DROWNING DETECTION AND RESPONSE SYSTEM

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ABSTRACT

A system for detecting and responding to potential drowning situations in particularly adapted to shallow pools and bathing tubs for infants and small children. One or more motion sensors detect potential drowning patterns based on intervals of above-water movements followed by cessation of such movements. Upon detection of a potential drowning pattern, the system implements a succession of responsive modes, including an alarm mode and culminating in a rescue mode, in which the water is rapidly drained from the pool/tub to prevent a submerged child from drowning.
DROWNING DETECTION AND RESPONSE SYSTEM

FIELD OF INVENTION

[0001] The present invention relates to the field of systems for monitoring swimming and wading pools to detect and prevent drowning. More particularly, the present invention relates to a monitoring system for small pools and tubs, which not only provides visual and audible warnings of potential drowning situations, but also implements automatic responsive action to prevent a drowning by quickly draining the water from the pool/tub.

BACKGROUND OF THE INVENTION

[0002] Drowning ranks fifth among the leading causes of accidental death in the U.S. Of these drowning victims, 20% are children under the age of 14. Even nonfatal drowning incidents can result in severe brain damage and long-term disabilities. While children are usually supervised in larger swimming pools, children in small “kiddie” pools and infant bathtubs are sometimes left unattended. Even a few inches of water may be enough to drown an infant or small child who has fallen in face down.

[0003] While devices exist to monitor pools and set off visual and/or audible alarms when a potential drowning is detected, these systems all depend upon the proximity of an adult rescuer to see/hear and respond to the alarms. But there is a very tight rescue timeframe of about two minutes, after which there is only about 1 minute to save the child and avoiding serious brain damage rapidly diminish.

[0004] “Kiddie” pools and infant bathtubs are small enough that it’s feasible to fully drain and empty them within the two-minute timeframe. This requires that the drain be enlarged from the ¾” to 1” drain plugs commonly provided in such pools/tubs. It also requires a system that will automatically open the drain once a potential drowning has been detected. It’s the purpose of the present invention to provide such a system.

SUMMARY OF THE INVENTION

[0005] The present invention comprises an enclosure for a small volume of water, such as a “kiddie” pool or infant bath tub, with one or more drain outlets sized to completely empty the pool, by gravity flow alone, within two minutes of the onset of a potential drowning situation.

[0006] The pool/tub has one or more motion sensors, which are interfaced with a microprocessor and are configured and aligned to monitor activity above the water line. When motion indicative of a child in the pool/tub has been detected for a specified “pre-alarm” period of time, for example 30 seconds, the microprocessor puts the system into an “alert” mode, such that if motion ceases for more than a pre-determined “pre-alarm” period, such as 30 seconds, the microprocessor initiates an “alarm” mode, in which visual and audible alarms are activated.

[0007] If detected above-water motion resumes within another pre-defined incremental “pre-rescue” period, such as 30 seconds, the alarms are de-activated and the system resets to “alert” mode. But if above-water motion does not resume within the “pre-rescue” period, the microprocessor initiates the system’s “rescue” mode, in which the visual/audible alarms continue and the drain outlet(s) is/are opened, allows the water to freely discharge and flow out of the pool/tub.

[0008] The discharge rate in “rescue” mode will determine the size of the drain outlet(s). The design discharge rate is based on an overall two-minute “rescue” interval, which includes the programmed “pre-alarm” and “pre-rescue” periods. Therefore, for the example in which both “pre-alarm” and “pre-rescue” periods are set at 30 seconds, the net discharge interval must be less than one minute. If the subject pool/tub contains 12 cubic feet of water, a minimum discharge rate of 0.2 cubic feet per second (cfs) is required. With a safety factor of two, a design discharge rate of 0.4 cfs is appropriate. Applying Bernoulli’s equation, based on an initial water depth of one foot, the area of the drain outlet needed to achieve the design discharge rate is about 20 square inches, which could, for example, be a 5-inch diameter round outlet or a 4½-inch square outlet.

[0009] In one embodiment of the present invention, the opening and closing of the drain outlet(s) is controlled by a solenoid-activated latch mechanism. Optionally, the systems “alarm” includes a telephonic and/or text warning message to pre-selected contacts. Another optional feature is an application software for “smart” mobile telephones, which allows a remote party to monitor the system’s status, activate one or more peripheral video cameras to view streaming real-time video of the incident, initiate the system’s “rescue” mode, or reset the system to “alert” mode.

[0010] The foregoing summarizes the general design features of the present invention. In the following sections, specific embodiments of the present invention will be described in some detail. These specific embodiments are intended to demonstrate the feasibility of implementing the present invention in accordance with the general design features discussed above. Therefore, the detailed descriptions of these embodiments are offered for illustrative and exemplary purposes only, and they are not intended to limit the scope either of the foregoing summary description or of the claims which follow.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. 1 is a perspective view of an exemplary child’s wading pool with a drowning detection and response system in the “alert” mode, according to the preferred embodiments of the present invention;

[0012] FIG. 2 is a perspective view of an exemplary child’s wading pool with a drowning detection and response system in the “rescue” mode, according to the preferred embodiments of the present invention;

[0013] FIG. 3 is a detail perspective view of an exemplary discharge outlet in the closed position with an exemplary solenoid-actuated latch mechanism, according to the preferred embodiments of the present invention;

[0014] FIG. 4 is a detail perspective view of an exemplary discharge outlet in the open position, according to the preferred embodiments of the present invention;

[0015] FIG. 5 is a process flowchart of exemplary operative system modes according to the preferred embodiments of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] Referring to FIG. 1, an exemplary “kiddie” pool is depicted with an exemplary drowning detection and response system, according to the preferred embodiments of the present invention 10. The pool enclosure 11 contains a vol-
A volume of water 12 filling it to a certain waterline 13. Two motion sensors 14 are positioned to detect motion above the waterline 13 on either side of the pool 11.

[0017] A drain outlet 15 in the side of the pool enclosure 11 has a drain opening 16 into which tightly fits a drain plug 17. The drain plug 17 is rotatably attached to the outer wall of the pool enclosure 11 by a lower hinge 18, and it is secured in the closed position by a latch mechanism 19. As best seen in FIG. 3, the latch mechanism 19 is actuated by a solenoid 20, such that the solenoid, when energized, holds the latch 19 in place, thereby keeping the drain plug 17 in a closed position. When de-energized, solenoid 20 releases the latch 19 to retract or rotate so as to allow the drain plug 17 to freely rotate downward into an open position, as depicted in FIGS. 2 and 3. The drain plug 17 has around its periphery a flexible water-tight plug gasket 21 that seals tightly with a conjugate drain gasket 22 around the periphery of the drain opening 16. As shown in FIG. 4, the drain opening 16 is preferably protected by a screen 29 to prevent objects inside the pool enclosure 11, such as toys and floats, from entering the drain opening 16 and blocking it. Enclosing panels 30 are preferably also placed around the drain outlet 15, so as to prevent objects or structures near the drain outlet 15 from interfering with the opening of the drain plug 17.

[0018] Referring to FIGS. 1 and 2, the system also comprises an alarm light 23 and an alarm horn 24, as well as a manual reset button 25, and an optional video camera 26, which is aimed at or scans the interior of the pool 11. The motion sensors 11, the solenoid 20, the alarm light 23 and horn 24, the reset button 25, and the video camera 26 are all interfaced with and controlled by a system microprocessor 27.

[0019] In programmed operation, as illustrated in the flowchart of FIG. 4, the motion sensors 14 are initially in a default “pre-alert” mode 101 until motion above the waterline 13 has been detected for a specified “pre-alert” interval 102, as in the case of the child depicted in FIG. 1. Upon such initial detection 102, the microprocessor 27 puts the system into an “alert” mode 103, in which a detected cessation of motion above the waterline 13 for a specified “pre-alarm” interval 104 will cause the microprocessor 27 to initiate a system “alarm” mode 105.

[0020] In the “alarm” mode 105, the alarm light 23 is flashing and the alarm horn 24 sounds. The motion sensors 14 continue to scan for motion above the waterline 13, and if such motion resumes within a specified “pre-rescue” interval 106, the alarms 23 24 are de-activated and the microprocessor resets the system to “alert” mode 105. If detected above-waterline motion does not resume within the “pre-rescue” interval 106, the microprocessor initiates the system’s “rescue” mode 107, as depicted in FIG. 2. In the “rescue” mode 107, the alarms 23 24 continue and the solenoid 20 is de-energized so that it releases the latch 19, thereby causing the drain plug 17 to rotate downward under the pressure of the pool water 12 so as to open the drain outlet 15 and allow the water 12 to flow freely out of the drain opening 16.

[0021] As previously discussed, the drain outlet is sized so as to achieve a design “rescue” discharge rate, at which rate the pool water 12 will be completely evacuated within a specified overall “rescue” interval, which includes the programmed “pre-alarm” 104 and “pre-rescue” 106 intervals. As discussed previously, the overall “rescue” interval, during which a child is potentially submerged, should not exceed a maximum of two minutes.

[0022] The manual reset button 15 serves to restore the system to the “pre-alert” mode 101 once the child has left the pool 11, or to terminate an initiated “alarm” or “rescue” mode 108 once an adult responder has arrived on the scene.

[0023] In another embodiment, multiple motion sensors 14, in conjunction with the video camera 26, monitor the individual movements of multiple children using the same pool 11, so that cessation of above-waterline motion for one or more of the children will cause the microprocessor to initiate the “pre-alarm” mode 104 and subsequent responsive modes as described above, regardless of continued movement of remaining children in the pool 11.

[0024] In yet another embodiment, the system microprocessor 27 includes a wireless telephonic component 28, which is activated in the system’s “alarm” mode 105 to send a warning message by voice and/or text to pre-programmed contacts. Another optional system feature is a remote monitoring application software for “smart” mobile telephones, which enables a remote user to monitor the system’s status and view real-time streaming video from the system’s video camera 26. The remote monitoring application software can also enable the remote user to initiate the system’s “alarm” and “rescue” modes 105 107, or remotely reset the system to the “alert” or “pre-alert” modes 103 101.

[0025] Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that many additions, modifications and substitutions are possible, without departing from the scope and spirit of the present invention as defined by the accompanying claims. What is claimed is:

1. A system for detecting and responding to a situation of potential drowning, comprising:
   - a volume of water contained within an enclosure, which defines an interior and an exterior, wherein the volume of water fills the interior of the enclosure up to a water-line;
   - one or more motion sensors positioned to detect movement above the waterline and able to distinguish intervals of movement above the waterline from intervals of movement cessation above the waterline;
   - one or more drain outlets, which fluidly communicate between the interior and the exterior of the enclosure, wherein each drain outlet has a releasable drain plug, and wherein each drain plug has an unreleased closed position, in which the volume of water is retained within the interior of the enclosure, and wherein each drain plug has a released open position, in which the volume of water freely flows from the interior of the enclosure through a drain opening to the exterior of the enclosure; and
   - wherein the motion sensors electrically communicate with the drain outlets, such that a detection by the motion sensors of a potential drowning pattern, comprising one or more intervals of movement above the waterline followed by one or more intervals of movement cessation above the waterline, causes the motion sensors to send one or more electrical signals to the drain outlets to effect a release of the drain plugs to the open position, thereby preventing the potential drowning by emptying the volume of water from the interior of the enclosure.

2. The system of claim 1, further comprising one or more audible or visual alarms, or one or more combinations of audible and visual alarms, wherein the motion sensors elec-
trically communicate with the alarms, such that the detection of the potential drowning pattern causes the motion sensors to send one more electrical signals to the alarms to effect an activation of the alarms.

3. The system of claim 2, further comprising a system microprocessor, which interfaces with the motion sensors and with the drain outlets and with the alarms, and which triggers the release of the drain plugs and the activation of the alarms.

4. The system of claim 3, wherein the closed position and the open position of the drain plugs is controlled by a solenoid-activated mechanism.

5. The system of claim 4, wherein the microprocessor initiates one or more system modes in response to the detection by the motion sensors of the potential drowning pattern.

6. The system of claim 5, wherein the system modes include an alarm mode, in which the alarms are activated, followed by a rescue mode, in which the drain plugs are released.

7. The system of claim 6, wherein the drain opening is sized so as to achieve a design rescue discharge rate, at which rate the volume of pool water will be completely evacuated from the interior of the enclosure within a specified overall rescue interval, not to exceed two minutes.

8. The system of claim 7, further comprising one or more video cameras, wherein the video cameras, in conjunction with the motion sensors, distinguish movements of multiple individuals within the enclosure, and wherein the microprocessor initiates one or more of the system modes in response to the detection by the motion sensors and the video cameras of the potential drowning pattern with respect to one or more individuals.

9. The system of claim 8, wherein the microprocessor includes a wireless telephonic component, wherein the wireless telephonic component is activated in the alarm mode to send a warning message, by voice or text, or a combination of voice and text, to pre-selected contacts.

10. The system of claim 9, further comprising an application software, wherein the application software enables a mobile telephone to remotely monitor the system modes in real time and to remotely view real-time streaming video from the video cameras.

11. The system of claim 10, wherein the application software also enables the mobile telephone to remotely initiate and terminate the alarm mode or the rescue mode of the system.

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