cui, pp.5-7), yielding predictable results. Janét, ¶180.

3. Claim 1 is Unpatentable over Cui and Fu-007

The Cui-Fu-007 combination renders independent claim 1 obvious. Janét, ¶181-211.

a. 1[pre]

Cui discloses or suggests 1[pre]. Janét, ¶182-185.

Cui discloses a system designed for “professional or commercial swimming pools,” including an underwater cleaning vehicle with **track-type crawling mechanisms 10** powered by **motors**

vehicle that receives images from camera 6, processes the images, and controls the drive means 12 accordingly, as explained in §§VII.D.1-VII.D.2); Renaud (EX1017), [0008], [0009], [0029]-[0030] (disclosing a processing device/microprocessor inside the cleaner that receives images from a vision system, processes the images to identify debris, and actuates the motor to direct the cleaner to the debris, as explained in §§VII.G.1-VII.G.2). Additionally, Fu-007's onboard controller is already configured to execute image-based cleaning tasks similar to Cui's—analyzing captured images and generating drive signals to control the vehicle's movement (e.g., adjusting drive wheels based on debris thresholds). Fu-007, pp.8–10, 14–16. **Because Fu-007's controller is already configured to execute image-based cleaning tasks**, a POSITA would have reasonably expected that Fu-007's controller could implement Cui's specific control logic (e.g., processing images to control crawling speed based on debris levels; Cui, pp.5–7), thereby yielding predictable results.

3. Claim 1 Unpatentable over Cui and Fu-007

181. In my opinion, the Cui-Fu-007 combination renders independent claim 1 obvious.

a. 1[pre] “A self-propelled pool cleaner for cleaning debris from a submerged surface of a swimming pool, comprising”

182. In my opinion, Cui discloses or suggests 1[pre].

183. Cui discloses a system designed for “professional or commercial swimming pools,” including an underwater cleaning vehicle with **track-type crawling mechanisms 10** powered by

15 and a computer 7 that processes sensor data and controls the vehicle. Cui, Abstract, Claim 1, pp.5-7, FIGS. 1-2, 6 (annotated below).

[images omitted]

Cui's cleaning vehicle is self-propelled, because computer 7 controls motors 15 to move the vehicle across pool surfaces. Cui, Claim 1, pp.5-6. Janét, ¶184.

Cui's system detects debris by comparing captured images with "pre-stored standard image information of a clean pool bottom"—"when there is a lot of sediment at the pool bottom, the grayscale level of the real-time captured image(s) is greatly different from the grayscale level of the original standard image(s)." Cui, Abstract, pp.4-7. Cui's system collects and cleans debris using "roller brush (11)," "brushless DC water pump motor (2)," and "filter bag (6)." Cui, Claim 1, pp.5-7; Janét, ¶185.

b. 1[a]

Cui discloses or suggests 1[a]. Janét, ¶186-187.

Cui's pool cleaner includes a vehicle body, i.e., housing 4 with integrated propulsion mechanisms (track-type crawling mechanisms 10, motors 15), cleaning components (motor 2, brushes 11, filter 6), and sensors (camera 5). Cui, Claim 1, pp.5-6, FIG.1 (annotated below). POSITAs would have understood this assembled structure constitutes a "vehicle body." Janét, ¶187.

hybrid stepper motors 15 and a computer 7 that processes sensor data and controls the vehicle. Cui, Abstract, Claim 1, pp.5-7, FIGS. 1-2, 6 (annotated below).

[images omitted]

184. Cui's cleaning vehicle is self-propelled because under the control of computer 7, motors 15 drive track-type crawling mechanisms 10 to move it autonomously across pool surfaces. Cui, Claim 1, pp.5-6.

185. Cui's system detects debris by capturing images with camera 5 and comparing them (via computer 7) with "pre-stored standard image information of a clean pool bottom"—"when there is a lot of sediment at the pool bottom, the grayscale level of the real-time captured image(s) is greatly different from the grayscale level of the original standard image(s)." Cui, Abstract, pp.4-7. Cui's system collects and cleans debris using "roller brush (11)," "brushless DC water pump motor (2)," and "filter bag (6)." Cui, Claim 1, pp.5-7.

b. 1[a] "a. a vehicle body"

186. In my opinion, Cui discloses or suggests 1[a].

187. Cui's pool cleaner includes a vehicle body, at least in the form of housing 4 with integrated propulsion mechanisms (track-type crawling mechanisms 10, motors 15), cleaning components (motor 2, brushes 11, filter 6), and sensors (camera 5). Cui, Claim 1, pp.5-6, FIG.1 (annotated below). A POSITA would have understood this assembled structure is the claimed "vehicle body" that travels within the pool.

[image omitted] c. 1[b] Cui discloses or suggests 1[b]. Janét, ¶188-191. Limitation 1[b] invokes §112¶6/§112(f); the function is “moving the vehicle body within the swimming pool,” and the corresponding structure includes “tracks...powered by a motor.” See §III.E. Cui discloses this function and structure by disclosing moving the vehicle via track-type crawling mechanisms 10 powered by motors 15. Cui, Claim 1, pp.5-7, FIGS. 1-2 (annotated below); EX1001, 3:33-45; Janét, ¶190-191. [images omitted]	[image omitted] c.1[b] “b. means for moving the vehicle body within the swimming pool” 188. In my opinion, Cui discloses or suggests 1[b]. 189. the format and content of 1[b] invoke claim interpretation under pre- AIA 35 U.S.C. §112 ¶6, or 35 U.S.C. §112(f). As explained in §VI.D, the recited function is “moving the vehicle body within the swimming pool,” and the corresponding structures are “wheels, rollers, tracks, other surface contacting members powered by a motor, a vacuum, or a liquid jet.” EX1001, 3:33-45, 10:15-17, FIGS.9-10. 190. Cui discloses moving the vehicle body within the swimming pool. Specifically, Cui discloses track-type crawling mechanisms 10 powered by motors 15. Cui, Claim 1, pp.5-6, FIGS. 1-2 (annotated below). Motors 15 are mounted on both sides of sealed motor cover 1, and track-type crawling mechanisms 10 are mounted at front and rear ends of housing 4. Cui, pp.5-6. [images omitted] 191. A POSITA would have understood that Cui’s track-type crawling mechanisms 10 powered by hybrid stepper motors 15 is substantially the same as the ’766 Patent’s disclosed “tracks...powered by a motor”—both are motor-powered track systems that contact pool surfaces to propel the vehicle body. This structure of Cui performs the claimed function because motors 15 drive track-type crawling mechanisms 10, which
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d. 1[c]

Cui discloses or suggests 1[c]. Janét, ¶192-193.

Cui's system includes a **pump motor 2** and **filter bag 6** (filter) that retains debris collected from the submerged surface. Cui, Claim 1, pp.5-6, FIG.1 (annotated below). POSITAs would have understood Cui's pump motor draws water containing debris from pool surfaces and filter bag retains the debris. Janét, ¶193.

[image omitted]

e. 1[d]

Cui discloses or suggests 1[d]. Janét, ¶194-196.

Cui discloses a **camera 5** “**mounted at** the upper front end of the **housing 4**” to observe pool surfaces. Cui, Claim 2, FIG. 1 (annotated below), pp.5-6; Janét, ¶195.

[image omitted]

contact pool surfaces and propel the vehicle body within the swimming pool. Cui, pp.5-7, FIGS. 1-3.

d. 1[c] “c. a filter configured to retain debris collected from the submerged surface”

192. In my opinion, Cui discloses or suggests 1[c].

193. Cui's system includes a filter configured to retain debris collected from the submerged surface, at least in the form of **filter bag 6**, which is in the water circulation system including **brushless DC water pump motor 2**. Cui, Claim 1, pp.5-6, FIG.1 (annotated below). A POSITA would have understood that Cui's pump motor 2 draws water containing debris from pool surfaces by suction and filter bag 6 retains this collected debris, while allowing clean water to pass through.

[image omitted]

e. 1[d] “d. at least one camera mounted directly or indirectly to the body for capturing an image of at least a first portion of the submerged surface; and”

194. In my opinion, Cui discloses or suggests 1[d].

195. Cui's pool cleaner includes **camera 5** “**mounted at** the upper front end of the **housing 4**,” which is part of the vehicle body, to observe pool surfaces ahead of the cleaner. Cui, Claim 2, FIG. 1 (annotated below), pp.5-6.

[image omitted]

Cui's camera "continuously captures images of areas to be cleaned located directly in front and below a crawling direction of the cleaner," including "sediment **at the pool bottom**," which are "compared with the original standard image(s) of the pool bottom" to identify debris. Cui, pp.5-7; Janét, ¶196. POSITAs would have understood that Cui's camera captures images of "at least a first portion of the submerged surface" because the camera observes the pool bottom—a submerged surface during cleaning—and debris/sediment thereon, and the area with debris constitutes the claimed "first portion." *Id.*

f. 1[e][i]

The Cui-Fu-007 combination discloses or suggests 1[e][i], because Cui discloses a controller, Fu-007 discloses a controller inside the vehicle body, and POSITAs would have been motivated to modify Cui's system to incorporate Fu-007's teaching of the onboard controller. Janét, ¶197.

Cui's pool cleaner includes **computer 7** (controller) separated from pool cleaner and is connected to the pool cleaner via cable 12. Cui, FIGS. 1-3. Computer 7 is connected to "the pool cleaner through the **cable assembly 12** and the **plug assembly 14**," and to **camera 5** through **image acquisition card 21** and processes captured images to generate control signals that adjust crawling speed based on detected debris levels. Cui, pp.5-7, FIGS. 1-2, 5-6 (annotated below); Janét, ¶198. Cui describes that "[t]he voltage signal is sent to...computer 7 for processing...A pulse

196. Cui describes that its camera "continuously captures images of areas to be cleaned located directly in front and below a crawling direction of the cleaner," including images showing "sediment **at the pool bottom**." Cui, pp.5-7. Cui describes that the captured images are "compared with the original standard image(s) of the pool bottom" to identify areas with debris requiring cleaning. Cui, pp.6-7. A POSITA would have understood that Cui's camera captures images of "at least a first portion of the submerged surface" because the camera observes the pool bottom surface and debris/sediment on that surface, and the pool bottom is a submerged surface when the pool is filled with water during cleaning operations, where an area with debris requiring cleaning constitutes the claimed "first portion of the submerged surface." Cui, pp.5-7.

f. 1[e][i] "e. a controller (i) positioned on or in the body,"

197. In my opinion, the Cui-Fu-007 combination discloses or suggests 1[e][i], because Cui discloses a controller, Fu-007 discloses a controller inside the vehicle body, and a POSITA would have been motivated to modify Cui's system to incorporate Fu-007's teaching of the onboard controller.

198. Cui's pool cleaner includes **industrial control computer 7** that is separated from pool cleaner and is connected to the pool cleaner via cable 12. Cui, FIGS. 1-3. The industrial control computer 7 is "connected to the pool cleaner through the **cable assembly 12** and the **plug assembly 14**." Cui, pp.5-6, FIGS. 1-2 (annotated below). The industrial control computer 7 is connected to **camera 5** through **image acquisition card 21** and processes captured images to generate control signals that adjust crawling speed based on detected debris levels. Cui, pp.5-7,

signal command output after processing...to separately control the drive of the two hybrid stepper motors 15.” Cui, pp.6-7; §IV.B.3.e (1[d]). POSITAs would have understood that Cui’s computer 7 is a “controller.” Janét, ¶198. [images omitted] Like Cui, Fu-007 discloses an underwater cleaning robot for swimming pools using camera-based control through a controller to generate, in response to captured images, control signals to move the pool cleaning body. §IV.A.2; Janét, ¶199. Fu-007 discloses a controller positioned in the body of its cleaning and moving platform. §§IV.A.2&IV.A.4.f; Fu-007, pp.8-9, 12-14, Claim 4, FIGS.2, 4 (annotated below); Janét, 200. [images omitted] This onboard controller connects to monitoring camera 2. Fu-007, pp.12-14, Claim 4, FIGS.1, 6 (annotated below); §IV.A.4.f. Janét, ¶201. [images omitted]	FIGS. 5-6 (annotated below). Cui further describes that “[t]he voltage signal is sent to...computer 7 for processing...A pulse signal command output after processing...to separately control the drive of the two hybrid stepper motors 15.” Cui, pp.6-7; <i>see also</i> §VII.B.3.e (1[d]). A POSITA would have understood that Cui’s industrial control computer 7 is a “controller.” [images omitted] 199. Like Cui, Fu-007 discloses an underwater cleaning robot for swimming pools using camera-based control. <i>See</i> §VII.A.2. Like Cui, Fu-007 uses a controller to generate, in response to captured images, at least one control signal to cause movement of the pool cleaning body within the swimming pool. 200. Fu-007 discloses a controller positioned in the body of its cleaning and moving platform. Specifically, as explained in §§VII.A.2, VII.A.4.f, Fu-007 discloses a “central processing unit” (controller) housed in control system enclosure 8 that is sealingly enclosed in robot main shell 19. Fu-007, pp.8-9, 12-14, Claim 4, FIGS.2, 4 (annotated below). [images omitted] 201. This onboard controller connects to the monitoring camera 2 via an internal “image acquisition card” and can be powered by an onboard “rechargeable battery box.” Fu-007, pp.12-14, Claim 4, FIGS.1, 6 (annotated below); <i>see also</i> §VII.A.4.f. [image omitted]
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For the reasons explained in §IV.B.2, POSITAs would have been motivated to modify Cui's system by substituting Cui's external computer 7 with Fu-007's onboard controller structure. Janét, ¶202. The modified system's onboard controller would be: (1) in electronic communication with Cui's camera via an onboard connection (e.g., Fu-007's image acquisition card; Fu-007, pp.12-14), (2) powered by Fu-007's rechargeable battery box (*id.*), and (3) configured to generate control signals for controlling the vehicle movement (e.g., wheel speed) based on captured images to clean the pool per control logics of Cui and/or Fu-007. Cui, pp.5-7; Fu-007, pp.14-16; Janét, ¶202.

g. 1[e][ii]

The Cui-Fu-007 combination discloses or suggests 1[e][ii]. Janét, ¶¶203- 205.

Cui's **computer 7** is connected to camera 5 through **image acquisition card 21**. Cui, Claim 3, pp.5-7, FIGS. 5-6 (annotated below). During cleaning, "camera 5...continuously captures images" and "[t]he video signal undergoes A/D conversion through the high-speed image acquisition card 21" for processing by computer 7. Cui, pp.5-7.

[images omitted]

As explained in §§IV.B.2&IV.B.3.f (1[e][i]), POSITAs would have been motivated, and reasonably expected success, to modify Cui's system by substituting Cui's external computer

202. For the reasons explained in §VII.B.2, a POSITA would have been motivated to modify Cui's system by substituting Cui's external computer 7 with Fu-007's onboard controller structure. In such modified system, Fu-007's onboard controller would be: (1) in electronic communication with Cui's camera via an onboard connection (e.g., Fu-007's image acquisition card; Fu-007, pp.12-14), (2) powered by a compatible power source (e.g., Fu-007's rechargeable battery box; *id.*), and (3) configured to generate control signals for controlling the vehicle movement (e.g., wheel speed) based on captured images to clean the pool per control logics taught by Cui and/or Fu-007. Cui, pp.5-7; Fu-007, pp.14-16.

g. 1[e][ii] "(ii) in electronic communication with the at least one camera, and"

203. In my opinion, the Cui-Fu-007 combination discloses or suggests 1[e][ii].

204. Cui describes that **computer 7** is connected to camera 5 through **image acquisition card 21**, and "the **image acquisition card 21** is connected to the **charge-coupled device (CCD) camera 5**." Cui, Claim 3, pp.5-7, FIGS. 5-6 (annotated below). During cleaning, "camera ...continuously captures images" and "[t]he video signal undergoes A/D conversion through the high-speed image acquisition card 21" for processing by computer 7. Cui, pp.5-7.

[image omitted]

205. As explained in §VII.B.2, §VII.B.3.f (1[e][i]), with a reasonable expectation of success, a POSITA would have been motivated to modify Cui's system by substituting Cui's external

with Fu-007's onboard controller structure to, e.g., eliminate external tether dependencies. Fu-007, pp.8-10, 12-14, Claim 4; Janét, ¶205. In this modified system, the onboard controller is in electronic communication with the camera (mounted to the vehicle body) via Fu-007's internal connection architecture. Fu-007, pp.12-14, Claim 4, FIGS. 1, 4, 6; Janét, ¶205.

h. 1[e][iii]

Cui's controller compares captured images with stored standard images to identify sediment/debris—"when there is a lot of sediment at the pool bottom, the grayscale level of the real-time captured image(s) is greatly different...resulting in a high comparison output voltage." Cui, pp.6-7. Based on this image-derived signal, "[a] pulse signal command output after processing...separately control[s] the drive of the two hybrid stepper motors 15." *Id.*, p.7. Thus, these are "control signal[s]" generated "in response to the captured image." Janét, ¶207.

As explained in §IV.B.3.e (1[d]), Cui's camera 5 captures images of areas "located directly in front and below a crawling

computer with Fu-007's onboard controller structure taught by Fu-007 to, e.g., eliminate external tether dependencies. *See* Fu-007, pp.8-10, 12-14, Claim 4. In this modified system, the onboard controller is in electronic communication with the camera (mounted to the vehicle body) via Fu-007's internal connection architecture (specifically, the camera connects to the central processing unit via an "image acquisition card"). Fu-007, pp.12-14, Claim 4, FIGS. 1, 4, 6. Thus, the Cui-Fu-007 combination discloses or suggests this limitation.

h. 1[e][iii] "(iii) 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."

206. In my opinion, the Cui-Fu-007 combination discloses or suggests 1[e][iii].

207. Cui discloses or suggests that its computer 7 (controller) "generate[s], in response to the captured image, at least one control signal to cause movement of the body within the swimming pool to...the first portion of the submerged surface." Specifically, Cui describes that its controller compares captured images with stored standard images to identify sediment/debris—"when there is a lot of sediment at the pool bottom, the grayscale level of the real-time captured image(s) is greatly different...resulting in a high comparison output voltage." Cui, pp.6-7. Based on this image-derived signal, "[a] pulse signal command output after processing...separately control[s] the drive of the two hybrid stepper motors 15." *Id.*, p.7. Thus, these are "control signal[s]" generated "in response to the captured image." As explained in §VII.B.3.e (1[d]), Cui's

direction of the cleaner.” Cui, Abstract, pp.5-7. Therefore, when the controller generates signals to adjust motor speed based on detected debris, the robot continues moving **toward** the debris-laden area identified in the image—i.e., the control signals cause movement “to” the first portion of the submerged surface. Janét, ¶207.

Additionally, Fu-007’s onboard controller generates control signals in response to captured images to cause movement to a targeted portion of the surface. Janét, ¶208. Specifically, Fu-007 describes that its central processing unit (controller) sets “a swimming pool cleanliness image threshold” and uses camera 2 to “take image(s) of the bottom of the swimming pool.” Fu-007, pp.10, 14-16. The controller then “determines a cleanliness level of the bottom of the swimming pool by comparing the image(s) with the threshold” and, based on this determination, “plans a cleaning movement” and “adjusts operating conditions of the four cleaning drive wheels 3...to complete the cleaning task.” *Id.* And this adjustment involves changing the “rotational speed of each wheel” such that the robot “may move in a direction determined by” the specific wheel speed combinations (e.g., rotating front wheels rapidly and rear wheels slowly). *Id.* POSITAs would have understood that by planning a cleaning movement based on the determined cleanliness level and adjusting wheel speeds to move in a specific direction, Fu-007’s controller generates control signals to cause the body to move “to” the identified portion of the submerged surface (e.g., the dirty area) to “complete the cleaning task.” *Id.*; Janét, ¶208.

camera 5 captures images of areas “located directly in front and below a crawling direction of the cleaner.” Cui, Abstract, pp.5-7. Therefore, when the controller generates signals to adjust motor speed based on detected debris, the robot continues moving forward **toward** the debris-laden area identified in the image—i.e., the control signals cause movement “to” the first portion of the submerged surface.

208. Additionally, Fu-007 discloses that its controller generates control signals in response to captured images to cause movement to a targeted portion of the surface. Specifically, Fu-007 describes that during autonomous cleaning, the central processing unit sets “a swimming pool cleanliness image threshold” and uses the monitoring camera 2 to “take image(s) of the bottom of the swimming pool.” Fu-007, pp.10, 14-16. The controller then “determines a cleanliness level of the bottom of the swimming pool by comparing the image(s) with the threshold” and, based on this determination, “plans a cleaning movement.” *Id.* To execute this planned movement, the controller “adjusts operating conditions of the four cleaning drive wheels 3...to complete the cleaning task.” *Id.* Fu-007 further explains that this adjustment involves changing the “rotational speed of each wheel” such that the robot “may move in a direction determined by” the specific wheel speed combinations (e.g., rotating front wheels rapidly and rear wheels slowly). *Id.* A POSITA would have understood that by planning a cleaning movement based on the determined cleanliness level and adjusting wheel speeds to move in a specific direction, Fu-007’s controller generates control signals to cause the body to move “to” the identified portion of the submerged surface (e.g., the dirty area) to “complete the cleaning task.” *Id.*

As explained in §§IV.B.2&IV.B.3.f (1[e][i]), POSITAs would have been motivated to modify Cui’s system to replace Cui’s external computer with Fu-007’s onboard controller structure to implement the control logics of Cui and/or Fu-007, including configuring the onboard controller to implement Fu-007’s image-based navigation logic—planning movements based on image thresholds. Janét, ¶209. POSITAs would have recognized that integrating Fu-007’s ability to “plan[] a cleaning movement” and execute specific directional movements would result in more effective and efficient cleaning. Fu-007, pp.14-16; Janét, ¶209. 4. Claim 2 Unpatentable over Cui and Fu-007 The Cui-Fu-007 combination renders Claim 2 obvious. Janét, ¶¶212-215. a. 2[pre], 2[a]-2[c], 2[e] Limitations 2[pre], 2[a]-2[c], and 2[e] are identical to 1[pre], 1[a]-1[c], and 1[e], respectively. For the reasons in §§IV.B.3.a-d (1[pre], 1[a]-1[c]), Cui discloses or suggests 2[pre] and 2[a]-	209. As explained in §VII.B.2, §VII.B.3.f (1[e][i]), a POSITA would have been motivated to modify Cui’s system to replace Cui’s external computer with Fu- 007’s onboard controller structure to implement the control logics taught by Cui and/or Fu-007, including configuring the onboard controller to implement Fu-007’s image-based navigation logic—specifically, planning movements based on image thresholds. Indeed, a POSITA would have recognized that integrating Fu-007’s ability to “plan[] a cleaning movement” and execute specific directional movements via “different wheel speed combinations” would result in more effective debris removal and improved “operating efficiency” compared to passive speed adjustment. Fu-007, pp.14-16. 210. The claim limitation uses the disjunctive “or” between “to” and “away from,” meaning the limitation is satisfied by teaching either alternative. Because the Cui-Fu-007 combination teaches control signals that cause movement “to” the first object, the Cui-Fu-007 combination discloses or suggests this element. 211. Therefore, in my opinion, Cui, in view of Fu-007, renders Claim 1 obvious. 4. Claim 2 Unpatentable over Cui and Fu-007 212. In my opinion, the Cui-Fu-007 combination renders Claim 2 obvious. a. 2[pre], 2[a]-2[c], 2[e] 213. Limitations 2[pre], 2[a]-2[c], and 2[e] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e], respectively. For at least the same reasons explained above in §§VII.B.3.a-d (1[pre],
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2[c]. Additionally, for the reasons in §§IV.B.3.f-h (1[e][i]-[iii]), the Cui-Fu-007 combination discloses or suggests limitation 2[e]. Janét, ¶213.

b. 2[d]

Limitations 2[d] and 1[d] only differ in:

1[d]	"camera"	"mounted directly or indirectly to"	"the body"
2[d]		"carried by"	

Cui discloses 2[d] because a camera "mounted directly...to the body" (§IV.B.3.e (1[d])) is also "carried by the body." Janét, ¶214.

5. Claim 3 Unpatentable over Cui and Fu-007

The Cui-Fu-007 combination renders Claim 3 obvious. Janét, ¶¶216-232.

a. 3[pre], 3[a]-3[c], 3[e][i]

Limitations 3[pre], 3[a]-3[c], and 3[e][i] are identical to 1[pre], 1[a]-1[c], and 1[e][i], respectively. For the reasons in §§IV.B.3.a-IV.B.3.d (1[pre], 1[a]-1[c]), Cui discloses or suggests 3[pre] and 3[a]-3[c]. Additionally, for the reasons in §IV.B.3.f (1[e][i]), the Cui-Fu-007 combination discloses or suggests limitation 3[e][i]. Janét, ¶217.

1[a]-1[c]), Cui discloses or suggests 2[pre] and 2[a]-2[c]. Additionally, for at least the same reasons explained above in §§VII.B.3.f-h (1[e][i]-[iii]), the Cui-Fu-007 combination discloses or suggests limitation 2[e].

b. 2[d]

214. Limitation 2[d] recites substantially the same features as limitation 1[d], with the only difference being that limitation 2[d] recites "at least one camera carried by the body," whereas limitation 1[d] recites "at least one camera mounted directly or indirectly to the body." As explained above in §VII.B.3.e (1[d]), Cui discloses "at least one camera mounted directly...to the body." Thus, Cui also discloses limitation 2[d], because a camera that is "mounted directly...to the body" is also "carried by the body."

215. Therefore, it is my opinion that Cui, in view of Fu-007, renders Claim 2 obvious.

5. Claim 3 Unpatentable over Cui and Fu-007

216. In my opinion, the Cui-Fu-007 combination renders Claim 3 obvious.

a. 3[pre], 3[a]-3[c], 3[e][i]

217. Limitations 3[pre], 3[a]-3[c], and 3[e][i] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e][i], respectively. For at least the same reasons explained above in §§VII.B.3.a-VII.B.3.d (1[pre], 1[a]-1[c]), Cui discloses or suggests 3[pre] and 3[a]-3[c]. Additionally, for at least the same reasons

b. 3[d]

Limitations 3[d] and 1[d] only differ in:

1[d]	"camera"	"mounted directly or indirectly to"	"the body"
3[d]		"positioned on or in, or carried by,"	

Cui discloses 3[d], because a camera "mounted directly...to the body" (§IV.B.3.e (1[d])) is also "positioned on or in, or carried by, the body." Janét, ¶218.

c. 3[e][ii]

The Cui-Fu-007 combination discloses or suggests 3[e][ii]. Janét, ¶¶219-227.

As explained in §IV.B.3.g (1[e][ii]), the Cui-Fu-007 combination discloses or suggests the controller "in electronic communication with the at least one **camera**."

The Cui-Fu-007 combination also discloses or suggests the controller "in electronic communication with...a **portable electronic device**." Janét, ¶221.

explained above in §VII.B.3.f (1[e][i]), the Cui-Fu-007 combination discloses or suggests limitation 3[e][i].

b. 3[d] "d. at least one camera positioned on or in, or carried by, the body for capturing an image of at least a first portion of the submerged surface; and"

218. Limitation 3[d] is substantially the same as limitation 1[d], with the only difference being that 3[d] recites "at least one camera **positioned on or in, or carried by**, the body," whereas 1[d] recites "at least one camera **mounted directly or indirectly to the body**." As explained above in §VII.B.3.e (1[d]), Cui discloses "at least one camera mounted directly...to the body." Thus, Cui also discloses 3[d], because a camera that is "mounted directly...to the body" is also "positioned on or in, or carried by, the body."

c.3[e][ii] "(ii) in electronic communication with the at least one camera and a portable electronic device, and"

219. In my opinion, the Cui-Fu-007 combination discloses or suggests 3[e][ii].

220. In my opinion, as explained in §VII.B.3.g (1[e][ii]), the Cui-Fu-007 combination discloses or suggests the controller "in electronic communication with the at least one **camera**."

221. In my opinion, the Cui-Fu-007 combination also discloses or suggests the controller "in electronic communication with...a **portable electronic device**."

Cui's computer 7 includes "a human-machine interface 16" displaying "the cleaned area...denoted by light blue, and the area that has not been cleaned yet...denoted by dark blue so that the working status of the cleaner can be seen at a glance." Cui, pp.6-7, Claim 3, FIG. 4. Importantly, Cui discloses that "[a]utomatic and manual switches are provided on the left of the panel diagram" of this interface, along with "'start', 'stop', and 'continue' switches." Cui, p.6, FIG. 4. Thus, Cui contemplates a system where the user can intervene, select modes (automatic vs. manual), and control the operation of the cleaner. Janét, ¶222.

[image omitted]

Fu-007 similarly discloses that two modes of its cleaning robot: "remote control [manual] and autonomous control." Fu-007, Abstract. Fu-007 describes that "[i]n the manual mode, a control signal is sent by manual operation using the **control keyboard (31)**" to "control the underwater cleaning robot via...**buoyant antenna (27)**" that "floats on a water surface to wirelessly communicate with the control keyboard 31" and is "connected to the robot via the **control signal buoyant antenna cable 35.**" Fu-007, pp.12-14, FIG. 8 (annotated below); Janét, ¶223.

[image omitted]

As explained in §IV.B.3.f (1[e][i]), POSITAs would have been motivated by the disclosure of wireless communication link between portable control keyboard 31 (PED) and the robot in Fu-007 to modify Cui's system to eliminate the external cable and move the controller onboard to improve autonomy and safety. Janét, ¶224. POSITAs would have been further motivated to incorporate Fu-007's "manual mode" functionality (including

222. Cui's computer 7 includes "a human-machine interface 16" that displays "the cleaned area...denoted by light blue, and the area that has not been cleaned yet...denoted by dark blue so that the working status of the cleaner can be seen at a glance." Cui, pp.6-7, Claim 3, FIG. 4. Importantly, Cui discloses that "[a]utomatic and manual switches are provided on the left of the panel diagram" of this interface, along with "'start', 'stop', and 'continue' switches." Cui, p.6, FIG. 4. Thus, Cui contemplates a system where the user can intervene, select modes (automatic vs. manual), and control the operation of the cleaner.

[image omitted]

223. Fu-007 also discloses that its underwater cleaning robot operates in two modes: "remote control [manual] and autonomous control." Fu-007, Abstract. Fu-007 describes that "[i]n the manual mode, a control signal is sent by manual operation using the **control keyboard (31)**" to "control the underwater cleaning robot via...**buoyant antenna (27)**" that "floats on a water surface to wirelessly communicate with the control keyboard 31" and is "connected to the robot via the **control signal buoyant antenna cable 35.**" Fu-007, pp.12-14, FIG. 8 (annotated below).

[image omitted]

224. As explained in §VII.B.3.f (1[e][i]), a POSITA would have been motivated by the disclosure of wireless communication link between the portable control keyboard 31 and the cleaning and moving platform in Fu-007 to modify Cui's system to eliminate the external cable and move the controller onboard to improve autonomy and safety. In this modified, untethered system, a POSITA would have been further motivated to incorporate Fu-

the control keyboard and buoyant antenna and cable). resulting in a modified system with a dual-mode (wired and wireless) capability, just as Fu-007 disclosed. Fu-007, pp.12-14, FIG. 8; Cui, pp.6-7, Claim 3, FIG. 4; Janét, ¶224.

POSITAs would have made such a modification to preserve Cui's existing manual control capabilities. Cui, pp.6-7, Claim 3, FIG. 4; Janét, ¶225. Cui's system relies on a "human-machine interface" with "manual switches" to allow the user to direct the robot. Cui, p.6. Removing the physical tether (as proposed in 1[e][i]) disconnects this wired interface, and POSITAs would have recognized that utilizing Fu-007's wireless "control keyboard" and "manual mode" provides a functional substitute, restoring the user's ability to manually "start," "stop," or steer the robot. Fu-007, pp.12-14; Cui, pp.6-7; Janét, ¶225.

Additionally, Fu-007 teaches that the wireless antenna mode is specifically advantageous for "short-term local cleaning." Fu-007, p.14. POSITAs would have been motivated to add this capability of Fu-007 to Cui's robot to allow for, e.g., quick cleaning tasks. *Id.*; Janét, ¶226.

POSITAs would have reasonably expected success because Cui already discloses a controller configured to accept "manual" inputs from an interface (Cui, p.6.) and Fu-007 discloses an

007's "manual mode" functionality (including the control keyboard and buoyant antenna and cable) to replace the functionality of Cui's shore-side human-machine interface. Fu-007, pp.12-14, FIG. 8; Cui, pp.6-7, Claim 3, FIG. 4.

225. A POSITA would have made such a modification for at least the following reasons. First, to preserve Cui's existing manual control capabilities. *See* Cui, pp.6-7, Claim 3, FIG. 4. Cui's system relies on a "human-machine interface" with "manual switches" to allow the user to direct the robot. Cui, p.6. Removing the physical tether (as proposed in 1[e][i]) disconnects this wired interface, and a POSITA would have recognized that utilizing Fu-007's wireless "control keyboard" and "manual mode" architecture provides a functional substitute, restoring the user's ability to manually "start," "stop," or steer the robot (e.g., via the "manual switches" logic) without requiring the hazardous physical tether. Fu-007, pp.12-14; Cui, pp.6-7.

226. Second, to enable "short-term local cleaning" and retrieval. Fu-007 teaches that the wireless antenna mode is specifically advantageous for "short-term local cleaning" where the robot operates "without using... the signal and power cable." Fu-007, p.14. A POSITA would have been motivated to add this capability to Cui's robot to allow for quick cleaning tasks or to manually drive the robot to the poolside for retrieval, leveraging Fu-007's teaching that the robot can be "directly...control[led]...via the control signal buoyant antenna" in this mode. *Id.*

227. A POSITA would have had a reasonable expectation of success. Cui already discloses a controller configured to accept "manual" inputs from an interface. Cui, p.6. And Fu-007

onboard controller configured to receive “manual mode” signals from a wireless keyboard via an antenna. Fu-007, p.14; Janét, ¶227. Adding Fu-007’s wireless input structure to trigger the manual control logic already present in Cui’s system would have been a routine integration of known electronic control modules, yielding predictable results. *Id.*

d. 3[e][iii]

The Cui-Fu-007 combination discloses or suggests 3[e][iii]. Janét, ¶¶228- 232.

The limitation requires the controller to generate signals in response to at least **one of the captured image or the PED**. Janét, ¶229.

The Cui-Fu-007 system satisfies this limitation through the “captured image” prong alone, because as explained in §§IV.B.3.f-h (1[e][i]-[iii]), POSITAs would have been motivated, and reasonably expected success, to incorporate Fu-007’s onboard controller and control logic to Cui’s system to generate control signals “in response to...the captured image” to steer the vehicle to debris-laden areas (the first portion of the submerged surface). Cui, pp.6-7; Fu-007, pp.14-16; Janét, ¶230.

Additionally, as explained in §IV.B.5.c (3[e][ii]), POSITAs would have been motivated, and reasonably expected success, to

discloses an onboard controller configured to receive “manual mode” signals from a wireless keyboard via an antenna. Fu-007, p.14. Integrating Fu-007’s wireless input structure to trigger the manual control logic already present in Cui’s system would have been a routine integration of known electronic control modules yielding predictable results.

d. 3[e][iii] “(iii) configured to generate, in response to at least one of the captured image or information from the portable electronic device, 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.”

228. In my opinion, the Cui-Fu-007 combination discloses or suggests 3[e][iii].

229. The limitation requires the controller to generate signals in response to at least **one of the captured image or the PED**.

230. In my opinion, the combined system satisfies this limitation through the “captured image” prong alone, because as explained in §§VII.B.3.f-VII.B.3.h (1[e][i]-[iii]), a POSITA would have been motivated to, with reasonable expectation of success, incorporate Fu-007’s onboard controller and control logic to Cui’s system to generate control signals “in response to...the captured image” to steer the vehicle “to...the first portion of the submerged surface” (e.g., to debris-laden areas). Cui, pp.6-7; Fu-007, pp.14-16.

231. Additionally, as explained in §VII.B.5.c (3[e][ii]), a POSITA would have been motivated, with a reasonable

modify Cui's system to incorporate Fu-007's "control keyboard" (PED) and "manual mode" functionality to preserve manual control capabilities in the untethered system, allowing the onboard controller is configured to receive information (manual commands) from the PED and accordingly generate control signals to steer the vehicle "to" a specific portion of the submerged surface. Fu-007, pp.12-14, FIG. 8; Cui, pp.6-7, Claim 3, FIG. 4; Janét, ¶231.

6. Claim 4 Unpatentable over Cui and Fu-007

Cui and Fu-007 render Claim 4 obvious. Janét, ¶¶233-236.

a. 4[pre], 4[a]-4[c], 4[e]

Limitations 4[pre], 4[a]-4[c], and 4[e] are identical to limitations 1[pre], 1[a]-1[c], and 1[e], respectively. For the reasons in §§IV.B.3.a-IV.B.3.d (1[pre], 1[a]-1[c]), Cui discloses or suggests 4[pre] and 4[a]-4[c]. Additionally, for the reasons in §§IV.B.3.f-IV.B.3.h (1[e][i]-[iii]), the Cui-Fu-007 combination discloses or suggests limitation 4[e]. Janét, ¶234.

b. 4[d]

Limitation 4[d] is nearly identical to limitation 1[d], differing only in that 4[d] omits the requirement that the camera be "mounted directly or indirectly to the body." Cui discloses 4[d],

expectation of success, to modify Cui's system to incorporate Fu-007's "control keyboard" (PED) and "manual mode" functionality to preserve manual control capabilities in the untethered system, allowing the onboard controller is configured to receive information (manual commands) from the portable electronic device and generate control signals to steer the vehicle "to" a specific portion of the submerged surface selected by the user (e.g., moving to a spot for "short-term local cleaning" or driving to the poolside for retrieval). Fu-007, pp.12-14, FIG. 8; Cui, pp.6-7, Claim 3, FIG. 4. 232. Therefore, it is my opinion that Cui, in view of Fu-007, renders Claim 3 obvious.

6. Claim 4 Unpatentable over Cui and Fu-007

233. In my opinion, the Cui-Fu-007 combination renders Claim 4 obvious.

a. 4[pre], 4[a]-4[c], 4[e]

234. Limitations 4[pre], 4[a]-4[c], and 4[e] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e], respectively. For at least the same reasons explained above in §§VII.B.3.a-VII.B.3.d (1[pre], 1[a]-1[c]), Cui discloses or suggests 4[pre] and 4[a]-4[c]. Additionally, for at least the same reasons explained above in §§VII.B.3.f-VII.B.3.h (1[e][i]-[iii]), the Cui-Fu-007 combination discloses or suggests limitation 4[e].

b. 4[d]

235. Limitation 4[d] recites substantially the same features as limitation 1[d], with the only difference being that limitation 4[d] omits the requirement that the camera be "mounted directly or indirectly to the body." As explained above in §VII.B.3.e

because a camera “mounted directly...to the body” (§IV.B.3.e (1[d])) satisfies the broader requirement. Janét, ¶235.	(1[d]), Cui discloses “at least one camera mounted directly...to the body” for capturing an image. Thus, Cui also discloses limitation 4[d], because the prior art’s disclosure of a mounted camera satisfies the broader requirement of a camera generally. 236. Therefore, it is my opinion that Cui, in view of Fu-007, renders Claim 4 obvious.
C. Ground 2B: Claim 5 is Unpatentable over Cui, Fu-007, and Porat 1. Porat Porat (EX1016) is prior art under AIA 35 U.S.C.§102(a)(1) and pre-AIA 35 U.S.C.§102(b). Janét, ¶237. Porat is analogous art to the ’766 Patent. Janét, ¶238. Porat discloses an automated robotic pool cleaner 10 with a housing 12, and electrochemical chlorine generator 30 “mounted on the interior of the housing.” Porat, Abstract, [0028]-[0029], FIGS. 1-2 (annotated below). [image omitted]	C. Ground 2B: Claim 5 is Unpatentable under AIA 35 U.S.C. §103 and Pre-AIA AIA 35 U.S.C. §103 over Cui, Fu-007, and Porat 1. Porat 237. Porat (EX1016) is U.S. Publication No. 20060053572A1 published on March 16, 2006. Porat is prior art under AIA 35 U.S.C. §102(a)(1) and is not subject to exceptions under AIA 35 U.S.C. §102(b)(1) because it was published more than one year before the effective filing date of the ’766 Patent which is no earlier than July 11, 2016. See §VI.C, <i>supra</i>. In addition, Porat is also prior art under pre-AIA 35 U.S.C. §102(b). 238. Porat discloses an automated self-propelled robotic pool cleaner “having a housing and drive means for moving the pool cleaner over at least the bottom wall of a pool” and “an electronic processor/controller in the form of an[sic] integrated circuit device 26” that “is connected...to the floating power cable 40 and also to the drive motor 20, pump motor 24 and electrochemical generator 30.” Porat, Abstract, [0029], FIGS. 1-2 (annotated below). Porat is analogous art to Claims 1-5 of the ’766 Patent.

Porat's **electronic processor/controller 26** controls electrochemical chlorine generator 30, which includes an outlet to "distribute the chlorine into the water proximate the exterior of the pool cleaner housing." *Id.*, Abstract, [0008],[0010], [0029], Claims 1, 8-9, FIG. 1 (above).

239. As illustrated in FIGS. 1–2 (annotated below), Porat's **pool cleaner 10** includes **housing 12**, drive means 14 powered by drive motor 20, cleaning brush 16, pump motor 24 with impeller 25 that draws water through a filter element, and **electrochemical chlorine generator 30** "mounted on the interior of the housing." Porat, [0028].

[image omitted]

240. Porat's electrochemical chlorine generator 30 is controlled by an **electronic processor/controller 26**. *Id.*, [0029], FIG. 1 (annotated above). The processor/controller 26 includes control means for initiating and terminating the operation of the chlorine generator 30. *Id.*, [0008], [0010], Claims 1, 8–9. The electrochemical chlorine generator 30 has "an outlet for discharging water containing chlorine ions produced by the electrochemical generator to thereby distribute the chlorine into the water proximate the exterior of the pool cleaner housing." *Id.*, Abstract, Claim 1.

241. Porat teaches that integrating a chemical dispenser onto a self-propelled pool cleaner provides advantages over conventional systems, including: (1) "efficiently and effectively distribut[ing] the chlorine throughout the volume of water in the pool so as to provide a uniform concentration of the desired chlorine ions" (*id.*, [0007]); and (2) providing "a method and apparatus for generating and adding chlorine to pools that is essentially self-contained and the use of which requires no installation services by a plumber and requires no separate or specialized electrical power connections for its operation" (*id.*, [0005]).

2. Motivation to Combine

2. Reasons for Combining Cui and Fu-007 with Porat

Both the Cui-Fu-007 combination and Porat disclose automated self-propelled robotic pool cleaners, and both sought to improve pool maintenance operations. As explained in §IV.B.2, the Cui-Fu-007 combination provides a pool cleaner using camera-based control to autonomously adjust cleaning operations. As explained in §IV.C.1, Porat similarly describes a robotic pool cleaner designed to improve pool maintenance by providing “a method and apparatus for generating and adding chlorine to pools that is essentially self-contained.” Porat, [0005]. POSITAs would have been motivated to combine the complementary teachings of Cui, Fu-007, and Porat to improve autonomous pool maintenance. Janét, ¶242.

POSITAs would have recognized that the teachings in the Cui-Fu-007 combination and Porat provide similar technical solutions to address similar issues. Janét, ¶243. *Compare* Cui, pp.4-6, Claim 1, FIGS. 1-3, *with* Fu-007, pp.7-10, 12-16, Claims 1-3, FIGS.1-3, 4, *and* Porat, [0028], Claims 1-2; §IV.C.1.

Accordingly, POSITAs would have investigated the technical teachings in Cui, Fu-007, and Porat to seek guidance when designing a pool cleaning system for specific pool maintenance considerations and applications. Janét, ¶243.

242. Both the Cui-Fu-007 combination and Porat disclose automated self-propelled robotic pool cleaners, and both sought to improve pool maintenance operations. As explained in §VII.B.2, the Cui-Fu-007 combination provides a pool cleaner using camera-based control to autonomously adjust cleaning operations based on detected debris. As explained in §VII.C.1, Porat similarly describes a robotic pool cleaner designed to improve pool maintenance by providing “a method and apparatus for generating and adding chlorine to pools that is essentially self-contained.” Porat, [0005]. A POSITA would have been motivated to combine the complementary teachings of Cui, Fu-007, and Porat to achieve improved autonomous pool maintenance operations.

243. A POSITA would have recognized that the teachings in the Cui-Fu-007 combination and Porat are directed to the same pool cleaning technical field, are based on recognition of the same or similar technical issues in pool maintenance, and provide similar technical solutions to address those issues. **Specifically, these references disclose self-propelled pool cleaners having a housing, drive means for moving the pool cleaner over pool surfaces, a pump, and a filter for removing debris. Compare Cui, pp.4–6, Claim 1, FIGS. 1–3, with Fu-007, pp.7–10, 12–16, Claims 1–3, FIGS.1–3, 4, and Porat, [0028], Claims 1–2; see also §VII.C.1 (summarizing Porat).** Accordingly, a POSITA would have investigated the technical teachings in Cui, Fu-007, and Porat to seek guidance when designing a pool cleaning system for specific pool maintenance considerations and applications.

244. As explained in §VII.B.2, the Cui-Fu-007 combination discloses physical debris removal using camera-guided adaptive

Porat discloses an onboard “electrochemical chlorine generator” (chemical dispenser) distributing chlorine “as the cleaner moves across the pool surfaces.” Porat, [0009], [0028], FIGS. 1-2; §IV.C.1. POSITAs would have been motivated to modify the Cui-Fu-007 combination by incorporating Porat's onboard chemical dispenser for at least two reasons. Janét, ¶244. First, POSITAs would have been guided by Cui, Fu-007, and Porat to make such combination to enhance the cleaning effectiveness of the Cui-Fu-007 pool cleaner by combining mechanical debris removal with Porat’s chemical dispenser. Janét, ¶245. POSITAs would have recognized that by incorporating Porat’s chemical dispenser into the Cui-Fu-007 combination, the modified system would have enhanced overall pool maintenance capability—allowing debris removal and chemical application in a single device. <i>Id.</i> Second, POSITAs would have been motivated to adopt this modification to improve convenience and reduce cost. Janét, ¶246. Porat notes conventional generators are expensive and require professional installation, whereas an integrated dispenser is “efficiently and effectively distribut[ing]” chlorine for “uniform concentration,” “essentially self-contained,” and	cleaning. As explained in §VII.C.1, Porat discloses an onboard chemical dispenser—specifically, “an integral on-board electrochemical chlorine generator” that is “mounted on the interior of the housing” and distributes chlorine “as the cleaner moves across the pool surfaces being cleaned.” Porat, [0009], [0028], FIGS. 1–2. The use of a pool cleaner for debris removal alone (Cui-Fu-007) and the use of a pool cleaner with an integrated chemical dispenser (Porat) had been two known design options. A POSITA would have been motivated to modify the Cui-Fu-007 combination by incorporating Porat's onboard chemical dispenser for at least two reasons. 245. First, a POSITA would have been guided by Cui, Fu-007, and Porat to make such a combination to enhance the cleaning effectiveness of the Cui-Fu-007 pool cleaner by combining mechanical debris removal with chemical application. The Cui-Fu-007 combination provides adaptive debris removal mechanically. As explained in §VII.C.1, Porat explicitly teaches that integrating a chemical dispenser onto a moving pool cleaner allows distribution of chlorine “as the cleaner moves across the pool surfaces being cleaned.” Porat, [0009]. A POSITA would have recognized that by incorporating Porat’s onboard chemical dispenser into the Cui-Fu-007 combination, the modified system would have enhanced overall pool maintenance capability—enabling both camera-guided debris removal and chemical application in a single automated device. 246. Second, a POSITA would have been motivated to adopt this modification to improve the convenience and reduce the cost of pool maintenance. As explained in §VII.C.1, Porat explains that conventional electrochemical chlorine generators “are installed in-line with the main pumping and filter system outside of the pool” and “are relatively expensive to purchase and
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requires “no installation services...[or] specialized electrical power connections.” Porat, [0002], [0005], [0007]; §IV.C.1. POSITAs would have recognized that incorporating Porat’s dispenser into Cui-Fu-007 provides these advantages. Janét, ¶246. POSITAs would have reasonably expected that adding Porat’s chemical dispenser into the Cui-Fu-007 cleaner would not require significant modification given their shared components, yielding predictable results. Janét, ¶247. 3. Claim 5 Unpatentable over Cui, Fu-007, and Porat	require the services of an experienced plumber and an electrician for their proper installation.” Porat, [0002]. Porat further teaches that integrating a chemical dispenser onto a self-propelled pool cleaner provides “a method and apparatus for generating and adding chlorine to pools that is essentially self-contained and the use of which requires no installation services by a plumber and requires no separate or specialized electrical power connections for its operation.” Porat, [0005]. A POSITA would have recognized that incorporating Porat’s onboard chemical dispenser into the Cui-Fu-007 combination would have provided pool owners with a single, self-contained device capable of performing multiple pool maintenance functions—debris detection, adaptive cleaning, and chemical application—without requiring additional equipment, professional installation, or separate power connections. 247. A POSITA would have had a reasonable expectation of success in making this combination because integrating a chemical dispenser onto a self-propelled pool cleaner was a well-known design choice, as explained in §VII.C.1, Porat’s electrochemical chlorine generator is already configured for mounting “on the interior of the housing” of a robotic pool cleaner having drive means, a pump, and a filter—structural components that are also present in the Cui-Fu-007 combination. Porat, [0028]. A POSITA would have reasonably expected that Porat’s chemical dispenser could be incorporated into the Cui-Fu-007 pool cleaner without significant modification, thereby yielding predictable results. 3. Claim 5 Unpatentable over Cui, Fu-007, and Porat
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The Cui-Fu-007-Porat combination renders Claim 5 obvious. Janét, ¶¶248-258. a. 5[pre], 5[a]-5[c] Cui discloses or suggests limitations 5[pre] and 5[a]-5[c] for the reasons in §IV.B.3.a-d (1[pre]-1[c]), because they are identical to 1[pre] and 1[a]-1[c]. Janét, ¶249. b. 5[d] The Cui-Fu-007-Porat combination discloses or suggests 5[d]. Janét, ¶¶250-254. As explained in §IV.B.3.b (1[a]), Cui discloses a pool cleaner comprising a vehicle body including housing 4. Cui, pp.5-6, Claim 1, FIG. 1. Porat describes that chlorine generator 30 “mounted on the interior of the housing” of pool cleaner 10 and controlled by integrated circuit device 26. Porat, [0028], FIGS. 1-2 (annotated below). [image omitted] As explained in §IV.C.2, POSITAs would have been motivated to add Porat’s onboard chemical dispenser to the Cui-Fu-007 combination. Janét, ¶252.	248. In my opinion, the Cui-Fu-007-Porat combination renders Claim 5 obvious. a. 5[pre], 5[a]-5[c] 249. Limitations 5[pre] and 5[a]-5[c] are exactly the same as limitations 1[pre] and 1[a]-1[c], respectively. For at least the same reasons explained above in §§VII.B.3.a-VII.B.3.d (1[pre], 1[a]-1[c]), Cui discloses or suggests 5[pre] and 5[a]-5[c]. b. 5[d] 250. In my opinion, the Cui-Fu-007-Porat combination discloses or suggests 5[d]. 251. As explained in §VII.B.3.b (1[a]), Cui discloses a pool cleaner comprising a vehicle body including housing 4. Cui, pp.5-6, Claim 1, FIG. 1. Porat describes that electrochemical chlorine generator 30 is “mounted on the interior of the housing” of pool cleaner 10 and controlled by an integrated circuit device 26. Porat, [0028], FIGS. 1-2 (annotated below). [image omitted] 252. As explained in §VII.C.2, a POSITA would have been motivated to modify the Cui-Fu-007 combination by incorporating Porat’s onboard chemical dispenser. 253. As explained in §VII.C.1, Porat’s “integral on-board electrochemical chlorine generator” is “mounted on the interior of the housing” of a self-propelled pool cleaner and configured to “distribute the chlorine into the water proximate the exterior
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c. 5[e]

Limitations 5[e] and 1[d] only differ in:

1[d]	"camera"	"mounted directly or indirectly to"	"the body"
5[e]		"on, in, or carried by"	"the vehicle body"

Cui discloses 5[e], because a camera "mounted directly...to the body" (§IV.B.3.e (1[d])) is also "on, in, or carried by the vehicle body." Janét, ¶255.

d. 5[f][i]

Limitations 5[f][i] and 1[e][i] only differ in:

of the pool cleaner housing" as the cleaner "moves across the pool surfaces being cleaned." Porat, Abstract, [0009], [0028], Claim 1. A POSITA would have understood that Porat's electrochemical chlorine generator is a "chemical dispenser" that is "on, in, or carried by the vehicle body."

254. In the Cui-Fu-007-Porat combination, Porat's electrochemical chlorine generator would be mounted on or in the Cui-Fu-007 pool cleaner housing. *See* §VII.C.2. As the Cui-Fu-007 pool cleaner moves across pool surfaces during camera-guided cleaning operations, the onboard chemical dispenser would distribute chlorine into the pool water, thereby providing both adaptive debris removal and chemical application.

c. 5[e]

255. Limitation 5[e] recites substantially the same features as limitation 1[d], with the only difference being that limitation 5[e] recites "at least one **camera on, in, or carried by** the vehicle body," whereas limitation 1[d] recites "at least one **camera mounted directly or indirectly to** the body." As explained above in §VII.B.3.e (1[d]), Cui discloses "at least one camera mounted directly...to the body." Thus, Cui also discloses limitation 5[e], because a camera that is "mounted directly...to the body" is also "on, in, or carried by the vehicle body."

d. 5[f][i]

256. Limitation 5[f][i] is substantially the same as limitation 1[e][i], with the only difference being that 5[f][i] recites a

1[e][i]	"controller"	"positioned on or in"	"the body"
5[f][i]		"on, in, or carried by"	"the vehicle body"

The Cui-Fu-007 combination discloses 5[f][i], because a controller "positioned on...the body" (§IV.B.3.f (1[e][i])) is also "on, in, or carried by the vehicle body." Janét, ¶256. e. 5[f][ii]-5[f][iii] The Cui-Fu-007 combination discloses or suggests limitations 5[f][ii] and 5[f][iii] for the reasons in §§IV.B.3.g-h 1[e][ii]-[iii]), because they are identical to 1[e][ii] and 1[e][iii]. Janét, ¶257.	controller "on, in, or carried by the vehicle body," whereas 1[e][i] recites a controller "positioned on or in the body." As explained above in §VII.B.3.f (1[e][i]), the Cui-Fu-007 combination discloses a controller "positioned on...the body." Thus, it is my opinion that the combination also discloses limitation 5[f][i], because a controller that is "positioned on...the body" is also "on, in, or carried by the vehicle body." e. 5[f][ii]-5[f][iii] 257. Limitations 5[f][ii] and 5[f][iii] are exactly the same as limitations 1[e][ii] and 1[e][iii], respectively. It is my opinion that for at least the same reasons explained above in §§VII.B.3.g-VII.B.3.h (1[e][ii]-1[e][iii]), Cui and Fu-007 disclose or suggest 5[f][ii] and 5[f][iii]. 258. Therefore, in my opinion, Cui, in view of Fu-007 and Porat, renders Claim 5 obvious.
D. Ground 3A: Claims 1-2 and 4 are Unpatentable under §103 over Knoll 1. Knoll Knoll (EX1006) is prior art under AIA 35 U.S.C. §102(a)(1) and pre-AIA 35 U.S.C. §102(b). Janét, ¶259.	D. Ground 3A: Claims 1-2 and 4 Are Unpatentable under AIA 35 U.S.C. §103 and Pre-AIA AIA 35 U.S.C. §103 over Knoll 1. Knoll 259. Knoll (EX1006) is German Patent Application Publication No. DE102007053310A1 published on June 10, 2009. Knoll is prior art under AIA 35 U.S.C. §102(a)(1) and is not subject to exceptions under AIA 35 U.S.C. §102(b)(1) because it was published more than one year before the effective filing date of the '766 Patent which is no earlier than July 11, 2016. See §

Knoll discloses an autonomous pool robotic cleaning vehicle with camera-based navigation. Knoll, Title, Abstract, [0001]-[0002], [0007], [0021], [0027], Claims 1-14, FIG. 1 (below). Knoll is analogous art to the '766 Patent. Janét, ¶¶260–262. [image omitted] Knoll's robotic vehicle 1 includes drive means 12, camera 6, light beam source 7, and control unit 11 for controlling the drive means. Knoll, [0007], [0027] [0028], FIGS. 1-2. Knoll's camera 6 captures images of the boundary surface, which evaluation unit 10 processes to derive "smallest distance measurement values" relative to the boundary. Knoll, [0028]. Control unit 11 uses these image-derived values to "automatically calculate[] a trajectory" and generate control signals that "control[] the drive means 12" to move the vehicle. Knoll, [0028], Claim 2, FIG. 2 (reproduced below).	VI.C, <i>supra</i>. In addition, Knoll is also prior art under pre-AIA 35 U.S.C. §102(b). 260. Knoll discloses "a pool robotic vehicle, in particular a pool cleaning robot, whose working element is, for example, a filter device and/or suction device and/or cleaning device" and disclose features of an autonomous pool cleaner with camera-based navigation capacities. Knoll, Title, Abstract, [0001]-[0002], [0007], [0021], Claims 1-14, Fig. 1 reproduced below, described in [0027]). Knoll is analogous art with respect to Claims 1-5 of the ' 766 Patent. [image omitted] 261. Knoll's system includes robotic vehicle 1 with drive means 12, distance-determining device 5 comprising digital camera 6 and light beam source 7 rotatably mounted on mounting plate 8, and control unit 11 for controlling the drive means. <i>See</i> Knoll, [0007], [0027]-[0028], FIGS. 1-2. The robotic vehicle is "a pool robot with a suction and/or filter and/or cleaning device" that operates on working area 3 formed by the pool bottom and delimited by boundary surface 4 (pool walls). <i>Id.</i> 262. Knoll's camera 6 captures images of the boundary surface, which evaluation unit 10 processes to derive "quasi-continuously determined smallest distance measurement values" relative to the boundary. Knoll, [0028]. Control unit 11 uses these image-derived values to "automatically calculate[] a trajectory" and generate control signals that "control[] the drive means 12" to move the vehicle "away from or toward" the boundary to maintain a "defined distance." Knoll, [0028], Claim 2, FIG. 2 (reproduced below).
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[image omitted]

2. Claim 1 is Unpatentable over Knoll

Knoll renders Claim 1 obvious. Janét, ¶¶263-297.

a. 1[pre]

Knoll discloses or suggests 1[pre]. Janét, ¶¶264-268.

Knoll discloses an “**autonomous robotic** vehicle 1 designed as a pool cleaning vehicle” with “drive means (12) for driving and steering” and a **control unit 11** that controls **drive means 12** and is “designed to **automatically calculate** a trajectory.” Knoll, Abstract; [0027]-[0028]; Claims 2, 14, FIG. 1 (annotated below); Janét, ¶267.

[image omitted]

Knoll’s robotic vehicle is a self-propelled pool cleaner that cleans debris from a submerged surface of a swimming pool, because it is a “pool robot with a suction and/or filter and/or cleaning device,” its drive means autonomously propels the vehicle under the control of control unit 11, and it operates on “working area 3...formed by the bottom of the pool” and cleans “a pool floor and/or the pool walls.” Knoll, [0007], [0027]-[0028], FIG. 1 (below); Janét, ¶268.

[image omitted]

[image omitted]

2. Claim 1 Unpatentable over Knoll

263. In my opinion, Knoll renders Claim 1 obvious.

a. 1[pre] “A self-propelled pool cleaner for cleaning debris from a submerged surface of a swimming pool, comprising:”

264. In my opinion, Knoll discloses or suggests 1[pre].

265. Knoll discloses an “autonomous robotic vehicle 1 designed as a pool cleaning vehicle” with “drive means (12) for driving and steering” and a **control unit 11** that controls **drive means 12** and is “designed to automatically calculate a trajectory.” Knoll, Abstract; [0027]-[0028]; Claims 2, 14, FIG. 1 (annotated below).

[image omitted]

266. Knoll’s robotic vehicle is a self-propelled pool cleaner because it is a “pool robot with a suction and/or filter and/or cleaning device” and its drive means autonomously propels the vehicle under the control of control unit 11. Knoll, [0007], [0028].

267. Knoll’s robotic vehicle equipped with a suction/filter/cleaning device, cleans debris from a submerged surface of a swimming pool because it operates on “working area 3...formed by the bottom of the pool” and achieves “a complete and efficient cleaning of a pool floor and/or the pool walls.” Knoll, [0007], [0027]-[0028], FIG. 1 (below).

b. 1[a] Knoll discloses or suggests 1[a]. Janét, ¶¶269-271. Knoll’s robotic vehicle 1 (system) includes drive means 12, control unit 11, and suction and/or filter and/or cleaning device. Knoll, Abstract, [0007], [0021], [0027]-[0028], Claims 1-2, 14, FIG.1 (annotated below). POSITAs would have understood that Knoll’s robotic vehicle—comprising the integrated physical structure housing these components—includes a “vehicle body.” Janét, ¶¶270–271. [image omitted] c. 1[b]	[image omitted] 268. A POSITA would have understood that Knoll’s robotic vehicle (pool cleaner) cleans debris from submerged pool surfaces—including working area 3 (pool bottom) and pool walls—because the pool bottom and walls are submerged when the pool is in normal service, and pool-cleaning robots are intended to operate in filled pools to clean debris from these submerged surfaces. b. 1[a] “a. a vehicle body;” 269. In my opinion, Knoll discloses or suggests 1[a]. 270. Knoll’s robotic vehicle 1 (pool cleaning system) includes various components: drive means 12 “for generating propulsion and for steering,” control unit 11 that “controls the drive means” and is “designed to automatically calculate a trajectory of the robotic vehicle,” and “suction and/or filter and/or cleaning device.” Knoll, Abstract, [0007], [0021], [0027]-[0028], Claims 1-2, 14, FIG.1 (annotated below). [image omitted] 271. A POSITA would have understood that Knoll’s robotic vehicle— comprising the integrated physical structure housing these components—constitutes the claimed “vehicle body.” c.1[b] “b. means for moving the vehicle body within the swimming pool;” 272. In my opinion, Knoll discloses or suggests 1[b].
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Limitation 1[b] invokes §112¶6/§112(f); the function is “moving the vehicle body within the swimming pool,” and the corresponding structure includes “**wheels...powered by a motor.**” See §III.E.

Knoll discloses this function and structure. Janét, ¶¶272-276. Specifically, Figure 1 shows robotic vehicle 1 with **wheels** contacting the pool bottom, and Knoll describes “**drive means** (12)...for generating propulsion and for steering.” Knoll, Abstract, [0028], Claims 1, 14, FIG. 1 (annotated below). P

POSITAs would have understood “drive means 12” comprises motors powering the wheels, thereby disclosing the corresponding structure. Janét, ¶¶275–276.

[image omitted]

273. The format and content of 1[b] invoke claim interpretation under pre-AIA 35 U.S.C. §112 ¶6, or 35 U.S.C. §112(f). As explained in §VI.D, the recited function is “moving the vehicle body within the swimming pool,” and the corresponding structure is wheels, rollers, tracks, or other surface contacting members powered by a motor, or vacuum or liquid jet. ’766 Patent, 3:31-43, 10:12-14, FIGS. 9-10.

274. Knoll’s Fig 1 (annotated below) shows robotic vehicle 1 with **drive means 12** and **wheels** contacting the pool bottom surface within working area 3. Knoll, Fig. 1.

[image omitted]

275. Knoll describes that “drive means (12) for driving and steering the robotic vehicle (1)” are configured “for generating propulsion and for steering the robotic vehicle 1.” Knoll, Abstract, [0028], Claims 1, 14. A POSITA would have understood that Knoll’s drive means 12 comprises motor(s) powering the wheels, because generating propulsion and steering for a wheeled robotic vehicle needs motor-driven wheel rotation.

276. A POSITA would have understood that Knoll thus discloses the claimed **function** and corresponding **structure**: **wheels contact the submerged pool surfaces and are powered by a motor to propel the vehicle body within the swimming pool.** Specifically, the ’766 Patent discloses wheels that propel the vehicle “along the submerged pool surfaces” and are “powered by a motor” (EX1001, 3:33-39), and Knoll similarly discloses wheels (Figure 1) that contact the pool bottom surface and are powered by motor(s) (as part of drive means 12) to move robotic vehicle 1 within the pool.

d. 1[c]

Knoll discloses or suggests 1[c]. Janét, ¶¶277-279.

Knoll discloses 1[c], because its pool cleaning robot includes “a filter device and/or suction device.” Knoll, [0007], [0021]. Knoll describes its robot operates on “working area 3...formed by the bottom of the pool” and its control unit is “located inside the robotic vehicle in a waterproof housing.” Knoll, [0008], [0027].

POSITAs would have understood that Knoll’s suction device draws water containing debris from the pool’s submerged surfaces by suction, and the filter device retains this collected debris. Janét, ¶¶278–279.

e. 1[d]

Knoll discloses or suggests 1[d]. Janét, ¶¶280-285.

Knoll discloses 1[d], because Knoll discloses a “distance-determining device 5 (sensor device), which...comprises a...digital **camera 6**” mounted on robotic vehicle 1. Knoll, [0028], FIG. 1 (annotated below); Janét, ¶¶281.

d.1[c] “c. a filter configured to retain debris collected from the submerged surface;”

277. In my opinion, Knoll discloses or suggests 1[c].

278. It is my opinion that Knoll discloses this limitation because its pool cleaning robot includes “a filter device and/or suction device.” Knoll, [0007], [0021]. Knoll describes its robot operates on “working area 3...formed by the bottom of the pool” and its control unit is “located inside the robotic vehicle in a waterproof housing.” Knoll, [0008], [0027].

279. A POSITA would have understood that Knoll’s suction device draws water containing debris from the pool’s submerged surfaces by suction, and the filter device retains this collected debris, **because Knoll’s robot operates on the bottom of the pool and has “waterproof housing” for its control unit (Knoll, [0008]), and the filters in pool cleaning systems, like Knoll’s, capture and retain debris while allowing clean water to pass through, preventing debris from recirculating back into the pool.**

e.1[d] “d. at least one camera mounted directly or indirectly to the body for capturing an image of at least a first portion of the submerged surface; and”

280. In my opinion, Knoll discloses or suggests 1[d].

281. Knoll discloses “at least one camera mounted directly or indirectly to the body” or carried by the body, because Knoll describes “robotic vehicle 1 is equipped with a distance-

[image omitted] As explained in §IV.D.2.b (1[a]), Knoll’s robotic vehicle includes a “vehicle body,” and POSITAs would have understood that camera 6, part of distance-determining device 5 arranged on robotic vehicle 1, is “mounted directly or indirectly to the body.” Janét, ¶¶282. Knoll also discloses “capturing an image of at least a first portion of the submerged surface.” Janét, ¶¶283–285. Knoll’s camera 6 observes “boundary surface 4” (pool walls), which are submerged surfaces. Knoll, [0007], [0018] (“a light beam is focused on the boundary line or boundary surface and observed with a camera”), [0027]-[0028], FIG. 1; §IV.D.2.a; Janét, ¶¶285. POSITAs would have understood camera 6 captures images of “at least a first portion of the submerged surface” because it views the pool walls/floor to detect the reflected light within the scene. <i>Id.</i>	determining device 5 (sensor device), which...comprises a...digital camera 6.” Knoll, [0028], FIG. 1 (annotated below). [image omitted] 282. As explained in §VII.D.2.b (1[a]), Knoll’s robotic vehicle is the claimed “vehicle body,” and a POSITA would have understood that camera 6, which is part of distance-determining device 5 arranged on robotic vehicle 1, is “mounted directly or indirectly to the body,” or carried by the body. 283. In my opinion, Knoll also discloses “the at least one camera...for capturing an image of at least a first portion of the submerged surface.” As explained in §VII.D.2.a (1[pre]), Knoll’s pool cleaning robot achieves “a complete and efficient cleaning of a pool floor and/or the pool walls,” where the pool bottom (working area 3) and pool walls (boundary surface 4) are submerged surfaces. Knoll, [0007], [0027]-[0028]. 284. Knoll describes that camera 6 is positioned to observe boundary surface 4 formed by pool walls. Knoll, [0028], FIG. 1. Knoll explains that “a light beam is focused on the boundary line or boundary surface and observed with a camera,” and that “the angle at which the light beam is observed changes and thus the position of its image on the camera’s photo sensor changes” as the “distance of the boundary line or the boundary surface (measurement object) from the sensor (e.g., a camera) changes.” Knoll, [0018]. 285. A POSITA would have understood that camera 6 captures images of “at least a first portion of the submerged surface” because: (1) the pool walls (boundary surface 4) observed by camera 6 are themselves submerged surfaces that Knoll’s robot
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f. 1[e][i]

Knoll discloses or suggests 1[e][i]. Janét, ¶¶286-289.

Knoll's robotic vehicle 1 includes control unit 11 (controller) inside the vehicle body that controls movement of the vehicle via **drive means 12**. Knoll, Abstract, [0008] (“**the control unit** is preferably **located inside the robotic vehicle** in a waterproof **housing**”), [0007], [0021], [0027]-[0028], Claims 1-2, 14, FIG.1 (annotated below); Janét, ¶¶289.

[image omitted]

cleans; and (2) for triangulation to determine distance, the camera captures an image of a scene—not merely a point or line—and the camera's field of view encompasses portions of the submerged pool surfaces (first portion), e.g., pool bottom and/or walls, within the scene where the light beam is reflected. Knoll, [0018], [0027]-[0028].

f.1[e][i] “e. a controller (i) positioned on or in the body,”

286. It is my opinion that Knoll discloses or suggests 1[e][i].

287. Knoll's robotic vehicle 1 includes a **control unit 11** inside the vehicle body that controls **drive means 12** and is “designed to automatically calculate a trajectory of the robotic vehicle,” and “suction and/or filter and/or cleaning device.” Knoll, Abstract, [0007], [0021], [0027]-[0028], Claims 1-2, 14, FIG.1 (annotated below).

[image omitted]

288. Knoll's robotic vehicle 1 includes various components: **drive means 12** “for generating propulsion and for steering,” **control unit 11** that “controls the drive means” and is “designed to automatically calculate a trajectory of the robotic vehicle,” and “suction and/or filter and/or cleaning device.” Knoll, Abstract, [0007], [0021], [0027]-[0028], Claims 1-2, 14, FIG.1 (annotated below).

[image omitted]

289. Knoll discloses the controller “positioned...in the body” because Knoll describes “the **control unit** is preferably **located**

g. 1[e][ii]

Knoll discloses or suggests its control unit (controller) is in electronic communication with camera 6, because it receives and processes image data from camera 6. Knoll, [0018], [0028], FIG. 1 (annotated below); Janét, ¶¶290–292. Knoll explains that “the distance-determining device uses...the rotating **camera** to determine the distance to the boundary line or boundary surface” and that the device includes an **evaluation unit 10**, part of a **control unit 11**, for determining the measured distance values. *Id.*

[image omitted]

inside the robotic vehicle in a waterproof housing or in the camera.” Knoll, [0008], FIG. 1 (annotated above). As explained in §VII.D.2.b (1[a]), robotic vehicle 1 is the claimed “vehicle body.” A POSITA would have understood that control unit 11 located “inside the robotic vehicle” is “positioned on or in the body,” or carried by the body.

g. 1[e][ii] “(ii) in electronic communication with the at least one camera, and”

290. In my opinion, Knoll discloses or suggests 1[e][ii].

291. Knoll discloses its control unit (controller) is in electronic communication with camera 6, because it receives and processes image data from camera 6. *See, e.g.*, Knoll, [0018], [0028]. Specifically, Knoll explains that “the distance-determining device uses the rotating light beam source and the rotating camera to determine the distance to the boundary line or boundary surface by triangulation” and that the device includes “an **evaluation unit 10** for evaluating or determining the measured distance values,” with “the evaluation unit 10 [being] part of a **control unit 11**.” Knoll, [0018], [0028], FIG. 1 (annotated below; showing **evaluation unit 10** (part of **control unit 11**) is connected to **camera 6** via a wire/cable.

[image omitted]

292. Knoll further explains that “a light beam is focused on the boundary line or boundary surface and observed with a camera,” and that as “the angle at which the light beam is observed changes...the **position of its image on the camera’s photo sensor changes**,” with “[t]he distance...then **calculated from the change in position**.” Knoll, [0018]. A POSITA would have

h. 1[e][iii]

Knoll discloses or suggests 1[e][iii]. Janét, ¶¶293-296.

Knoll discloses generating control signals “in response to the captured image.” Knoll’s control unit 11 (controller) receives sensor information from distance-determining device 5 (which includes camera 6) and “controls the drive means 12 as a function of...quasi-continuously determined smallest distance measurement values.” Knoll, [0028].

POSITAs would have understood that Knoll’s control unit generates control signals “in response to the captured image” because the control signals are based on distance measurements derived from images captured by camera 6. Knoll, [0018]; Janét, ¶¶294.

Knoll also discloses generating control signals to cause movement “to, or away from,” a portion of boundary surface 4 (first portion of the submerged surface), because Knoll’s control

understood that control unit 11 is in electronic communication with camera 6 because, to calculate distance values from images captured on the camera, evaluation unit 10, part of control unit 11, would receive data from camera 6 for processing. Knoll, [0018], [0028].

h. 1[e][iii] “(iii) 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 surfact.”

293. In my opinion, Knoll discloses or suggests 1[e][iii].

294. Knoll discloses generating control signals “in response to the captured image.” Specifically, Knoll’s control unit 11 receives sensor information from a distance-determining device 5 (which includes camera 6) and “controls the drive means 12 as a function of...quasi-continuously determined smallest distance measurement values.” Knoll, [0028]. Knoll also explains that the distance measurement values are derived from images captured by camera 6, where “the position of its image on the camera’s photo sensor changes” based on the distance to boundary surface 4, and “[t]he distance...is then calculated from the change in position.” Knoll, [0018]. A POSITA would have understood that Knoll’s control unit generates control signals “in response to the captured image” because the control signals are based on distance measurements derived from images captured by camera 6.

295. Knoll also discloses generating control signals to cause movement “to, or away from, the first portion of the submerged surface.” As explained in §VII.D.2.e (1[d]), a portion of

unit controls drive means 12 so that “the robotic vehicle maintains a defined distance from the boundary line and/or boundary surface” as the vehicle travels. Knoll, [0011], Claim 4, FIG. 2 (below); §IV.D.2.e; Janét, ¶¶295. [image omitted] POSITAs would have understood that, to maintain a defined distance from boundary surface 4, Knoll’s control unit generates control signals that move the vehicle body away from boundary surface 4 when the distance becomes too small and toward it when too large. Janét, ¶296. 3. Claim 2 Unpatentable over Knoll Knoll renders Claim 2 obvious. Janét, ¶¶298-301. a. 2[pre], 2[a]-2[c], 2[e][i]-[iii] Limitations 2[pre], 2[a]-2[c], and 2[e][i]-[iii] are identical to 1[pre], 1[a]-1[c], and 1[e][i]-[iii], respectively. For the reasons in §§IV.D.2.a-d, f-h (1[pre], 1[a]-1[c], 1[e][i]-[iii]), Knoll discloses or suggests 2[pre], 2[a]-2[c], 2[e][i]-[iii].	boundary surface 4 captured by camera 6 constitutes the “first portion of the submerged surface.” Knoll further explains that control unit 11 controls drive means 12 “in such a way that the robotic vehicle maintains a defined distance from the boundary line and/or boundary surface” as the vehicle travels working area 3 in a plurality of laps. Knoll, [0011], Claim 4, FIG. 2 (below). [image omitted] 296. A POSITA would have understood that, to maintain a defined distance from boundary surface 4 (first portion of the submerged surface), Knoll’s control unit generates control signals that cause the vehicle body to move away from boundary surface 4 when the measured distance becomes too small and toward boundary surface 4 when the measured distance becomes too large. 297. Therefore, it is my opinion that Knoll renders Claim 1 obvious. 3. Claim 2 Unpatentable over Knoll 298. In my opinion, Knoll renders Claim 2 obvious. a. 2[pre], 2[a]-2[c], 2[e] 299. Limitations 2[pre], 2[a]-2[c], and 2[e] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e], respectively. It is my opinion that, for at least the same reasons explained above in §§VII.D.2.a-VII.D.2.d (1[pre], 1[a]-1[c]), Knoll discloses or suggests 2[pre] and 2[a]-2[c]. Additionally, for at least the same reasons explained above in §§VII.D.2.f-VII.D.2.h (1[e][i]-[iii]), Knoll discloses or suggests limitations 2[e][i]-[iii].
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b. 2[d]

Limitations 2[d] and 1[d] only differ in:

1[d]	"camera"	"mounted directly or indirectly to"	"the body"
2[d]		"carried by"	

Knoll discloses 2[d], because Knoll's camera "mounted directly...to the body" (§IV.D.2.e (1[d])) is also "carried by the body." Janét, ¶300.

4. Claim 4 Unpatentable over Knoll

Knoll renders Claim 4 obvious. Janét, ¶¶302-305.

a. 4[pre], 4[a]-4[c], 4[e][i]-[iii]

Limitations 4[pre], 4[a]-4[c], and 4[e][i]-[iii] are identical to 1[pre], 1[a]-1[c], and 1[e][i]-[iii], respectively. For the reasons in §§IV.D.2.a-d, f-h (1[pre], 1[a]-1[c], 1[e][i]-[iii]), Knoll discloses or suggests 4[pre], 4[a]-4[c], and 4[e][i]-[iii].

b. 4[d]

Limitation 4[d] is nearly identical to limitation 1[d], differing only in that 4[d] omits the requirement the camera be "mounted

b. 2[d]

300. Limitation 2[d] is substantially as limitation 1[d], with the only difference being that 2[d] recites "at least one camera carried by the body," whereas 1[d] recites "at least one camera mounted directly or indirectly to the body." As explained above in §VII.D.2.e (1[d]), Knoll discloses "at least one camera mounted directly...to the body." Thus, it is my opinion that Knoll also discloses limitation 2[d], because a camera that is "mounted directly...to the body" is also "carried by the body."

301. Therefore, it is my opinion that Knoll renders Claim 2 obvious.

4. Claim 4 Unpatentable over Knoll

302. In my opinion, Knoll renders Claim 4 obvious.

a. 4[pre], 4[a]-4[c], 4[e]

303. Limitations 4[pre], 4[a]-4[c], and 4[e] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e], respectively. For at least the same reasons explained above in §§VII.D.2.a-VII.D.2.d (1[pre], 1[a]-1[c]), Knoll discloses or suggests 4[pre] and 4[a]-4[c]. Additionally, for at least the same reasons explained above in §§VII.D.2.f-VII.D.2.h (1[e][i]-[iii]), Knoll discloses or suggests limitation 4[e].

b. 4[d]

304. Limitation 4[d] recites substantially the same features as limitation 1[d], with the only difference being that Limitation

directly or indirectly to the body.” Janét, ¶304. Knoll discloses 4[d], because a camera “mounted directly...to the body” (§IV.D.2.e (1[d])) satisfies the broader requirement. <i>Id.</i>	4[d] omits the requirement that the camera be “mounted directly or indirectly to the body.” As explained above in §VII.D.2.e (1[d]), Knoll discloses “at least one camera mounted directly...to the body” for capturing an image. Thus, in my opinion, Knoll also discloses limitation 4[d], because the prior art’s disclosure of a mounted camera satisfies the broader requirement of a camera generally. 305. Therefore, it is my opinion that Knoll renders Claim 4 obvious.
E. Ground 3B: Claim 3 Is Unpatentable over Knoll and Fu-957 1. Fu-957 Fu-957 (EX1015), which is analogous art, discloses a pool cleaning robot comprising a cleaning robot main unit with a filter, housing body, transmission systems, cleaning rollers, and control circuit board. Fu-957, Abstract, Claim 1-2, pp.6-75, FIGS. 1-2 (below); Janét, ¶¶306-310. [images omitted]	E. Ground 3B: Claim 3 Is Unpatentable under AIA 35 U.S.C. §103 and Pre-AIA AIA 35 U.S.C. §103 over Knoll and Fu-957 1. Fu-957 306. Fu-957 (EX1015) is Chinese Patent Application Publication No. CN101481957A published on July 15, 2009 and is prior art under AIA 35 U.S.C. §102(a)(1) and is not subject to exceptions under AIA 35 U.S.C. §102(b)(1) because it was published more than one year before the effective filing date of the ’766 Patent which is no earlier than July 11, 2016. <i>See</i> §VI.C, <i>supra</i>. In addition, Fu-957 is also prior art under pre-AIA 35 U.S.C. §102(b). 307. Fu-957 discloses a swimming pool cleaning robot comprising a cleaning robot main unit with a filter, housing body, transmission systems, cleaning rollers, and “the control circuit board of an underwater controller...mounted inside the sealed enclosure cover.” Fu-957, Abstract, Claim 1, pp.6–75, FIGS. 1–2. Fu-957 is analogous art to Claims 1–5 of the ’766 Patent. 308. Fu-957’s swimming pool cleaning robot includes a

Fu-957's underwater controller includes a microcontroller (MCU) that processes sensor data and generates control signals to control the drive motors 139A and thereby the transmission systems 15. <i>Id.</i>, pp.7-9, 16-18, FIGS. 13, 15-16.	cleaning robot main unit 1, a power control box 2, and a remote controller 3. <i>Id.</i>, Abstract, Claim 1, FIG. 1. [image omitted] 309. The cleaning robot main unit 1 comprises a filter 11, a housing body component 12, an axial-flow pump and sealed enclosure 13, a housing cover component 14, transmission systems 15, cleaning rollers 16, and a self-buoyant cable 17. <i>Id.</i>, pp.6-7, Claims 1-2, FIG. 2. [images omitted] 310. Fu-957 describes a sealed housing for the underwater controller. Fu-957, Claim 1, FIG.13 (annotated below). Specifically, Fu-957 describes that “[t]he sealed enclosure cover 135 and the sealed enclosure body 139 are connected through a cylindrical-surface sealing connection with a sealing ring and are locked with screws.” <i>Id.</i>, pp.12-13, FIG.7 (annotated below). “Inside the sealed enclosure, a heat-conducting plate 136 is installed, on which the pump control circuit board [137] and the underwater controller circuit board [138] are fixedly mounted.” <i>Id.</i> Drive motors 139A are mounted at both side ends of the sealed enclosure body 139, with “connection end plates...sealingly fitted to holes of the sealed enclosure body by sealing rings.” <i>Id.</i> [images omitted] 311. Fu-957's underwater controller includes a microcontroller (MCU) that processes sensor data and generates control signals to control the drive motors 139A and thereby the transmission systems 15. <i>Id.</i>, pp.7-9, 16-18, FIGS. 13, 15-16. Fu-957
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Fu-957's system also includes a remote controller 3 is a portable handheld device comprising a display screen 33, membrane keys 39, communication circuit board 34, and battery box 35. <i>Id.</i>, p.14, Claim 6, FIG. 4 (below). The remote controller provides two-way communication with the cleaning robot main unit via the power control box 2 and self-buoyant cable 17, enabling the display screen to show "an operating status of the cleaning robot main unit" and the keys to "set an automatic work mode and manual operations." <i>Id.</i>, Abstract, Claim 6, pp.10, 14, FIGS.12-13 (annotated below). [images omitted] When the keys are pressed, the cleaning robot main unit "crawl[s] and clean[s] along the path controlled by the operator's intention." <i>Id.</i>, p.18.	discloses that "the microcontroller issues a command to control the rotational speeds of the two drive motors," and that "the two drive motors of the cleaning robot respectively drive the left and right transmission systems." <i>Id.</i>, pp.16-18. Fu-957 discloses that "an overload sensor is provided in the control system of the cleaning robot to detect and determine touching conditions during crawling and cleaning and to issue a corresponding signal to cause the cleaning robot to enter the next step of program operation." <i>Id.</i>, Abstract. Fu-957 also discloses that "[a]n accelerometer is provided on the circuit board of the underwater controller." <i>Id.</i>, Claims 5, 8. During cleaning operations, "when the sensor detects and the microcontroller (MCU) determines that the cleaning robot main unit has touched a pool wall," the MCU "issues a command" to control subsequent movement. <i>Id.</i>, pp.17-18. 312. Fu-957's remote controller 3 is a portable handheld device comprising a display screen 33, membrane keys 39, communication circuit board 34, and battery box 35. <i>Id.</i>, p.14, Claim 6, FIG. 4. The remote controller provides two-way communication with the cleaning robot main unit via the power control box 2 and self-buoyant cable 17, enabling the display screen to show "an operating status of the cleaning robot main unit and receive[] alarm signals," and the membrane keys to "set an automatic work mode and manual operations." <i>Id.</i>, Abstract, Claim 6, pp.10, 14, FIGS.12-13 (annotated above). [images omitted] 313. Fu-957 teaches that when "the manual keys for moving forward, backward, and for turning left or right are pressed manually, the cleaning robot main unit may crawl and clean along the path controlled by the operator's intention." <i>Id.</i>,
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2. Motivations to Combine Both Knoll and Fu-957 disclose autonomous pool cleaning robots, and both sought to improve pool cleaning operations. <i>See</i> Knoll, [0005], [0007]; Fu-957, Abstract; Janét, ¶315. POSITAs would have been motivated to add complementary teachings of Fu-957 to Knoll to improve pool cleaning with, e.g., enhanced user control Fu-957 teaches (Fu-957, pp.10, 14). Janét, ¶315. POSITAs would have recognized that both are directed to the same pool cleaning technical field and provide similar technical solutions to address similar issues. Janét, ¶316. Specifically, both disclose self-propelled pool cleaners having an onboard controller that processes sensor data and generates control signals for navigation. <i>Compare</i> Knoll, [0007]-[0008], [0027]-	p.18. Fu-957 also teaches alarm functions including “automatic shutdown protection and alarm when the main unit emerges from water, jam alarm and protection when the main unit is stuck during cleaning, and a filter-pocket pore clogging alarm.” <i>Id.</i>, p.10. 314. Fu-957 further discloses sequential cleaning methods for swimming pools of different shapes, including a “full-span back-and-forth path method” for rectangular pools and a “half-span back-and-forth path method” for non-rectangular pools. <i>Id.</i>, Abstract, Claims 8–9. 2. Reasons for Combining Knoll and Fu-957 315. Both Knoll and Fu-957 disclose autonomous pool cleaning robots and both sought to improve pool cleaning operations. Knoll describes a robotic vehicle that can achieve “path-optimized and completely covered” cleaning of a pool “without the need to program a correspondingly optimized path.” Knoll, [0005], [0007]. As explained in §§VII.A.2-VII.A.3, Fu-957 similarly describes a pool cleaning robot capable of “sequential full-coverage cleaning” of swimming pools. Fu-957, Abstract. A POSITA would have been motivated to combine the complementary teachings of Knoll and Fu-957 to achieve improved pool cleaning operations with enhanced user control. 316. A POSITA would have recognized that the teachings in Knoll and Fu-957 are directed to the same pool cleaning technical field, are based on recognition of the same or similar technical issues in pool cleaning, and provide similar technical solutions to address those issues. Specifically, both references disclose self-propelled pool cleaners having a housing, drive
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[0028], FIG. 1 *with* Fu-957, Abstract, Claim 1, pp.6-10, 16-18; §IV.E.1.

Thus, POSITAs would have investigated the technical teachings in both to seek guidance when designing a pool cleaning system. Janét, ¶316.

Knoll's robotic vehicle 1 operates autonomously under the control of control unit 11. Knoll, [0028], Claim 2. Fu-957 discloses a portable remote controller 3 that enables two-way communication with the pool cleaner and allows user control of cleaning operations. *See* §IV.E.1.

POSITAs would have been motivated to add Fu-957's remote control functionalities into Knoll to enable users to manually direct Knoll's cleaner to specific areas or override automatic operation when desired, complementing Knoll's autonomous

means for moving the pool cleaner over pool surfaces, an onboard controller housed in a waterproof enclosure that processes sensor data and generates control signals for navigation, and sensors for detecting conditions during cleaning operations. *Compare* Knoll, [0007]–[0008], [0027]–[0028], FIG. 1 (control unit 11 inside waterproof housing processing distance information from sensor device 5 to control drive means 12), *with* Fu-957, Abstract, Claim 1, pp.6–10, 16-18, Claim 9 (microprocessor inside sealed enclosure processing sensor data from overload sensor and accelerometer to control transmission systems 15); *see also* §VII.E.1. Accordingly, a POSITA would have investigated the technical teachings in both Knoll and Fu-957 to seek guidance when designing a pool cleaning system for specific pool cleaning considerations and applications.

317. Knoll's robotic vehicle 1 operates autonomously under the control of control unit 11, which “is designed to automatically calculate a trajectory” based on sensor information from distance-determining device 5. Knoll, [0028], Claim 2. Fu-957 discloses a portable remote controller 3 that enables two-way communication with the pool cleaner and allows user control of cleaning operations. *See* §VII.E.1; Fu-957, Abstract, Claim 6, pp.10, 14, 18, FIGS. 4, 12-13. The use of a fully autonomous pool cleaner (Knoll) and the use of a pool cleaner with remote user control capability (Fu-957) had been two known design options. A POSITA would have been motivated to modify Knoll by incorporating Fu-957's portable remote controller and communication architecture for at least two reasons.

318. First, a POSITA would have been guided by Knoll and Fu-957 to make such a combination to add user control functionalities to Knoll's autonomous pool cleaner. Knoll's robotic vehicle 1 operates autonomously without continuous user

cleaning capabilities. Knoll, Abstract, [0027]-[0028]; Fu-957, p.18; Janét, ¶318.

POSITAs would also have been motivated to make this modification to add Fu-967's remote monitoring (Fu-957, p.10, Claim 6) to Knoll,

providing users with real-time monitoring into Knoll's cleaning operations and alert users to potential problems, thereby improving user experience and facilitating timely maintenance. Janét, ¶319.

POSITAs would reasonably expected success because Fu-957 demonstrates a working implementation of two-way communication between a portable remote controller and an underwater pool cleaning robot via a power control box relay. §IV.E.1; Fu-957, pp.10, 18, Claim 6, FIG. 13; Janét, ¶320.

intervention. Knoll, Abstract, [0027]-[0028]. As explained in §VII.E.1, Fu-957 teaches that a portable remote controller enables the robot to operate "according to operator's intention" and allows manual control for "moving forward, backward, and for turning left or right." Fu-957, p.18, Claim 6. A POSITA would have recognized that incorporating Fu-957's portable remote controller would enable users to manually direct Knoll's cleaner to specific areas or override automatic operation when desired, complementing Knoll's autonomous cleaning capabilities.

319. Second, a POSITA would have been motivated to adopt this modification to add the remote monitoring of Knoll's cleaning operations. As explained in §VII.E.1, Fu-957 teaches that its remote controller "displays an operating status of the cleaning robot main unit and receives alarm signals." Fu-957, p.10, Claim 6. Fu-957 further teaches alarm functions including "automatic shutdown protection and alarm when the main unit emerges from water, jam alarm and protection when the main unit is stuck during cleaning, and a filter-pocket pore clogging alarm." Fu-957, p.10, Claim 6. A POSITA would have recognized that incorporating Fu-957's portable remote controller would have provided users with real-time visibility into Knoll's cleaning operations and alert users to potential problems, thereby improving user experience and facilitating timely maintenance.

320. A POSITA would have had a reasonable expectation of success in making this combination because Fu-957 demonstrates a working implementation of two-way communication between a portable remote controller and an underwater pool cleaning robot via a power control box relay. See §VII.E.1; Fu-957, pp.10, 18, Claim 6, FIG. 13. Both Knoll

Because Fu-957’s communication architecture—including portable remote controller 3, power control box relay 2, and cable connection 17—is already designed for integration with a pool cleaning robot having an onboard controller, POSITAs would have reasonably expected that Fu-957’s communication architecture could be integrated with Knoll, yielding predictable results. Janét, ¶320.

3. Claim 3 Unpatentable over Knoll and Fu-957

The Knoll-Fu-957 combination renders Claim 3 obvious. Janét, ¶¶321-333.

a. 3[pre], 3[a]-3[c], 3[e][i]

Knoll discloses 3[pre], 3[a]-3[c], and 3[e][i] for the reasons in §§IV.D.2.a-d, f (1[pre]-1[c], 1[e][i]), because they are identical to 1[pre], 1[a]-1[c], and 1[e][i]. Janét, ¶322.

b. 3[d]

Limitation 3[d] is nearly identical to 1[d], differing only:

1[d]	“camera”	“mounted directly or indirectly to”	“the body”
3[d]		“positioned on or in, or carried by,”	

and Fu-957 are pool cleaners with onboard controllers inside waterproof housings that process sensor data and generate control signals for navigation. Knoll, [0008]; Fu-957, Abstract, pp.7-9, 17-18, Claim 1. Because Fu-957’s communication architecture—including portable remote controller 3, power control box relay 2, and cable connection 17—is already designed for integration with a pool cleaning robot having an onboard controller, a POSITA would have reasonably expected that Fu-957’s communication architecture could be integrated with Knoll’s control unit 11, thereby yielding predictable results.

3. Claim 3 Unpatentable over Knoll and Fu-957

321. In my opinion, the Knoll-Fu-957 combination renders Claim 3 obvious.

a. 3[pre], 3[a]-3[c], 3[e][i]

322. Limitations 3[pre], 3[a]-3[c], and 3[e][i] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e][i], respectively. It is my opinion, for at least the same reasons explained above in §§VII.D.2.a-VII.D.2.d (1[pre], 1[a]-1[c]), Knoll discloses or suggests 3[pre] and 3[a]-3[c]. Additionally, it is my opinion that, for at least the same reasons explained above in §VII.D.2.f (1[e][i]), Knoll discloses or suggests limitation 3[e][i].

b. 3[d]

323. Limitation 3[d] is substantially the same as limitation 1[d], with the only difference being that 3[d] recites “at least one camera positioned on or in, or carried by, the body,” whereas 1[d] recites “at least one camera mounted directly or indirectly to the body.” As explained above in §VII.D.2.e (1[d]), Knoll

Knoll discloses 3[d], because a camera “mounted directly...to the body” (§IV.D.2.e (1[d])) is also “positioned on or in, or carried by, the body.” Janét, ¶323.

c. 3[e][ii]

The Knoll-Fu-957 combination discloses or suggests 3[e][ii]. Janét, ¶¶324-330.

As explained in §IV.D.2.g (1[e][ii]), Knoll discloses the controller “in electronic communication with the at least one **camera**.”

The Knoll-Fu-957 combination discloses the controller “in electronic communication with...a **portable electronic device**.” Janét, ¶326.

Fu-957 discloses a portable remote controller 3 (portable electronic device, “PED”) for user control of pool cleaning operations. Fu-957, Title, Abstract, Claims 1, 6, FIGS. 1, 4, 12; §IV.E.1; Janét, ¶327. Fu-957 further discloses electronic communication between remote controller 3 (PED) and the underwater controller inside the cleaning robot main unit via power control box 2.

As shown in FIG. 13 (annotated below), Fu-957’s remote controller 3 communicates wirelessly with power control box 2, which communicates with the underwater controller via self-buoyant cable 17. Fu-957, Claim 6, p.14, FIG. 13.

discloses “at least one camera mounted directly...to the body,” and thus, also discloses limitation 3[d], because a camera that is “mounted directly...to the body” is also “positioned on or in, or carried by, the body.”

c.3[e][ii] “(ii) in electronic communication with the at least one camera and a portable electronic device, and”

324. In my opinion, the Knoll-Fu-957 combination discloses or suggests 3[e][ii].

325. As explained in §VII.D.2.g (1[e][ii]), Knoll discloses the controller “in electronic communication with the at least one **camera**.”

326. In my opinion, the Knoll-Fu-957 combination discloses the controller “in electronic communication with...a **portable electronic device**.”

327. As explained in §VII.E.1, Fu-957 discloses a portable remote controller 3 for user control of pool cleaning operations. Fu-957, Title, Abstract, Claims 1, 6, FIGS. 1, 4, 12. A POSITA would have understood that Fu-957’s remote controller 3 constitutes a “portable electronic device,” because it is a handheld device comprising display screen 33, membrane keys 39, communication circuit board 34, and battery box 35. Fu-957, p.14, Claim 6, FIGS.4, 12.

328. As further explained in §VII.E.1, Fu-957 discloses electronic communication between the remote controller 3 (portable electronic device) and the underwater controller inside the cleaning robot main unit via power control box 2.

[images omitted] As explained in §IV.E.2, POSITAs would have been motivated to combine Knoll with Fu-957's remote controller (PED) and communication/control mechanism between an onboard controller and the remote controller. Janét, ¶329. In the Knoll-Fu-957 combination, Knoll's control unit 11 (controller) would be: (1) in electronic communication with camera 6 (as explained in §IV.D.2.g) and a PED (per Fu-957's remote controller 3); (2) configured to receive control commands from Fu-957's PED via power control box 2; and (3) configured to generate control signals to control the vehicle to "crawl and clean along the path controlled by the operator's intention" based on signals indicating the pressed manual control keys. §IV.E.2; Knoll, [0008], [0028]; Fu-957, Claim 6, pp.10, 14, 18, FIG. 13; Janét, ¶330. As explained in §IV.E.2, POSITAs would have a reasonable expectation of success in implementing this combination. Janét, ¶330. d. 3[e][iii]	As shown in FIG. 13 (annotated below), Fu-957's remote controller 3 communicates wirelessly with power control box 2, and power control box 2 communicates with the underwater controller via self-buoyant cable 17. Fu-957, Claim 6, p.14, FIG. 13. [images omitted] 329. As explained in §VII.E.2, a POSITA would have been motivated to combine Knoll with Fu-957's remote controller (portable electronic device) and communication/control mechanism between an onboard controller and the remote controller. 330. In the Knoll-Fu-957 combination, Knoll's control unit 11 (controller) would be: (1) in electronic communication with camera 6 (as explained in §VII.D.2.g) and a portable electronic device (per Fu-957's remote controller 3 communicating with the onboard controller via power control box 2 and self-buoyant cable 17); (2) configured to receive control commands from, and transmit status information to, the portable electronic device via power control box 2; and (3) configured to generate control signals to control the vehicle to "crawl and clean along the path controlled by the operator's intention" based on signals indicating "the manual keys for moving forward, backward, and for turning left or right...[being] pressed manually." See §VII.E.2; Knoll, [0008], [0028]; Fu-957, Claim 6, pp.10, 14, 18, FIG. 13. As explained in §VII.E.2, a POSITA would have a reasonable expectation of success in implementing this combination. d.3[e][iii] "(iii) configured to generate, in response to at least one of the captured image or
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Knoll discloses or suggests 3[e][iii] because as explained in §IV.D.2.h (1[e][iii]), Knoll discloses control unit 11 configured to generate, “in response to...the captured image,” at least one control signal to cause movement “to, or away from, the first portion of the submerged surface. Knoll, [0011], [0018], [0028]; Janét, ¶¶331-332. F. Ground 3C: Claim 5 Is Unpatentable over Knoll and Porat 1. Motivation to Combine Both Knoll and Porat disclose autonomous pool cleaning robots. <i>See</i> §IV.D.1, §IV.C.1. POSITAs would have been motivated to combine the teachings of Knoll and Porat to improve pool cleaning. Janét, ¶334. Both Knoll and Porat disclose autonomous pool cleaning robots. <i>See</i> §IV.D.1, §IV.C.1. POSITAs would have been motivated to	information from the portable electronic device, 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.” 331. In my opinion, Knoll or the Knoll-Fu-957 combination discloses or suggests 3[e][iii]. 332. The limitation requires the controller to generate signals in response to one of the captured image or the PED. As explained in §VII.D.2.h (1[e][iii]), Knoll discloses control unit 11 configured to generate, “in response to...the captured image,” at least one control signal to cause movement “to, or away from, the first portion of the submerged surface,” and thus, Knoll teaches or suggests this limitation. <i>See also</i> Knoll, [0011], [0018], [0028]. 333. Therefore, it is my opinion that the Knoll-Fu-957 combination renders Claim 3 obvious. F. Ground 3C: Claim 5 Is Unpatentable under AIA 35 U.S.C. §103 and Pre-AIA AIA 35 U.S.C. §103 over Knoll and Porat 1. Reasons for Combining Knoll and Porat 334. Both Knoll and Porat disclose autonomous pool cleaning robots. <i>See</i> §VII.D.1, §VII.C.1. Knoll describes a robotic vehicle that can achieve “pathoptimized and completely covered” cleaning of a pool. Knoll, [0005], [0007]. Porat discloses a robotic pool cleaner with an integrated chemical dispenser that “produces and distributes chlorine ions...as the cleaner moves.”
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combine the teachings of Knoll and Porat to improve pool cleaning. Janét, ¶334. POSITAs would have recognized that both provide complementary technical solutions to address pool maintenance issues. Janét, ¶335. Both references disclose self-propelled pool cleaners having drive means for moving the pool cleaner and an onboard controller for navigation. <i>Compare</i> Knoll, [0007]-[0008], [0027]-[0028], FIG. 1, <i>with</i> Porat, Abstract, [0029], FIGS. 1-2. Accordingly, POSITAs would have investigated both to seek guidance when designing a pool cleaning system. Janét, ¶335. Porat discloses an integrated electrochemical generator 30 (chemical dispenser) for “produc[ing] and distribut[ing] chlorine ions...as the cleaner moves”. Porat, [0009], [0028], Claim 1. POSITAs would have been motivated to including Porat’s chemical dispenser to Knoll to create a single autonomous	Porat, Title, Abstract, [0009]. A POSITA would have been motivated to combine the teachings of Knoll and Porat to achieve improved pool cleaning and chemical application. 335. A POSITA would have recognized that the teachings in Knoll and Porat are directed to the same pool cleaning technical field, are based on recognition of the same or similar technical issues in pool maintenance, and provide complementary technical solutions to address those issues. Specifically, both references disclose self-propelled pool cleaners having a housing, drive means for moving the pool cleaner over pool surfaces, and an onboard controller for navigation. <i>Compare</i> Knoll, [0007]-[0008], [0027]-[0028], FIG. 1, <i>with</i> Porat, Abstract, [0029], FIGS. 1-2. Accordingly, a POSITA would have investigated the technical teachings in both Knoll and Porat to seek guidance when designing a pool cleaning system for specific pool cleaning considerations and applications. 336. Knoll and Porat, however, differ in their approach to pool maintenance. Knoll's robotic vehicle 1 focuses on mechanical cleaning—traversing pool surfaces along calculated trajectories to remove debris. Knoll, [0005], [0007], [0012]. Porat discloses integrating a chemical dispenser, specifically “an electrochemical generator 30 for producing chlorine,” into a robotic pool cleaner. Porat, Abstract, [0009], [0028], Claim 1. A POSITA would have been motivated to modify Knoll by incorporating Porat’s chemical dispenser for at least two reasons. 337. First, a POSITA would have been motivated to enable Knoll’s cleaner to simultaneously sanitize water and remove debris. A POSITA would have recognized that integrating Porat’s chlorine generator, which “produces and
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device capable of performing both mechanical cleaning and chemical sanitization in one pass. Janét, ¶¶336-337. Additionally, POSITAs would have recognized that because Knoll’s vehicle traverses the pool surfaces along calculated trajectories, equipping it with Porat’s dispenser would “efficiently and effectively distribute[] the chlorine” into the water as the cleaner travels. Knoll, [0005], [0010]-[0012]; Porat, Abstract, [0009], [0028], Claim 1; Janét, ¶338. POSITAs would have reasonably expected success because incorporating a chemical dispenser into a robotic pool cleaner like Knoll’s had been well-known, and such modification to Knoll would have yielded predictable results. Porat, [0028]; Durvasula, [0015]; Knoll, [0007], [0027]-[0028]; Janét, ¶339. 2. Claim 5 Unpatentable over Knoll and Porat The Knoll-Porat combination renders Claim 5 obvious. Janét, ¶¶340-350. a. 5[pre], 5[a]-5[c], 5[f][ii]-5[f][iii] Limitations 5[pre], 5[a]-5[c], 5[f][ii], and 5[f][iii] are identical to limitations 1[pre], 1[a]-1[c], 1[e][ii], and 1[e][iii], respectively. For the reasons in §§IV.D.2.ad and IV.D.2.g-h (1[pre], 1[a]-1[c],	distributes chlorine ions...as the cleaner moves,” into Knoll’s robotic vehicle 1 would create a single autonomous device capable of performing both mechanical cleaning and chemical sanitization in one pass. Porat, [0009]. 338. Second, a POSITA would have recognized that because Knoll’s vehicle traverses the pool surfaces along calculated trajectories (e.g., ring-shaped paths), equipping it with Porat’s dispenser would “efficiently and effectively distribute[] the chlorine” into the water “proximate the exterior of the pool cleaner housing” as the cleaner “moves across the pool surfaces being cleaned.” Knoll, [0005], [0010]-[0012]; Porat, Abstract, [0009], [0028], Claim 1. 339. Similar to the explanation in §VII.C.2 regarding the combination of Cui-Fu-007 and Porat, a POSITA would have had a reasonable expectation of success in making this combination because incorporating a chemical dispenser into a robotic pool cleaner like Knoll’s had been well-known, and incorporating Porat’s chemical dispenser into Knoll’s vehicle would have yielded predictable results. <i>See, e.g.</i>, Porat, [0028]; Durvasula, [0015]; Knoll, [0007], [0027]-[0028]. 2. Claim 5 Unpatentable over Knoll and Porat 340. It is my opinion that the Knoll-Porat combination renders Claim 5 obvious. a. 5[pre], 5[a]-5[c], 5[f][ii]-5[f][iii] 341. Limitations 5[pre], 5[a]-5[c], 5[f][ii], and 5[f][iii] are exactly the same as limitations 1[pre], 1[a]-1[c], 1[e][ii], and 1[e][iii], respectively. In my opinion, for at least the same
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1[e][ii]-[iii]), Knoll discloses or suggests 5[pre], 5[a]-5[c], and 5[f][ii]-5[f][iii]. Janét, ¶341.

b. 5[d]

The Knoll-Porat combination discloses or suggests 5[d]. Janét, ¶¶342-346.

As explained in §IV.D.2.b (1[a]), Knoll discloses robotic vehicle 1 comprising a vehicle body including housing 2. Janét, ¶343.

As explained in §IV.C.1, Porat discloses a robotic pool cleaner with an **onboard electrochemical generator 30** (chemical dispenser) that “produc[es] chlorine” and “distributes chlorine ions...as the cleaner moves.” Porat, Abstract, [0009], [0028]; Janét, ¶344. Porat, Abstract, [0009], [0028], Claims 1, 11, 16, FIGS. 1-2 (annotated below).

[image omitted]

As explained in §IV.F.1, POSITAs would have been motivated to incorporate Porat’s chemical dispenser into Knoll’s housing 2 (vehicle body) with a reasonable expectation of success.

reasons explained above in §§VII.D.2.a-VII.D.2.d and VII.D.2.g-VII.D.2.h (1[pre], 1[a]-1[c], 1[e][ii]-[iii]), Knoll discloses or suggests 5[pre], 5[a]-5[c], and 5[f][ii]-5[f][iii].

b. 5[d] “d. a chemical dispenser on, in, or carried by The vehicle body;”

342. In my opinion, the Knoll-Porat combination discloses or suggests 5[d].

343. As explained in §VII.D.2.b (1[a]), Knoll discloses robotic vehicle 1 comprising a vehicle body including housing 2. Knoll, [0027], FIG. 1.

344. As explained in §VII.C.1, Porat discloses a robotic pool cleaner with an **onboard chemical dispenser**. Porat, Title, Abstract, Claims 1, 11, 16, FIGS. 1-2 (annotated below). Specifically, Porat discloses “an electrochemical generator 30” that is carried by the cleaner’s housing. Porat, [0028]–[0029], FIGS. 1–2 (annotated below). **A POSITA would have understood that Porat’s onboard electrochemical generator 30 constitutes a “chemical dispenser” because it “produc[es] chlorine” and “distributes chlorine ions...as the cleaner moves.” Porat, Abstract, [0009], [0028].**

[image omitted]

345. As explained in §VII.F.1, a POSITA would have been motivated to incorporate Porat’s chemical dispenser into Knoll’s housing 2 (vehicle body) to enable simultaneous chemical application and debris removal, and to efficiently distribute chlorine via Knoll’s calculated traversal paths. Also as explained

c. 5[e]

Limitations 5[e] and 1[d] only differ in:

1[d]	"camera"	"mounted directly or indirectly to"	"the body"
5[e]		"on, in, or carried by"	"the vehicle body"

As explained above in §IV.D.2.e (1[d]), Knoll discloses "at least one camera mounted directly...to the body." Thus, Knoll also discloses limitation 5[e], because a camera that is "mounted directly...to the body" is also "on, in, or carried by the vehicle body." Janét, ¶347.

d. 5[f][i]

Limitations 5[f][i] and 1[e][i] only differ in:

1[e][i]	"controller"	"positioned on or in"	"the body"
5[f][i]		"on, in, or carried by"	"the vehicle body"

in §VII.F.1, a POSITA would have had a reasonable expectation of success to implement this combination.

346. In my opinion, in the Knoll-Porat combination, Knoll's robotic vehicle 1 would include Porat's electrochemical generator 30 (chemical dispenser) carried by Knoll's housing 2 (body), thereby disclosing "a chemical dispenser on, in, or carried by the body." See §VII.F.1; Knoll, [0027], FIG. 1; Porat, [0028]–[0029], FIGS. 1–2.

c. 5[e]

347. Limitation 5[e] is substantially the same as limitation 1[d], with the only difference being that 5[e] recites "at least one camera on, in, or carried by the vehicle body," whereas 1[d] recites "at least one camera mounted directly or indirectly to the body." As explained above in §VII.D.2.e (1[d]), Knoll discloses "at least one camera mounted directly...to the body." Thus, in my opinion, Knoll also discloses limitation 5[e], because a camera that is "mounted directly...to the body" is also "on, in, or carried by the vehicle body."

d. 5[f][i]

348. Limitation 5[f][i] is substantially the same as limitation 1[e][i], with the only difference being that limitation 5[f][i] recites a controller "on, in, or carried by the vehicle body," whereas limitation 1[e][i] recites a controller "positioned on or in the body." As explained above in §VII.D.2.f (1[e][i]), Knoll discloses a controller "positioned on or in the body." Thus, it is my opinion that Knoll also discloses limitation 5[f][i], because a

Knoll discloses 5[e], because a camera “mounted directly...to the body” (§IV.D.2.f (1[d])) is also “on, in, or carried by the vehicle body.” Janet, ¶348. e. 5[f][ii]-5[f][iii] Limitations 5[f][ii] and 5[f][iii] are identical to limitations 1[e][ii] and 1[e][iii], respectively. For the reasons in §§IV.D.2.g-h (1[e][ii] and 1[e][iii]), Knoll discloses or suggests 5[f][ii] and 5[f][iii]. Janet, ¶349.	controller that is “positioned on or in the body” is also “on, in, or carried by the vehicle body.” e. 5[f][ii]-5[f][iii] 349. Limitations 5[f][ii] and 5[f][iii] are exactly the same as limitations 1[e][ii] and 1[e][iii], respectively. For at least the same reasons explained above in §§VII.D.2.g-VII.D.2.h (1[e][ii] and 1[e][iii]), Knoll discloses or suggests 5[f][ii] and 5[f][iii]. 350. Therefore, it is my opinion that the Knoll-Porat combination renders Claim 5 obvious.
G. Ground 4A: Claims 1-4 Are Unpatentable under §103 over Renaud 1. Renaud Renaud (EX1017) is prior art and is analogous art. Janet, ¶¶351-352. Renaud discloses a “pool cleaner.” Renaud, Abstract, [0002], [0022]-[0023], [0037], [0039], FIGS. 1-3 (cleaners 200/200a’/200b’/200c’/200”; annotated below).	G. Ground 4A: Claims 1-4 Are Unpatentable under 35 U.S.C. §103 over Renaud 1. Renaud 351. Renaud (EX1017) is U.S. Publication No. 20140263087A1 published on September 18, 2014. Renaud is prior art under AIA 35 U.S.C. §102(a)(1) and is not subject to exceptions under AIA 35 U.S.C. §102(b)(1) because it was published more than one year before the effective filing date of the ’766 Patent which is no earlier than July 11, 2016. <i>See §VI.C, supra.</i> 352. As explained below, Renaud discloses a self-propelled pool cleaning robot using controls based on camera images. Renaud is analogous art with respect to Claims 1-5 of the ’766 Patent.

[images omitted] 2. Claim 1 Unpatentable over Renaud Renaud renders Claim 1 obvious. Janét, ¶¶353-381 . a. 1[pre] Renaud discloses or suggests 1[pre]. Janét, ¶¶354-357. Renaud discloses a “pool cleaner.” Renaud, Abstract, [0002], [0022]-[0023], [0037], [0039], FIGS. 1-3 (cleaners 200/200a’/200b’/200c’/200”; annotated below). Renaud describes that its robotic pool cleaners move along the pool floor and/or walls to clean debris from the pool surfaces. Renaud, [0003]. [images omitted] Renaud’s pool cleaner is “self-propelled” because it includes “an electronically commutated motor,” “wheels 206...for moving the cleaner 200 in the swimming pool,” and a “vision system...communicat[ing] with the cleaner 200 to drive...wheels 206...in the direction of the area of debris.” Renaud, [0023], [0025], [0030]; Janét, ¶356.	2. Claim 1 Unpatentable over Renaud 353. In my opinion, Renaud renders Claim 1 obvious. a. 1[pre] “A self-propelled pool cleaner for cleaning debris from a submerged surface of a swimming pool, comprising” 354. In my opinion, Renaud discloses or suggests 1[pre]. 355. Renaud discloses a “swimming pool cleaner.” Renaud, Title, Abstract, [0002], [0022]-[0023], [0037], [0039], FIGS. 1-3 (cleaners 200/200a’ (“positioned at the water line”) /200b’ (“positioned at the bottom of the swimming pool”)/200c’ (“positioned in a docking orientation relative to the docking station”)/200”). Renaud further describes that “[r]obotic swimming pool cleaners are generally designed to move along the swimming pool floor and/or walls to clean the necessary surfaces from, e.g., debris, sediment, and the like.” Renaud, [0003]. [images omitted] 356. Renaud discloses the pool cleaner is “self-propelled” because Renaud describes cleaner 200 includes “a motor, e.g., an electronically commutated motor” and “wheels 206, e.g., rollers, tracks, and the like, for moving the cleaner 200 in the swimming pool 102.” Renaud, [0023], [0025]. Renaud further describes that “the vision system can communicate with the cleaner 200 to drive and/or steer the wheels 206 of the cleaner 200 in the direction of the area of debris.” Renaud, [0030]. A POSITA
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Renaud's pool cleaner also "clean[s] debris from a submerged surface of a swimming pool" because it "cleans near, the walls...of the pool" in "bottom mode" and uses "a suction pump impeller" to "collect the debris in the swimming pool" and collects "debris collected from the swimming pool 102" into "a debris container" located in housing 202. Renaud, [0022]-[0023], [0030]; Janét, ¶357.

b. 1[a]

Renaud discloses or suggests 1[a], because Renaud's cleaner 200 "includes a housing 202 which includes a plurality of components," such as a motor, a storage device, and a processing device, a debris container, and wheels 206, and POSITAs would have understood that the assembled structure of cleaner 200 constitutes the "vehicle body." Renaud, [0023], [0025], FIGS. 1-3; Janét, ¶359.

would have understood that a robotic cleaner with an onboard motor that drives and steers wheels for movement under the control of the onboard vision system is "self-propelled."

357. Renaud discloses the pool cleaner "cleaning debris from a submerged surface of a swimming pool" because Renaud describes cleaner 200 "traverses, and cleans near, the walls (e.g., vertical or horizontal walls) of the pool" in "bottom mode" and "rises to the water surface and cleans the water surface" in "top mode." Renaud, [0022]. Renaud further describes cleaner 200 uses "a suction pump impeller" to "collect the debris in the swimming pool" and collects "debris collected from the swimming pool 102" into "a debris container" located in housing 202. Renaud, [0023], [0030]. A POSITA would have understood that cleaner 200 cleans a submerged surface below the water surface at least when operating in "bottom mode."

b. 1[a] "a. a vehicle body;"

358. In my opinion, Renaud discloses or suggests 1[a].

359. As explained in §VII.G.2.a (1[pre]), Renaud discloses **cleaner 200/200a'** ("positioned at the water line")/**200b'** ("positioned at the bottom of the swimming pool 102")/**200c'** ("positioned in a docking orientation relative to the docking station 300")/**200"**. Renaud, [0022]-[0023], [0037], [0039], FIGS. 1-3 (annotated above). Renaud describes "cleaner 200 includes a housing 202 which includes a plurality of components therein," including "a motor, e.g., an electronically commutated motor, a storage device, and a processing device," as well as "a debris container," and "wheels 206, e.g., rollers, tracks, and the like." Renaud, [0023], [0025], FIGS. 1-3. A POSITA would have understood that the assembled structure of cleaner 200—

c. 1[b]

Renaud discloses or suggests 1[b]. Janét, ¶¶360-363.

Limitation 1[b] invokes §112¶6/§112(f); the function is “moving the vehicle body within the swimming pool,” and the corresponding structure includes “wheels...powered by a motor.” See §III.E.

Renaud discloses this function and structure by describing cleaner 200 including **wheels 206** powered by a motor to move the cleaner within the pool. Renaud, [0009], [0023], [0025], [0030], FIGS. 1-3 (annotated below); Janét, ¶362-363.

[images omitted]

comprising housing 202 and the components within or carried by it—that travels within the pool constitutes the claimed “vehicle body.”

c. 1[b] “b. means for moving the vehicle body within the swimming pool;”

360. It is my opinion that Renaud discloses or suggests 1[b].

361. The format and content of 1[b] invoke claim interpretation under 35 U.S.C. §112(f). As explained in §VI.D, the recited function is “moving the vehicle body within the swimming pool,” and the corresponding structure is “wheels, **rollers, tracks, or other surface contacting members** powered by a motor, or vacuum or liquid jet.” ’766 Patent, 3:31-43, 10:12-14, FIGS. 9-10.

362. Renaud discloses identical function because it describes cleaner 200 “includes wheels 206...for **moving the cleaner 200** in the swimming pool 102.” Renaud, [0025]. **Renaud further describes the “vision system can communicate with the cleaner 200 to drive and/or steer the wheels 206 of the cleaner 200 in the direction of the area of debris.”** Renaud, [0030]. *See also* Renaud, [0003] (“Robotic swimming pool cleaners are generally designed to move along the swimming pool floor and/or walls”). 363. Renaud discloses identical corresponding structure. Renaud describes cleaner 200 includes “**wheels 206**, e.g., rollers, tracks, and the like” powered by “a **motor**, e.g., an electronically commutated **motor**.” Renaud, [0009], [0023], [0025], FIGS. 1-3 (annotated below).

[images omitted]

d. 1[c] Renaud discloses or suggests “a filter configured to retain debris” because Renaud’s cleaner 200 includes a debris container/bag and uses “a suction pump impeller to collect the debris” in the pool into the debris container located in housing 202. Renaud, Abstract, [0006], [0015], [0022], [0023], [0030], [0033], [0036], Claim 20; Janét, ¶364-367. e. 1[d] Renaud discloses or suggests 1[d]. Janét, ¶368-370.	d. 1[c] “c. a filter configured to retain debris collected from the submerged surface;” 364. In my opinion, Renaud discloses or suggests 1[c]. 365. As explained in §VII.G.2.a (1[pre]), Renaud’s cleaner 200 collects debris from submerged surfaces of the swimming pool. Renaud, [0022], [0023], [0030]. 366. Renaud discloses “a filter configured to retain debris” because Renaud describes cleaner 200 includes “debris container” or “debris bag” for “collecting the debris collected from the swimming pool 102.” Renaud, Abstract, [0006], [0015], [0023], [0030], Claim 20. Renaud also describes cleaner 200 uses “a suction pump impeller to collect the debris in the swimming pool into the debris container located in the housing 202 of the cleaner 200.” Renaud, [0030]. 367. Renaud further describes “[t]he self-cleaning of the debris container, e.g., a debris bag” where “the debris container of the cleaner 200 can be cleaned/emptied into the debris container of the docking station 300.” Renaud, [0033], [0036]. A POSITA would have understood that Renaud’s debris container/debris bag of cleaner 200 retains debris—otherwise, there would be no need to clean or empty the debris container/bag of cleaner 200 as Renaud describes. e. 1[d] “d. at least one camera mounted directly or indirectly to the body for capturing an image of at least a first portion of the submerged surface; and” 368. In my opinion, Renaud discloses or suggests 1[d].
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Renaud discloses “at least one camera mounted directly or indirectly to the body” because Renaud describes cleaner 200 includes a housing and a vision system, which includes a camera, and the vision system is inside “inside the cleaner 200.” Renaud, [0008]; *see also id.*, [0029], Claim 1; Janét, ¶369-370.

Renaud discloses the camera “for capturing an image of at least a first portion of the submerged surface” because its vision system “identify[ies] areas on the pool floor, walls...where debris or dirt exists..., such as at the bottom” by “sensing areas of optical contrast.” Renaud, [0029], [0031]; Janét, ¶369.

POSITAs would understand Renaud’s camera captures images to identify these “areas of debris” (first portion) on the floor and walls (submerged surfaces). *Id.*

f. 1[e][i]

369. Renaud discloses “at least one camera mounted directly or indirectly to the body” because Renaud describes cleaner 200 includes a housing and a vision system, which includes a camera. Renaud, [0008], Claim 1. As explained in §VII.G.2.b (1[a]), cleaner 200 includes the claimed “vehicle body.” Renaud discloses the camera “for capturing an image of at least a first portion of the submerged surface” because Renaud describes “the sensors of the vision system can interact with the controller and/or processing device to identify **areas on the pool floor, walls and/or water line where debris or dirt exists** in the swimming pool 102, such as at the **bottom (on the horizontal or vertical walls).**” Renaud, [0029]. Renaud further describes the vision system “**identifies areas of debris by sensing areas of optical contrast, for example, generated by a foreign object, debris and/or dirt.**” Renaud, [0031]. A POSITA would have understood that a camera of the vision system captures images to facilitate identification of specific “areas of debris” or “areas of optical contrast” (first portion) on pool floor and walls (submerged surfaces), **which constitute the claimed “at least a first portion of the submerged surface.”**

370. Renaud discloses or suggests the camera is mounted on the body because Renaud explicitly identifies the camera as a component of the “vision system” (Renaud, [0008]) and physically locates the vision system “inside the cleaner 200” (e.g., “the vision system can include a PCB...disposed inside the cleaner 200”) (Renaud, [0029]).

f. 1[e][i] “e. a controller (i) positioned on or in the body,”

Renaud discloses or suggests 1[e][i] because it includes a “processing device..., such as a microprocessor, **inside...cleaner 200**” which interacts with the camera to control the cleaner. Renaud, [0008]-[0009], [0029]-[0030]; Janét, ¶¶371-374.

Specifically, Renaud’s processing device “access[es] the programmed data” to “identify areas...where debris or dirt exists” and “actuate the motor to direct the swimming pool cleaner to the debris.” Renaud, [0009], [0029]-[0030]; Janét, ¶372. POSITAs would understand that this device—which processes data and generates signals to control the motor—constitutes the claimed “controller.” Janét, ¶373. Further, Renaud’s processing device is inside cleaner 200 and thus is “positioned...in” cleaner 200 (body). Janét, ¶374; IV.G.2.b. Renaud describes cleaner 200 includes “a vision system” with “sensors (e.g., camera) and programming stored on the storage device for processing by the **processing device**.” Renaud, [0008].

371. In my opinion, Renaud discloses or suggests 1[e][i] because it describes a “processing device..., such as a microprocessor, **inside...cleaner 200**” and a “PCB (not shown) disposed **inside the cleaner 200**,” which interacts with the sensors to control the cleaner. Renaud, [0008]-[0009], [0029]-[0030].

372. Renaud describes cleaner 200 includes “a vision system” with “sensors (e.g., **camera**) and programming stored on the storage device for processing by the **processing device**.” Renaud, [0008]. Renaud further describes “the vision system can include “[a] **processing device** (not shown), such as a **microprocessor, inside of the cleaner 200**...can access the programmed data related to the vision system for **actuating the motor**.” Renaud, [0029]. Renaud describes “the **sensors** of the vision system can **interact with** the controller and/or **processing device** to identify areas on the pool floor, walls and/or water line where debris or dirt exists.” *Id.* Renaud also describes that “[u]pon identifying debris located in the swimming pool, the vision system can **actuate the motor** to direct the swimming pool cleaner to the debris.” Renaud, [0009]. *See also* Renaud, [0030] (“the vision system can communicate with one or more motors of the cleaner 200, to **actuate, or control the speed of, the motor**.”).

373. A POSITA would have understood that Renaud’s processing device/microprocessor (controller) receiving data from the camera, processing that data, and generating signals to actuate/control the motor—constitutes the claimed “controller.”

374. In my opinion, as explained in §VII.G.2.b (1[a]), cleaner 200 is the claimed “vehicle body.” A POSITA would have understood that the processing device “disposed inside the

g. 1[e][ii] Renaud discloses or suggests that its processing device (controller) is in electronic communication with the camera, because it describes that “the sensors [e.g., camera] of the vision system can interact with the...processing device [controller] to identify areas on the pool floor.” Renaud, [0008], [0029]; Janét, ¶¶XXXX. h. 1[e][iii] Renaud discloses or suggests 1[e][iii]. Janét, ¶¶376-380. Renaud discloses or suggests that its processing device (controller) generates control signals “in response to the captured image.” Janét, ¶¶377-379. Specifically, Renaud’s vision system “includes sensors (e.g., camera) and programming stored on the storage device for processing by the processing device,” and the processing device “access[es] the programmed data related to the vision system for actuating the motor.” Renaud, [0008], [0029]. The vision system “identifies areas of debris by sensing areas of optical contrast...generated by a foreign object, debris and/or dirt” on pool floor and walls (submerged surfaces), and sensors “provide	cleaner 200” is positioned “on or in the body” or carried by the body. g. 1[e][ii] “(ii) in electronic communication with the at least one camera, and” 375. It is my opinion that Renaud discloses or suggests that its processing device (controller) is in electronic communication with the at least one camera because it describes that “the sensors [e.g., camera] of the vision system can interact with the...processing device [controller] to identify areas on the pool floor.” Renaud, [0008], [0029]. h. 1[e][iii] “(iii) 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.” 376. It is my opinion, Renaud discloses or suggests 1[e][iii]. 377. Renaud discloses or suggests that its processing device (controller) generates control signals “in response to the captured image.” 378. Specifically, Renaud’s vision system “includes sensors (e.g., camera) and programming stored on the storage device for processing by the processing device,” and the processing device “access[es] the programmed data related to the vision system for actuating the motor.” Renaud, [0008], [0029]. The vision system “identifies areas of debris by sensing areas of optical contrast...generated by a foreign object, debris and/or dirt” on pool floor and walls (submerged surfaces), and sensors “provide
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location information to the processor...for directing the swimming pool cleaner to the debris.” Renaud, [0008], [0031]; Janét, ¶378. Renaud also describes that its processing device controls a controller to actuate the motor for movement of the cleaner.” Renaud, [0025]. POSITAs would have understood that Renaud’s processing device (the claimed “controller”) processes the programming and image data to generate the control signals that actuate the motors, causing the vehicle body to move to the debris area (the first portion), because it identifies debris based on “optical contrast”—i.e., based on visual/image data from the camera. Janét, ¶379. Renaud also discloses the processing device generating control signals to cause movement “to...the first portion.” Specifically, “[u]pon identifying debris...the vision system [via the processing device] can actuate the motor to direct the swimming pool cleaner to the debris.” Renaud, [0009], Claim 3, [0030] (steer wheels “in the direction of the area of debris”), [0025]. POSITAs would understand that the processing device generates these signals to actuate the motor and steer the vehicle specifically to the “area of debris” (first portion). Janét, ¶380.	location information to the processor...for directing the swimming pool cleaner to the debris.” Renaud, [0008], [0031]. Renaud also describes that its processing device controls a controller to actuate the motor for movement of the cleaner.” Renaud, [0025]. 379. A POSITA would have understood that Renaud’s processing device (the claimed “controller”) processes the programming and image data to generate the control signals that actuate the motors, causing the vehicle body to move to the debris area (the first portion), because it identifies debris based on “optical contrast”—i.e., based on visual/image data from the camera. This is because Renaud explicitly tasks the processing device with the high-level logic: it receives the sensor data ([0029]) and “actuates” the controller/motor to move the cleaner ([0025], [0029]). Thus, a POSITA would understand that the “processing device” generates the necessary signals to “direct” or “steer” the cleaner specifically to the debris identified by the camera. Renaud, [0009], [0030]. 380. Renaud also discloses the processing device generating control signals to cause movement “to...the first portion.” Specifically, “[u]pon identifying debris...the vision system [via the processing device] can actuate the motor to direct the swimming pool cleaner to the debris.” Renaud, [0009], Claim 3, [0030] (steer wheels “in the direction of the area of debris”), [0025]. A POSITA would understand that the processing device generates these signals to actuate the motor and steer the vehicle specifically to the “area of debris” (first portion). 381. Therefore, in my opinion, Renaud renders Claim 1 obvious.
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3. Claim 2 is Unpatentable over Renaud

Renaud renders Claim 2 obvious. Janét, ¶¶382-385.

a. 2[pre], 2[a]-2[c], 2[e]

Limitations 2[pre], 2[a]-2[c], and 2[e][i]-[iii] are identical to limitations 1[pre], 1[a]-1[c], and 1[e], respectively. For the reasons in §§IV.G.2.a-d, IV.G.2.f-h (1[pre], 1[a]-1[c], 1[e][i]-1[e][iii]), Renaud discloses or suggests 2[pre] and 2[a]-2[c]. Janét, ¶383.

a. 2[d]

Limitations 2[d] and 1[d] only differ in:

1[d]	"camera"	"mounted directly or indirectly to"	"the body"
2[d]		"carried by"	

Renaud discloses 2[d], because a camera "mounted directly...to the body" (§IV.G.2.e (1[d])) is also "carried by the body." Janét, ¶384.

4. Claim 3 Unpatentable over Renaud

Renaud renders Claim 3 obvious. Janét, ¶¶386-397.

a. 3[pre], 3[a]-3[c], 3[e][i]

Limitations 3[pre], 3[a]-3[c], and 3[e][i] are identical to limitations 1[pre], 1[a]-1[c], and 1[e][i], respectively. For the

3. Claim 2 Unpatentable over Renaud

382. In my opinion, Renaud renders Claim 2 obvious.

a. 2[pre], 2[a]-2[c], 2[e]

383. Limitations 2[pre], 2[a]-2[c], and 2[e][i]-[iii] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e], respectively. It is my opinion that, for at least the same reasons explained above in §§VII.G.2.a-VII.G.2.d, VII.G.2.f-VII.G.2.h (1[pre], 1[a]-1[c], 1[e][i]-1[e][iii]), Renaud discloses or suggests 2[pre] and 2[a]-2[c].

b. 2[d]

384. Limitation 2[d] is substantially the same as limitation 1[d], with the only difference being that 2[d] recites "at least one camera carried by the body," whereas 1[d] recites "at least one camera mounted directly or indirectly to the body." As explained above in §VII.G.2.e (1[d]), Renaud discloses "at least one camera mounted directly or indirectly to the body." Thus, Renaud also discloses 2[d], because a camera that is "mounted directly or indirectly to the body" is also "carried by the body." 385. Therefore, in my opinion, Renaud renders Claim 2 obvious.

4. Claim 3 Unpatentable over Renaud

386. In my opinion, Renaud renders Claim 3 obvious.

a. 3[pre], 3[a]-3[c], 3[e][i]

387. Limitations 3[pre], 3[a]-3[c], and 3[e][i] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e][i], respectively. It

reasons in §§IV.G.2.a-d, f (1[pre], 1[a]-1[c], 1[e][i]), Renaud discloses or suggests 3[pre], 3[a]-3[c], and 3[e][i]. Janét, ¶387.

b. 3[d]

Limitations 3[d] and 1[d] only differ in:

1[d]	"camera"	"mounted directly or indirectly to"	"the body"
3[d]		"positioned on or in, or carried by,"	

Renaud discloses 3[d], because a camera "mounted directly...to the body" (§IV.G.2.e (1[d])) is also "positioned on or in, or carried by, the body." Janét, ¶388.

c. 3[e][ii]

Renaud discloses or suggests 3[e][ii]. Janét, ¶¶389-394.

As explained in §IV.G.2.g (1[e][ii]), Renaud discloses the controller "in electronic communication with the at least one camera." Renaud also discloses that its controller is "in electronic communication with...a portable electronic device." Janét, ¶390.

Renaud discloses a docking station 300 that communicates with the cleaner 200 via a wireless antenna 316 and transceiver to send/receive signals. Renaud, [0026], [0033], FIG. 1 (below).

[image omitted]

is my opinion that, for at least the same reasons explained above in §§VII.G.2.a-VII.G.2.d, VII.G.2.f (1[pre], 1[a]-1[c], 1[e][i]), Renaud discloses or suggests 3[pre], 3[a]-3[c], and 3[e][i].

b. 3[d]

388. Limitation 3[d] is substantially the same as limitation 1[d], with the only difference being that 3[d] recites "at least one camera positioned on or in, or carried by, the body," whereas 1[d] recites "at least one camera mounted directly or indirectly to the body." As explained above in §VII.G.2.e (1[d]), Renaud discloses "at least one camera mounted directly or indirectly to the body." Thus, in my opinion, Renaud also discloses limitation 3[d], because a camera that is "mounted directly or indirectly to the body" is also "positioned on or in, or carried by, the body."

c.3[e][ii] "(ii) in electronic communication with the at least one camera and a portable electronic device, and"

389. In my opinion, Renaud discloses or suggests 3[e][ii].

390. As explained in §VII.G.2.g (1[e][ii]), Renaud discloses the controller in electronic communication with the at least one camera." Renaud also discloses that its controller is "in electronic communication with...a portable electronic device."

391. Renaud discloses a docking station 300 that communicates with the cleaner 200 via a wireless antenna 316 and transceiver to send/receive signals. Renaud, [0026], [0033], FIG. 1 (below).

[image omitted]

Renaud further discloses the station is self-powered via a battery pack and includes a user interface 330 for accessing “cleaning paths” to control the cleaner. Renaud, [0032]-[0032].

POSITAs would have understood or found it obvious that Renaud docking station 300 is the “portable electronic device” in communication with the controller of cleaner 200 via wireless antenna 316, because the explicit disclosure of a “battery pack located in the docking station 300” (Renaud, [0033]) demonstrates a design choice for portability, allowing operation independent of fixed wall outlets. Janét, ¶393.

Additionally, Renaud discloses “a remote control... and/or joystick...allow[ing] a user to manually control the position” of cleaner 200. Renaud, [0032]. POSITAs would have understood or found it obvious that these devices are “portable electronic devices,” at least because these terms—remote control and joystick—describe handheld, carried by a user to operate cleaner 200 from a distance. Janét, ¶394. Furthermore, these devices are “in electronic communication” with the controller of cleaner 200 because Renaud discloses they are used to “manually control the position” of the cleaner (Renaud, [0032]), a function that necessarily requires transmitting control signals to the cleaner’s internal controller to actuate the motors. Janét, ¶394.

d. 3[e][iii]

392. Renaud further discloses the station is self-powered via a battery pack and includes a user interface 330 for accessing "cleaning paths" to control the cleaner. Renaud, [0032]-[0032].

393. A POSITA would have understood or found it obvious that Renaud docking station 300 is the “portable electronic device” in communication with the controller of cleaner 200 via wireless antenna 316, because the explicit disclosure of a “battery pack located in the docking station 300” (Renaud, [0033]) demonstrates a design choice for portability, allowing operation independent of fixed wall outlets.

394. Additionally, Renaud also discloses “a remote control... and/or joystick...allow[ing] a user to manually control the position” of cleaner 200. Renaud, [0032]. A POSITA would have understood or found it obvious that these devices are “portable electronic devices,” at least because these terms—remote control and joystick—describe handheld, carried by a user to operate cleaner 200 from a distance. Furthermore, these devices are “in electronic communication” with the controller of cleaner 200 because Renaud discloses they are used to “manually control the position” of the cleaner (Renaud, [0032]), a function that necessarily requires transmitting control signals to the cleaner’s internal controller to actuate the motors.

d.3[e][iii] “(iii) configured to generate, in response to at least one of the captured image or information from the portable electronic device, at least one control signal to cause movement of the body within

The limitation requires the controller to generate signals in response to one of the captured image or the PED. Janét, ¶¶395-396. As explained in §IV.G.2.h (1[e][iii]), Renaud discloses the controller configured to generate, “in response to...the captured image,” at least one control signal to cause movement “to, or away from, the first portion of the submerged surface.” 5. Claim 4 Unpatentable over Renaud Renaud renders Claim 4 obvious. Janét, ¶¶398-401. a. 4[pre], 4[a]-4[c], 4[e][i]-[iii] Limitations 4[pre], 4[a]-4[c], and 4[e][i]-[iii] are identical to limitations 1[pre], 1[a]-1[c], and 1[e][i]-[iii], respectively. For the reasons in §§IV.G.2.a-c and IV.G.2.f-h (1[pre], 1[a]-1[c], 1[e][i]-[iii]), Renaud discloses or suggests 4[pre], 4[a]-4[c], and 4[e][i]-[iii]. Janét, ¶399. b. 4[d] Limitation 4[d] is nearly identical to limitation 1[d], differing only in that 4[d] omits the requirement that the camera be	the swimming pool to, or away from, the first portion of the submerged surface.” 395. In my opinion, the Renaud-Durvasula combination discloses or suggests 3[e][iii]. 396. The limitation requires the controller to generate signals in response to one of the captured image or the PED. As explained in §VII.G.2.h (1[e][iii]), Renaud discloses the controller configured to generate, “in response to...the captured image,” at least one control signal to cause movement “to, or away from, the first portion of the submerged surface.” 397. Therefore, it is my opinion that Renaud renders Claim 3 obvious. 5. Claim 4 Unpatentable over Renaud 398. In my opinion, Renaud renders Claim 4 obvious. a. 4[pre], 4[a]-4[c], 4[e][i]-[iii] 399. Limitations 4[pre], 4[a]-4[c], and 4[e][i]-[iii] are exactly the same as limitations 1[pre], 1[a]-1[c], and 1[e][i]-[iii], respectively. It is my opinion that, for at least the same reasons explained above in §§VII.G.2.a-VII.G.2.d and VII.G.2.f-VII.G.2.h (1[pre], 1[a]-1[c], 1[e][i]-[iii]), Renaud discloses or suggests 4[pre], 4[a]-4[c], and 4[e][i]-[iii]. b. 4[d] 400. Limitation 4[d] is substantially the same as limitation 1[d], with the only difference being that 4[d] omits the requirement
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“mounted directly or indirectly to the body.” Renaud discloses or suggests 4[d], because Renaud’s camera “mounted directly...to the body” (§IV.G.2.e (1[d])) satisfies the broader requirement. Janét, ¶400.	that the camera be “mounted directly or indirectly to the body.” As explained above in §VII.G.2.e (1[d]), Renaud discloses “at least one camera mounted directly or indirectly to the body” for capturing an image. Thus, in my opinion, Renaud also discloses limitation 4[d], because Renaud’s disclosure of a mounted camera satisfies the broader requirement of a camera generally. 401. Therefore, in my opinion, Renaud renders Claim 4 obvious.
. Ground 4B: Claim 5 Is Unpatentable over Renaud and Durvasula 1. Motivation to Combine Both Renaud and Durvasula disclose autonomous robotic pool cleaners. <i>See</i> §§IV.A.1, IV.G.1. POSITAs would have been motivated to combine the teachings of Renaud and Durvasula to improve pool cleaning and sanitization. Janét, ¶402. POSITAs would have recognized that the teachings in Renaud and Durvasula are directed to the same pool cleaning technical field and provide complementary technical solutions to address similar issues. Janét, ¶403. Specifically, both disclose self-propelled pool cleaners having a housing, drive means for moving the pool cleaner over pool surfaces, a filter or debris	H. Ground 4B: Claim 5 Is Unpatentable under AIA 35 U.S.C. §103 and Pre-AIA AIA 35 U.S.C. §103 over Renaud and Durvasula 1. Reasons for Combining Renaud with Durvasula 402. Both Renaud and Durvasula disclose autonomous robotic pool cleaners. Renaud describes a swimming pool cleaner system that “permits cleaners to perform cleaning operations in a swimming pool while minimizing the interaction and/or supervision of users.” Renaud, [0042]. Durvasula similarly describes a pool cleaning system utilizing “a powered robotic surface cleaning vehicle to travel adjacent water containing surfaces of a pool while submerged within the pool.” Durvasula, Abstract. A POSITA would have been motivated to combine the teachings of Renaud and Durvasula to achieve improved pool cleaning and sanitization. 403. A POSITA would have recognized that the teachings in Renaud and Durvasula are directed to the same pool cleaning technical field, are based on recognition of the same or similar technical issues in pool maintenance, and provide complementary technical solutions to address those issues. Specifically, both references disclose self-propelled pool

container for collecting debris, and a controller for navigation. <i>Compare</i> Renaud, [0008], [0023], [0025], FIGS. 1-3, <i>with</i> Durvasula, [0014]-[0016], [0020]-[0022], FIGS. 1, 9-10. Accordingly, POSITAs would have investigated the technical teachings in both Renaud and Durvasula to seek guidance when designing a pool cleaning system for specific pool cleaning considerations and applications. Janét, ¶403. Both Renaud and Durvasula contemplate sanitization in addition to mechanical debris removal, but differ in their approach. Janét, ¶404. Renaud discloses a UV light on the bottom surface of the cleaner “for disinfecting and/or killing bacteria and other undesired organisms in the swimming pool.” Renaud, [0010], [0040]. Durvasula discloses “a chemical dispenser to closely apply pool cleaning chemicals to the pool surfaces as the vehicle 30 traverses such surfaces.” Durvasula, [0015]. POSITAs would have been motivated to modify Renaud by incorporating Durvasula’s chemical dispenser. Janét, ¶¶405-406. First, POSITAs would have been motivated to enhance the sanitization functionalities already taught by Renaud. Janét, ¶405. Renaud already contemplates a clear design intent to integrate sanitization with debris removal, disclosing a UV light “for disinfecting and/or killing bacteria and other undesired organisms.” Renaud, [0010], [0040]. POSITAs would have recognized that incorporating Durvasula’s chemical dispenser would provide a complementary chemical treatment, thereby achieving multi-modal sanitization (UV and chemical) alongside mechanical cleaning. Durvasula, [0015]; Renaud, [0040]; Janét, ¶405.	cleaners having a housing, drive means (e.g., wheels, rollers, tracks) for moving the pool cleaner over pool surfaces, a filter or debris container for collecting debris, and a controller for navigation. <i>Compare</i> Renaud, [0008], [0023], [0025], FIGS. 1–3, <i>with</i> Durvasula, [0014]–[0016], [0020]–[0022], FIGS. 1, 9–10. Accordingly, a POSITA would have investigated the technical teachings in both Renaud and Durvasula to seek guidance when designing a pool cleaning system for specific pool cleaning considerations and applications. 404. Both Renaud and Durvasula contemplate sanitization in addition to mechanical debris removal, but differ in their approach. Renaud discloses a UV light on the bottom surface of the cleaner “for disinfecting and/or killing bacteria and other undesired organisms in the swimming pool.” Renaud, [0010], [0040]. Durvasula discloses “a chemical dispenser to closely apply pool cleaning chemicals to the pool surfaces as the vehicle 30 traverses such surfaces.” Durvasula, [0015]. A POSITA would have been motivated to modify Renaud by incorporating Durvasula’s chemical dispenser for at least two reasons. 405. First, a POSITA would have been motivated to enhance the sanitization functionalities already taught by Renaud. Renaud already contemplates a clear design intent to integrate sanitization with debris removal, disclosing a UV light “for disinfecting and/or killing bacteria and other undesired organisms.” Renaud, [0010], [0040]. A POSITA would have recognized that incorporating Durvasula’s chemical dispenser would provide a complementary chemical treatment, thereby achieving multi-modal sanitization (UV and chemical) alongside mechanical cleaning methods. Durvasula, [0015]; Renaud, [0040].
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Second, POSITAs would have recognized that because Renaud's cleaner traverses pool surfaces using its vision system to identify and navigate to debris, equipping it with Durvasula's chemical dispenser would efficiently and effectively distribute pool cleaning chemicals throughout the pool as the cleaner moves. Renaud, [0029]-[0031]; Durvasula, [0015]; Janét, ¶406.

POSITAs would have reasonably expected success, because incorporating a chemical dispenser into a robotic pool cleaner like Renaud's had been well-known, and incorporating Durvasula's chemical dispenser into Renaud's cleaner body would have yielded predictable results. Porat, [0028]; Durvasula, [0015]; Renaud, [0010], [0023], [0040]; Janét, ¶407.

2. Claim 5 Unpatentable over Renaud and Durvasula

The Renaud-Durvasula combination renders Claim 5 obvious. Janét, ¶¶ 408-417.

a. 5[pre], 5[a]-5[c], 5[f][ii]-5[f][iii]

Limitations 5[pre], 5[a]-5[c], 5[f][ii], and 5[f][iii] are identical to limitations 1[pre], 1[a]-1[c], 1[e][ii], and 1[e][iii], respectively. For the reasons in §§IV.G.2.ac and IV.G.2.g-h (1[pre], 1[a]-1[c], 1[e][ii]-[iii]), Renaud discloses or suggests 5[pre], 5[a]-5[c], and 5[f][ii] and 5[f][iii]. Janét, ¶409.

406. Second, a POSITA would have recognized that because Renaud's cleaner traverses pool surfaces using its vision system to identify and navigate to debris, equipping it with Durvasula's chemical dispenser would efficiently and effectively distribute pool cleaning chemicals throughout the pool volume as the cleaner moves. Renaud, [0029]-[0031]; Durvasula, [0015].

407. A POSITA would have had a reasonable expectation of success in making this combination because incorporating a chemical dispenser into a robotic pool cleaner like Renaud's had been well-known, and incorporating Durvasula's chemical dispenser into Renaud's cleaner body would have yielded predictable results. *See, e.g.*, Porat, [0028]; Durvasula, [0015]; Renaud, [0010], [0023], [0040].

2. Claim 5 Unpatentable over Renaud and Durvasula

408. In my opinion, the Renaud-Durvasula combination renders Claim 5 obvious.

a. 5[pre], 5[a]-5[c], 5[f][ii]-5[f][iii]

409. Limitations 5[pre], 5[a]-5[c], 5[f][ii], and 5[f][iii] are exactly the same as limitations 1[pre], 1[a]-1[c], 1[e][ii], and 1[e][iii], respectively. It is my opinion that, for at least the same reasons explained above in §§VII.G.2.a-VII.G.2.d and VII.G.2.g-VII.G.2.h (1[pre], 1[a]-1[c], 1[e][ii]-[iii]), Renaud discloses or suggests 5[pre], 5[a]-5[c], and 5[f][ii] and 5[f][iii].

b. 5[d] As explained in §IV.G.2.b (1[a]), Renaud discloses cleaner 200 comprising a vehicle body. Renaud, [0022]-[0023], [0037], [0039], FIGS. 1-3. As explained in §IV.A.8.b (5[d]), Durvasula discloses a chemical dispenser to “closely apply pool cleaning chemicals to the pool surfaces as the vehicle 30 traverses such surfaces.” Durvasula, [0015]. POSITAs would have understood that Durvasula’s chemical dispenser constitutes “a chemical dispenser on, in, or carried by the vehicle body” because it is incorporated into vehicle 30 and applies chemicals “as the vehicle 30 traverses” the pool surfaces. <i>Id.</i>; Janét, ¶412. As explained in §IV.H.1, POSITAs would have been motivated to incorporate Durvasula’s chemical dispenser into Renaud’s cleaner 200 (vehicle body) to enhance the cleaning functionalities taught by Renaud. Janét, ¶413. Renaud already contemplates a clear design intent to integrate sanitization with debris removal, disclosing a UV light on the bottom surface “for disinfecting and/or killing bacteria and other undesired organisms.” Renaud, [0010], [0040]. POSITAs would have recognized that incorporating Durvasula’s chemical dispenser would provide a complementary chemical residual that persists in the water column long after the cleaner has passed. Durvasula, [0015]; Janét, ¶413. Also as explained in §IV.H.1, POSITAs would have had a reasonable expectation of success to implement this combination.	b.5[d] “d. a chemical dispenser on, in, or carried by the vehicle body;” 410. In my opinion, the Renaud-Durvasula combination discloses or suggests 5[d]. 411. As explained in §VII.G.2.b (1[a]), Renaud discloses cleaner 200 comprising a vehicle body. Renaud, [0022]-[0023], [0037], [0039], FIGS. 1-3. 412. As explained in §VII.A.8.b (5[d]), Durvasula discloses a chemical dispenser to “closely apply pool cleaning chemicals to the pool surfaces as the vehicle 30 traverses such surfaces.” Durvasula, [0015]. A POSITA would have understood that Durvasula’s chemical dispenser constitutes “a chemical dispenser on, in, or carried by the vehicle body” because it is incorporated into vehicle 30 and applies chemicals “as the vehicle 30 traverses” the pool surfaces. <i>Id.</i> 413. As explained in §VII.H.1, a POSITA would have been motivated to incorporate Durvasula’s chemical dispenser into Renaud’s cleaner 200 (vehicle body) to enhance the cleaning functionalities taught by Renaud. Renaud already contemplates a clear design intent to integrate sanitization with debris removal, disclosing a UV light on the bottom surface “for disinfecting and/or killing bacteria and other undesired organisms.” Renaud, [0010], [0040]. A POSITA would have recognized that incorporating Durvasula’s chemical dispenser would provide a complementary chemical residual that persists in the water column long after the cleaner has passed. Durvasula, [0015]. Also as explained in §VII.H.1, a POSITA would have had a reasonable expectation of success to implement this combination.
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In the Renaud-Durvasula combination, Renaud’s cleaner 200 would include Durvasula’s chemical dispenser carried by Renaud’s housing 202 (vehicle body), thereby disclosing “a chemical dispenser on, in, or carried by the vehicle body.” §IV.H.1; Renaud, [0022]–[0023], FIGS. 1-3; Durvasula, [0015]; Janét, ¶¶414.

c. 5[e]

Limitations 5[e] and 1[d] only differ in:

1[d]	“camera”	“mounted directly or indirectly to”	“the body”
5[e]		“on, in, or carried by”	“the vehicle body”

Renaud discloses or suggests 5[e], because a camera “mounted directly...to the body” (§IV.G.2.e (1[d])) is also “on, in, or carried by the vehicle body.” Janét, ¶415.

d. 5[f][i]

Limitations 5[f][i] and 1[e][i] only differ in:

1[e][i]	“controller”	“positioned on or in”	“the body”
5[f][i]		“on, in, or carried by”	“the vehicle body”

414. In my opinion, in the Renaud-Durvasula combination, Renaud’s cleaner 200 would include Durvasula’s chemical dispenser carried by Renaud’s housing 202 (vehicle body), thereby disclosing “a chemical dispenser on, in, or carried by the vehicle body.” *See* §VII.H.1; Renaud, [0022]–[0023], FIGS. 1–3; Durvasula, [0015].

a. 5[e] “e. at least one camera on, in, or carried by the vehicle body, for capturing an image of at least a first portion of the submerged surface; and”

415. Limitation 5[e] is substantially the same as limitation 1[d], with the only difference being that 5[e] recites “at least one camera **on, in, or carried by** the vehicle body,” whereas 1[d] recites “at least one camera **mounted directly or indirectly to** the body.” As explained above in §VII.G.2.e (1[d]), Renaud discloses “at least one camera mounted directly or indirectly to the body.” Thus, it is my opinion that Renaud also discloses 5[e], because a camera that is “mounted directly or indirectly to the body” is also “on, in, or carried by the vehicle body.”

b. 5[f][i] “f. a controller (i) on, in, or carried by the vehicle body,”

416. Limitation 5[f][i] is substantially the same as limitation 1[e][i], with the only difference being that 5[f][i] recites a controller “**on, in, or carried by** the vehicle body,” whereas 1[e][i] recites a controller “positioned **on or in** the body.” As explained above in §VII.G.2.f (1[e][i]), Renaud discloses a controller “positioned on or in the body.” Thus, in my opinion, Renaud also discloses 5[f][i], because a controller that is

Renaud discloses or suggests 5[f][i], because Renaud's controller "positioned on or in the body" (§IV.G.2.f (1[e][i])) is also "on, in, or carried by the vehicle body." Janét, ¶416.

"positioned on or in the body" is also "on, in, or carried by the vehicle body."

417. Therefore, it is my opinion that the Renaud-Durvasula combination renders Claim 5 obvious.