

SHOWER DRAIN DEVICES, SHOWER DRAIN SYSTEMS, AND METHODS OF MANUFACTURING AND USING THE SAME

CLAIMS OF PRIORITY

[0001] This application claims priority of applications No. 1-2022-04928 and No. 1-2022-04929, entitled “Phễu thoát nước và hệ thống giám sát ngăn mùi và chống ngập tại phễu thoát nước này”, filed on 08/03/2022 in the Republic Socialist of Vietnam; and US application No.US 18/159,086, filed on 01/24/2023 in The United State of America. The patent applications identified above are incorporated here by reference in their entirety to provide continuity of disclosure.

FIELD OF THE INVENTION

[0002] The present invention relates generally to shower drains. More specifically, the present invention relates to a shower drain having dual connecting chambers overflowing mechanism designed to keep out bad odor and to minimize clogging.

BACKGROUND ART

[0003] All bathrooms have shower drains on the shower floors to drain off water. Shower drains --connected to drainpipes which lead water to the sewer – comprise a hollow cylindrical plastic body portion and a metal cover grate or strainer. The drains are positioned on the pipe so that the cover grate is flush with the shower floors. Often shower drains are often clogged by hair and debris build-up such as soaps, dirt, or grime. The

clogged drains are more than just a nuisance. They can cause flooding or sewer backup. When this issue is allowed to progress, contaminated water floods all over the floor giving off rotten egg smell. Finally, expensive water damage to the bathroom results. Typically, the rotten egg smell is created when bacteria grows in the drainage system and breaks down waste, forming hydrogen sulfide (H₂S).

[0004] There are many attempts to solve the shower drain clogging problems. One of the methods has been the use of a p-trap which is a U-shaped or P-shaped section of the drainage system positioned right after the drain. P-trap holds water which acts as a barrier to prevent gas in the drainage system from seeping back up the drain into the home. However, if the P-trap is dry, then there is not any water in the trap to block the gas from seeping up through the drain. This happens if the bathroom has not been used for a longtime or blocked by solid waste or broken drainage vent. If the bathroom has not been used for a while, then water has to be used to fill up the P-trap. But when there is a blocked or broken drainage vent, a vacuum in the drain line is created, which empties the water in the P-trap. In addition, dirt and grime that has been collected in the bottom of the P-trap may also be causing the rotten egg smell because this area is prone to bacteria growth.

[0005] Next referring to **FIG. 1**, a prior-art shower drain **100** that uses overflowing or spill-over mechanism to block out rotten egg odor is illustrated. Shower drain **100** is a goose neck (G-type) that uses overflowing mechanism to retain water at the G-neck section. This water blocks bad odor H₂S gases from the sewer. Shower drain **100** includes a strainer body **101**, a locknut **102**, and a trap section **103**. Trap section **103** includes an inner filter **106** and two openings **104** and **105**. Inner filter **106** is in a form

of a mesh intended to retain hair and solid wastes while passes water **111** to trap section **103**. As water **121** rises to the rims of openings **104** and **105**, it overflows outward to the sewer. Shower drain **100** is usually made with materials coated with chrome (Cr), Nikel (Ni). Customers have commented that the prior art shower drain **100** or the likes are slow in draining off water due to its structure that is difficult to integrate to the bath floor. Most importantly, bad odors are still seeping up toward the bath floor because hair and solid soap residues are easily intertwined and clogging inner filter **106**.

[0006] In high-rise buildings or condominium projects, when bathrooms in higher floors are clogged, it is often difficult to remove the clogging debris from shower drain **100** in consideration to residents on the floor below. In higher floors apartments, clogs tend to clump together deep into the pipes due to gravity. When flooding, clogged drains, and leaky water sources caused damage to the apartments, it is difficult to repair the damaged walls caused by water. Therefore, it is essential in high-rise condominium projects to use shower drains to avoid clogs, floods, and water damage.

[0007] When people turn on the water faucet in a bathroom or bathtub. They often forget to turn it off due to some distractions such as telephone calls, an ongoing TV program or a movie that they are watching, etc. This causes flooding and water seeping to the floors below. Consequently, precious water is wasted. Ceiling, floor, and walls of the residences below are also damaged. Shower drain 100 of the prior-art fails to fix these problems. The markets and consumers such as elderly people need a solution to these above described problems.

[0008] Therefore, what is needed is a new shower drain that can retain a body of water that blocks bad odor gases such as hydrogen sulfide (H₂S) and carbon monoxide (CO), etc.

[0009] What is needed is a new shower drain that can effectively drain off water on the bath floor.

[00010] What is needed is a new shower drain that can be easily to install or remove from the bath floors.

[00011] Furthermore, what is needed is new shower drains that are clog free that can be used in high rise buildings and condos.

[00012] Finally, what is needed is a shower drain that can be both decorous and effective in draining waste water.

[00013] The first type (surface drain) and second type (edge drain) shower drains and the method of manufacturing the same disclosed in the present invention solve the above-described problems and objectives.

SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to provide a shower drain and a method for draining off excess water from a floor to a sewer are provided which includes: a water inlet unit configured to receive the excess water; a double layer water outlet unit, mechanically coupled to the water inlet module to form a reservoir having a bottom connecting chambers that contain a body of water at a predetermined height that force the excess water beyond said predetermined height to overflow into the sewer; and a water level sensor circuitry placed inside double layer water outlet unit for transmitting the water level information inside the reservoir.

[00014] Another object of the present invention is to provide a method for making a shower drain for draining off excess water from a floor to a sewer which includes the following steps: (a) providing a water inlet unit configured to receive the excess water; and (b) providing a double layer water outlet unit, mechanically coupled to the water inlet unit to form a reservoir with bottom connecting chambers that force the excess water beyond a predetermined height to overflow into a sewer, and (c) detecting the water level inside the reservoir by placing a water level sensor circuit coupled to an antenna on top of the water inlet unit.

[00015] Another object of the present invention is to provide a shower drain system that includes water level sensor configured to sense the water levels within the connecting chambers. The water sensor is installed inside the shower drains transmitting water level and flooding signals to a gateway nearby. The gateway includes receivers for receiving the water levels and flooding signals as well as odor, temperature, light, and image signals. A server communicates with the gateways to transmit the

signals to a central control room so that water damage and inconveniences can be avoided and/or prevented.

[00016] Yet another object of the present invention is to provide a network

[00017] Another object of the present invention is to provide shower drain that can retain a body of water that blocks bad odor gases such as hydrogen sulfide (H₂S).

[00018] Another object of the present invention is to provide a new shower drain that can effectively drain off water on the bath floor.

[00019] Another object of the present invention is to provide a new shower drain that can be easily to install or remove from the bath floors.

[00020] Another object of the present invention is to provide new shower drains that are clog free or resistant to clog which can be used in high rise buildings and condos.

[00021] Another object of the present invention is to provide a shower drain that can be both decorous and conveniently placed anywhere on the bathroom floor.

[00022] These and other advantages of the present invention will no doubt become obvious to those of ordinary skill in the art after having read the following detailed description of the preferred embodiments, which are illustrated in the various drawing figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[00023] The accompanying drawings, which are incorporated in and form a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

[00024] **FIG. 1** shows a prior-art bath strain that employs the overflowing of water that blocks bad odors;

[00025] **FIG. 2** shows a three-dimension (3D) perspective diagram of a first type shower drain (surface drain) in accordance with an exemplary embodiment of the present invention;

[00026] **FIG. 3A** shows a pattern that is both decorous and effective in draining off water of the first type shower drain in accordance with a first exemplary embodiment of the present invention;

[00027] **FIG. 3B** shows another pattern among many patterns that is both decorous and effective in draining off water of the first type shower drain in accordance with a first exemplary embodiment of the present invention;

[00028] **FIG. 4** shows three-dimension (3D) diagram of the first structure of the first type shower drain in accordance with an aspect of the present invention;

[00029] **FIG. 5** shows three-dimension (3D) cut-away diagram of the first structure of the first type shower drain when separated into top part and bottom part in accordance with an aspect of the present invention;

[00030] **FIG. 6** shows three-dimension (3D) diagram of the first structure of the first type shower drain when combined the top part and the bottom part together in accordance with an aspect of the present invention;

[00031] FIG. 7 shows the two-dimension (2D) diagram that illustrates the operating principle of the first type shower drain in accordance with an aspect of the present invention;

[00032] FIG. 8 shows the three-dimension (3D) diagram of a second type shower drain (edge flow) in accordance with an aspect of the present invention;

[00033] FIG. 9 shows the three-dimension (3D) diagram illustrating the structure of the second type shower drain (edge flow) in accordance with an aspect of the present invention;

[00034] FIG. 10 shows the two-dimension (2D) diagram illustrating the inner structure of the second type shower drain (edge flow) in accordance with an aspect of the present invention in accordance with an aspect of the present invention;

[00035] FIG. 11 shows the two-dimension (2D) diagram that illustrates a second-type bath drain system and its operating principle in accordance with an aspect of the present invention;

[00036] FIG. 12 is a schematic diagram of a wireless water level sensor transmitter module in accordance with an aspect of the present invention;

[00037] FIG. 13 is a schematic diagram of a wireless gateway module receiver module in accordance with an aspect of the present invention in accordance with an aspect of the present invention;

[00038] FIG. 14 shows a schematic diagram of a bath drain system capable of detecting water level and flood in a bathroom floor of a house in accordance with an exemplary embodiment of the present invention;

[00039] FIG. 15 shows a system level of a server for the bath drain system capable of detecting water level and flood in a bathroom floor in accordance with an exemplary embodiment of the present invention;

[00040] FIG. 16 is a network of bath drain systems that connect gateway modules and servers together in accordance with an exemplary embodiment of the present invention;

[00041] FIG. 17 is a flow chart of a method of manufacturing the bath drain system including electronic sensors and in accordance with an aspect of the present invention; and

[00042] FIG. 18 shows a flow chart of a method of use of bath drain system including detecting water level and unintentional bathroom flood in accordance with an aspect of the present invention.

[00043] The figures depict various embodiments of the technology for the purposes of illustration only. A person of ordinary skill in the art will readily recognize from the following discussion that alternative embodiments of the structures and methods illustrated herein may be employed without departing from the principles of the technology described herein.

DETAILED DESCRIPTION OF THE INVENTION

[0050] Reference will now be made in detail to the preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. While the invention will be described in conjunction with the preferred embodiments, it will be understood that they are not intended to limit the invention to these embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims. Furthermore, in the following detailed description of the present invention, numerous specific details are set forth in order to provide a thorough understanding of the present invention. However, it will be obvious to one of ordinary skill in the art that the present invention may be practiced without these specific details. In other instances, well-known methods, procedures, and components have not been described in detail so as not to unnecessarily obscure aspects of the present invention.

[0051] Disclosed in the present specification is novel bath showers that include a water inlet unit removably inserted to a water outlet unit whose operation is based on the bottom connecting chambers principle to force water and debris into the sewer. In many preferred embodiments of the present invention, a water level sensor and other sensors such as odor sensor are provided that detect the water levels inside the water outlet unit. The odor sensor and other sensors are conveniently packaged in a gateway module that is wall mounted outside of the shower drains to detect the hydrogen sulfide (H_2S) and other gases such as carbon monoxide (CO) inside the bathroom. Yet in many embodiments, the shower drains and the sensors are networked using gateway modules and servers to monitor the water flow inside the bathrooms in order to avoid flooding and

clogging situations, thus saving water and repairing costs. The network of bath drains of the present invention are applicable in smart cities, condominium projects, hotels, resorts, apartment complexes.

[0052] Now referring to **FIG. 2**, a 3-dimensional (3D) perspective diagram of a first type (surface drain) shower drain **200** in accordance with an exemplary embodiment of the present invention is illustrated. First type shower drain **200** is a surface drain that allows water to drain off from various copyrightable patterns imprinted on the surface of a lid **300**. Next is a panel **220** connected to a double layer outer core **230** which is plugged into a tailpiece **240**. Tailpiece **240** is an opening that leads water to the sewer. In first type shower drain **200**, shower water (not shown) enters the openings cut into various patterns on lid **300** and then falls into double outer core **230** and then to tailpiece **240** and finally to the sewer system. Panel **220** and double layer core **230** are easy to separate. They are also easily removed from tailpiece **240**. Double layer core **230** has connecting chambers that (a) keep a fixed water column and (b) force overflowing (spill-over) of any excess water into tailpiece **240** so that the water level is in equilibrium in both chambers. This fixed amount of water columns blocks bad odor gases such as hydrogen sulfide (H_2S) or carbon monoxide (CO). After removed, panel **220** and double layer outer core **230** can be cleared from hair and solid wastes such as soaps, grimes, or dirt.

[0053] In **FIG. 3A**, a lotus flower pattern cut on lid **300A** in accordance with an exemplary embodiment of the first type shower drain **200** is illustrated. Lid **300A** has a solid background **301A** and openings **302A** that are patterned into the lotus flower shape. The openings **302A** and the structure of panel and double layer outer core **230** are designed to ensure high drainage speed. In many embodiments of the present invention,

the drainage speed of first type shower drain **200** is 25 – 200 liters per hour. Lotus flower patter **300A** can be accomplished by laser cutters, 3D printers, or CNC machine tools.

[0054] Next in **FIG. 3B**, a crab pattern cut lid **300B** in accordance with an exemplary embodiment of first type shower drain **200** is illustrated. Crab pattern **300B** has a solid background **301B** and openings **302B** that are patterned into the crab shape. The openings **302A** and the structure of panel and double layer outer core **230** ensure high drainage speed. In many embodiments of the present invention, the drainage speed of first type shower drain **200** is 25 – 200 liters per hour. Crab pattern **300B** can be accomplished by laser cutters, 3D printers, or CNC machine tools. It is noted that other copyrightable patterns of lid **300** are within the scope of the first type shower drain **200**.

[0055] Next referring to **FIG. 4**, a three-dimension (3D) diagram showing the structure of a first type shower drain **400** in accordance with an exemplary embodiment of the present invention is illustrated. Shower drain **400** includes lid **300** removably coupled to an inner core **410** by a lock nut **251**. In many embodiments of the present invention, inner core **410** includes a top circular surface **414** with a first radius R_1 connected to a truncated cone section **413**. Truncated cone section **413** is extended into a cylindrical body section having a first height H_1 and a second radius R_2 . Top circular surface **414** of inner core **410** is a solid surface while the bottom surface **412** of cylindrical body section **411** is opened (hollow). Lid **300** and inner core **410** constitutes a water inlet module **440** of shower drain **400**.

[0056] Continuing with **FIG. 4**, panel **220** is an open top cubic box with lateral side **221** having a thickness D_1 and height T_1 . In various embodiments of the present invention, thickness T_1 is 2-10 mm and height T_1 is 10-80 mm. Double layer outer core

230 is situated at the center of panel **220**. Double layer outer core **230** has the shape of open top truncated cone with a truncated cone inner layer **232** with radius R_3 and a truncated cone outer layer **231** with radius R_4 . Double layer outer core **230** is designed that R_4 is greater than R_3 . With that, a reservoir **233** exists between inner layer **232** and outer layer **231**. The base of panel **220** is inclined at an angle Θ between 20° to 30° toward the center so that excess water flows toward reservoir **233**. At the four corner of panel **220**, there are four spacers **222** having a height about 5mm to 20 mm. Panel **220** is fused with double layer outer **230** to form a water outlet unit **450**. In assembly, lid **300** is connected to inner core **410** by lock nut **251** to form water inlet unit **440**. Then, water inlet unit **440** is removably coupled to water outlet unit **450**. In various embodiments of the present invention, shower drain **400** is made up stainless steel or Inox 304 which contains 8.1% Nickel (Ni), 1% manganese (Mn), 18% Chromium (Cr), and 72.9% iron (Fe).

[0057] Now turning to **FIG. 5**, a 3D cutaway diagram of that shows the inner structure shower drain **200** in accordance with an exemplary embodiment of the present invention is illustrated. As seen, lid **300** includes a threaded bolt **303** protruding downward for mating with lock nut **251**. Upper surface **414** of inner core **410** includes a thru hole **406** for threaded bolt **303** to pass through. Inner core **410** is hollow with a hollow space **405**. For double layer outer core **230**, inner layer **232** has the top rim lower than that of outer layer **231** by a distance d approximately 5-50mm. Inner layer **232** is hollow with a hollow space **501**. Outer layer **231** is hollow above a solid bottom side **234**. This form reservoir **233**.

[0058] **FIG. 6** illustrates a fully assembled first type shower drain **600** in accordance with an exemplary embodiment of the present invention. When lid **300** is secured to inner

core **410** with nut locknut **251**, top surface of lid **300** is flush with the edge of panel **220**. Inner core **410** is completely contained within outer core **230**. Due to the dimensional differences between inner layer **410** and outer layer **231**, i.e., height ΔH_1 at the top and ΔH_2 at the bottom and radius R_3 and R_4 , a first chamber **601** and a second chamber **602** are formed inside hollow space **233**. In many preferred embodiments of the present invention, H_1 is 3-120mm, ΔH_1 is 4-50 mm, and ΔH_2 is 4-50 mm. The operations of first type shower drain **200** is illustrated in **FIG. 7**.

[0059] Now referring to **FIG. 7**, a 2D diagram representing the first type shower drain system **700** including an odor sensor and a water level sensor in combination with other sensors in accordance with an exemplary aspect of the present invention is illustrated. In many embodiments of the present invention, an odor sensor **1331** fabricated inside a gateway module **1300**. Gateway module **1300** is mounted outside of shower drain **200** for detecting bad odor such as hydrogen sulfide (H_2S) emanating from the sewer. In some embodiments of the present invention, gateway module **1300** is mounted on a wall or on the ceiling **711** of a bathroom. Gateway module **1300** also contains other types of sensors that will describe more in **FIG. 13**. Advert now to **FIG. 7**, Hydrogen sulfide is a colorless gas with is toxic, corrosive, and flammable. This triple threat, combined with high toxicity at low levels make make early detection essential. This H_2S gas is produced through bacteria breakdown of organic matter, making its presence relatively easy within confined spaces of the sewer. Human nose can smell the characteristic rotten egg smell of H_2S from around 0.5 ppm. Odor sensor **1331** is Alphasense H_2S sensor. In other embodiments, carbon monoxide and H_2S sensor such as COH-A2 sensor is used. The structure and operation of odor sensor **1331** are well known in the art and need not

discussed in details within the present application. A water level sensor system **1200** is attached to the bottom side of top surface **414** of cylindrical section **411** of inner core **400**. An antenna **1224**, electrically coupled to water level sensor system **1200** via an electrical cable **1231**, is placed outside atop of solide background **301** to transmit the water level information to gateway module **1300**. Water levels are sensed by a first (high) metal probe **1101**, a second (middle) metal probe **1102**, and a third (low) metal probe **1103**, all connected together by an electrical cable **1104**. In various preferred embodiments of the present invention, water level sensor system **1200** detects both water level within hollow space **233**, first chamber **601**, and second chamber **602**. As a consequence, water level detector **1200** can detect unintentional flood caused by distracted and forgetful owners. If high water level is maintained for $T_{\min}$ of 30 minutes or more, water level sensor system **1200** inform the owner and concierges, and then turn off the water source. The schematic and operation of water level sensor **1200** is described in full in **FIG. 12**.

[0060] In operation, after water **711** from the shower or from other sources such as faucets is flowing through openings **302** of lid **300** filling up first chamber **601** and second chamber **602**. The water level is eventually raises to the rim of inner core **401** and overflow to the sewer via space **501**. Hair and assortment of solid wastes such as soaps, dirt, and slimes, etc. are collected at the bottoms of first chamber **601** and second chamber **602**. Due to the principle of connecting chambers, water levels on both sides of first chamber **601** and second chamber **602** are forced to be the same. This creates a force to continuously push clump of hair and debris into second chamber **602**. Thus, first type shower drain **200** of the present invention is clog free. In rare occasions when first chamber **601** and second chamber **602** were clogged, owner and/or concierge are

informed. In this case, lid **300** and inner core **231** are easily removed by a hook (not shown) through openings **302** to expose panel **220** and hollow space **233** of first chamber **601** and second chamber **602**. Clogs are easily removed. Water level sensor system **1200** is for extra security when shower drain **200** is both clogged and water kept running. With the design of first type shower drain **200**, even when owner forgot to turn off the water source, the connecting first chamber **601** and second channel **602** are always forcing water to be flown into hollow space **501** then to the sewer. This is due to the connecting first chamber **601** and second chamber **602** cause a water level **701** in both chambers to be the same. In many embodiments of the present invention, the height of water column inside first chamber **601** and second chamber **602** is 3-120mm and the drainage speed is 25-200 liters per hour. The operations of water level sensor system **1200** and gateway module **1300** will be described in **FIG. 12** and **FIG. 13** respectively.

[0061] **FIG. 2** to **FIG. 7**, first type shower drain **200** achieves the following objectives of the present invention:

[0062] (1) high drainage speed;

[0063] (2) clog free;

[0064] (3) easy to assemble;

[0065] (4) aesthetically decorous in any bathrooms

[0066] (5) easy to clean;

[0067] (6) dangerous gas detection; and

[0068] (7) flood detection

[0069] **FIG. 8** to **FIG. 11** describe a second type shower drain of the present invention that is edge drain. The second type shower drain of the present invention operates the

same principle as first type shower drain **200** described in **FIG. 2- FIG. 7**. The operating principle of both first type shower drain and second type shower drain is the overflowing of connecting double chamber. The only difference is the drainage or the manner water is drained.

[0070] Now referring to **FIG. 8**, a three dimension (3D) perspective diagram of a second type shower drain **800** that uses edge drain mechanism in accordance with an exemplary embodiment of the present invention is illustrated. Shower drain **800** includes an inner panel **810**, an outer panel **820**, an inner core **910** (see **FIG. 9**), and a double layer outer core **840**. Double layer outer core **840** is inserted snugly to tailpiece **240** (see **FIG. 11**) of the sewer system (not shown). Inner panel **810** and outer panel **820** have the same open top parallelepiped shape whose base is a square. The width W_i of inner panel **810** is slightly smaller than the width W_o of outer panel **820**. The thickness T of both inner panel **810** and outer panel **820** are the same and is 2-10 mm. As seen, inner panel **810** is placed inside outer panel **820** so that a gutter drainage **899** of width ΔW is formed along the common perimeter of both inner and outer panels **810** and **820**. The height H of both inner panel **810** and outer panel **820** is the same and substantially less than their widths W_i and W_o . The height of inner panel **810** and outer panel **820** is 15-80 mm. Therefore their rims are flushed to one another and to the floor of the bathroom (not shown). On the top surface of the base of inner panel **810**, there are holes **811** designed for ejecting floor bricks (not shown). A hollow space **813** of inner panel **810** is designed to hold a decorative floor brick.

[0071] Next, referring to **FIG. 9**, a three dimension (3D) perspective diagram of a second type shower drain **800** before assembling in accordance with an exemplary

embodiment of the present invention is illustrated. As seen, inner panel **810** is connected with inner core **910** to form a water inlet unit **940**. Inner core **910** is shaped as a hollow truncated cone with a lateral side **911** and an open bottom **913**. In many embodiments of the present invention, inner core **910** includes a truncated cone section with a radius R_1 and lateral side **911**. In the second type shower drain embodiment, inner core **910** is fused permanently at the center of a bottom side **812** of inner panel **810** to form water inlet unit **940**. The structure of outer panel **820** is the same as that of shower drain **400** described above in **FIG. 4** except that outer panel **820** has more spacers **822** designed to support the weight of decorative floor bricks and those of users. Double layer outer core **830** has the shape of an open top truncated cone and is fused to second panel **820** to form a water outlet unit **950**. Double layer outer core **830** includes an outer layer **831** with radius R_3 concentric with an inner layer **832** with radius R_2 , where R_3 is greater than R_2 . With this design, a reservoir **823** is formed between inner layer **832** and outer layer **831**. The bottom surface of outer panel **820** is inclined at an angle Θ between 20° to 30° toward the center so that excess water flows toward hollow space **823**. The flowing rate or drainage speed is 25 to 200 liters per hour. At the four corner of outer panel **820**, there are eight spacers **822** having a height about 5mm to 20 mm. To assemble, inner core **910** with truncated cone **911** are inserted into double layer outer core **830** until bottom side **812** of inner panel **810** rests firmly on spacers **822**. **FIG. 10** will further disclose the inner structure of shower drain **800**.

[0072] Referring now to **FIG. 10**, a 2D diagram of that shows the inner structure shower drain **800** in accordance with an exemplary embodiment of the present invention is illustrated. As seen, inner panel **810** is a hollow open top parallelepiped with an inner

hollow space **813**. At bottom side **812** there are supporting feet **912**. Inner core **910** includes a lateral side **911** and a hollow inner space **912** and an open bottom side **913**. Lateral side **911** has a height H_1 . Inner panel **810** is fused permanently to inner core **910** to form water inlet unit **940**. The interior side of outer panel **820** is planted with spacers **822** on both sides. Spacers **822** and feet **812** are designed to support the total weight on shower drain **800** since second type of shower drain **800** may be installed in the middle of the bathroom. Decorative bath brick installed inside the hollow space **813** are the same as those in the bathroom. While first type shower drain **200** is usually placed at the corners or near the walls, outer panel **820** is also a open top hollow parallelepiped **821** with an inner hollow space **823**. A bottom side **824** of second open top hollow parallelepiped **821** is fused permanently with double layer outer core **830** to form water outlet unit **950**. Double layer outer core **830** is an open top hollow truncated cone with outer layer **831** and inner layer **832**, both with height H_2 . Inner layer **832** has a radius R_2 which is smaller than the radius R_3 of and outer layer **831**. Henceforth, a reservoir **833** is formed therebetween. Since inner layer **832** is an open top hollow truncated cone, it has a hollow space **1011** in fluid communication with the sewer.

[0073] Now referring to **FIG. 11**, a 2D diagram of a second type shower drain system **1100** in accordance with an exemplary aspect of the present invention is illustrated. In many embodiments of the present invention, an odor sensor **1331** fabricated inside a gateway module **1300**. Gateway module **1300** is mounted outside of shower drain **800** for detecting bad odor such as hydrogen sulfide (H_2S) emanating from the sewer. In some embodiments of the present invention, gateway module **1300** is mounted on a wall or on the ceiling **1121** of a bathroom. Gateway module **1300** also contains other types of

sensors that will describe more in **FIG. 13**. Odor sensor **1331** is Alphasense H₂S sensor. In other embodiments, carbon monoxide and H₂S sensor such as COH-A2 sensor is used. The structure and operation of odor sensor **1331** are well known in the art and need not discussed in details within the present application. A water level sensor system **1200** is attached to the bottom side **812** of inner panel **810**. An antenna **1224**, electrically coupled to water level sensor system **1200** via an electrical cable **1231**, is placed outside atop of a decorative brick **1131** to transmit the water level information to gateway module **1300**. Water levels are sensed by a first (high) metal probe **1101**, a second (middle) metal probe **1102**, and a third (low) metal probe **1103**, all connected together by an electrical cable **1104**. In various preferred embodiments of the present invention, water level sensor system **1200** detects both water level within reservoir **833**, first chamber **1111**, and second chamber **1112**. As a consequence, water level detector **1200** can detect unintentional flood caused by distracted and forgetful owners. If high water level is maintained for $T_{\min}$ of 30 minutes or more, water level sensor system **1200** inform the owner and concierges, and then turn off the water source. The schematic and operation of water level sensor **1200** is described in full in **FIG. 12**.

[0074] Water **1131** from the shower or from other sources such as faucets are flowing through edges **1101** formed between first panel **810** and second panel **820**, filling up first chamber **1111**, second chamber **1112**, third chamber **1113**, and fourth chamber **1114**. The water level eventually raises to the top rim of inner core **401** and overflows to the sewer via space **1011**. Hair and assortment of solid wastes such as soaps, etc. are collected at the bottoms of first chamber **1111** and second chamber **1112**. Due to the principle of connecting tanks, water levels **1141** on both sides of first chamber **1111** and

second chamber **1112** are always the same. This creates a force to continuously push hair and debris into second chamber **1112** and eventually to hollow space **1011** leading to the sewer. Thus, second type shower drain **800** of the present invention is clog free. In rare occasions when reservoir **833** were clogged, first panel **810** is easily removed by a hook, a grasp, or a thong (not shown) through edge **1101** to expose reservoir **833** for clean-up. Clogs are easily removed.

[0075] Continuing with **FIG. 11**, water level sensor system **1200** is for extra security when shower drain **800** is both clogged and water was allowed to run. With the design of second type shower drain **800**, even when owner forgot to turn off the water source, the connecting first chamber **1111** and second channel **1112** are always forcing water to be flown into hollow space **1011** then to the sewer. This is due to the connecting first chamber **1111** and second chamber **1112** cause a water level **701** in both chambers to be the same. In many embodiments of the present invention, the height of water column inside first chamber **1111** and second chamber **1112** is 3-120mm and the drainage speed is 25-200 liters per hour. The operations of water level sensor system **1200** and gateway module **1300** will be described in **FIG. 12** and **FIG. 13** respectively.

[0076] **FIG. 8** to **FIG. 11**, second type shower drain **800** achieves the following objectives of the present invention:

[0077] (1) high drainage speed;

[0078] (2) clog free;

[0079] (3) easy to assemble;

[0080] (4) aesthetically decorous in any bathrooms

[0081] (4) easy to clean; and

[0082] (5) can be decorative that matches the pattern of the floor bricks.

[0083] Now turning to **FIG. 12**, a schematic diagram of a water level sensor system **1200** that is placed inside either first type shower drain **700** or second type of shower drain **1100** in accordance with an exemplary embodiment of the present invention is illustrated. Please advert to **FIG. 7** and **FIG. 11** for the placements of water level sensor system **1200** inside each type of shower drain **200** or **800**. Water level sensor system **1200** is a wireless transmitter that transmits the water level inside connecting chambers **1111** and **1112**. Water level sensor system **1200** includes a water level sensor integrated circuit (IC) **1201** that outputs various digital signal levels to an encoder **1221**, and a DIP switch **1222**. The output of DIP switch **1222** is fed to a wireless transmitter **1223** that uses antenna **1224** (see **FIG. 7** and **FIG. 11**). A power supply unit **1210** provides a voltage supply V_{CC} to the above listed components. Power supply unit **1210** is battery operated which includes a 9-V battery, a smoothing circuit **1212**, and a sleep mode circuit **1213**.

[0084] In many embodiments of the present invention, water level sensor **1201** is a ULN2003 which are connected to a high metal probe **1101**, a medium metal probe **1102**, and a low metal probe **1103** for detecting high, middle, and low water levels respectively. The electrical connections of ULN2003 for water level detection are shown in the datasheet and need not described in details herein. Encoder **1221** is an integrated circuit (IC) HT12E. The parallel outputs (D_0 to D_7) of encoder **1221** are fed into DIP switch **1222** which converts these parallel data to serial data D_{OUT} . This output data is fed to transmitter **1223**. Transmitter **1223** is an ASK RF transmitter transmitting the water level signals at 433 MHz. Sleep mode circuit **1213** is a power management integrated circuit (PMIC) LM10504 made by Texas Instruments Inc.

[0085] Next referring to **FIG. 13**, a schematic diagram of a gateway module **1300** that receives signals from either first type shower drain **700** or second type of shower drain **1100** and other sensors in accordance with an exemplary embodiment of the present invention is illustrated. Gateway module **1300** is an intermediate circuitry designed to collect all sensors signals and send them to a server for further processing (see **FIG. 15**). Gateway module **1300** includes an RF antenna **1301** coupled to a receiver **1302**. Output signal from receiver **1302** is fed to a DIP switch **1303** and then to a decoder **1304**. Outputs of decoder **1304** are fed to at least one timers **1331**. Timers **1331** are 555 ICs that set time thresholds for high water level and low water level respectively. Other sensors including an odor sensor **1331**, a light sensor **1332**, and/or other sensors **1333** such as temperature sensor (thermometer) are connected to a microcontroller unit (MCU) **1341** for processing. MCU **1341** receives information from water level sensors **1201**, timer **1322**, odor sensor **1331**, light sensor **1332**, and other sensors **1333** (e.g., thermostat, and/or cameras). MCU **1341** processes the information and issues appropriate commands to water source controllers **1441**.

[0086] In various embodiments of the present invention, antenna is **1301** a through-hole mount 433Mhz RF antenna model CRFT-MG0433-30170-1M-SMA with 2dB gain and 50 Ω impedance. For wall-mounted gateway module 1300, receiver antenna can be either spring, FPC, PCB, rubber duck, fiberglass, through hole screw mount antenna. Decoder **1304** is an integrated circuit (IC) HT12D. The parallel outputs D_{IN} of encoder **1221** are fed into decoder **1304** which converts water level signal data to parallel data (D_0 to D_7). Odor sensor **1331** is either a hydrogen sulfide (H_2S) and/or carbon monoxide (CO) sensor. H_2S sensor is a MQ-136 Arduino compatible. Light sensor **1332** is a BH

1750 Arduino light sensor. Temperature sensor **1333** is a DHT11, LM35DZ, or LM335 integrated circuits. Water source controller **1441** is equipped with an Arduino solenoid water valve. MCU **1341** is Arduino microcontrollers such as Node MCU (ESP8266), Teensy 3.6 that uses a 32-bit 180MHz ARM Cortex-M4 processor, MSP430 Launchpad, the Multi-tool STM32, PocketBeagle (the Linux Alternative), or a FPGA which is programmable gate arrays. It is noted that other ICs and control language such as Linux, C++ that perform the same disclosed functions are within the scope of the present invention.

[0087] FIG. 14 is a schematic diagram of dwellings such as smart homes, offices, condos, or apartments **1400** that are equipped with the shower drain system in accordance with an exemplary embodiment of the present invention. The shower drain systems **700** and **1100** as described in FIG. 7, FIG. 11, FIG. 12, and FIG. 13 above are used to achieve the following objectives of the present invention:

[0088] (a) a clog free shower drain that uses the fluid connecting chambers to eliminate clogging.

[0089] (b) water sensor and transmitter that communicates the water level information inside the shower drain to avoid dry off, flooding, bad odor, and thus avoiding damage to the shower floor and possibly rooms there below.

[0090] (c) Users, homeowners, hotel concierges, control room employees can be notified of the drainage situation in each room, thus avoiding flood damage, bad odor, and waste of water leading to saving money and efforts.

[0091] Smart home system **1400** includes a plurality of residences **1410**. In each residence **1410**, there are a kitchen **1411** with at least one kitchen sinks **1421**, a laundry

room **1422** with a washing machine **1422**, a bath room **1413** with washbasin (or sink) **1413** and a toilet bowl **1414**, a shower room **1414** with a bathtub **1425**. All of these fixtures are connected to water conduits **1433**. Water tubes transport water **1435** to all the above listed rooms. Water **1434** and its flow rate are controlled by solenoid valve controllers **1441**. Bathroom and shower room floors **1415** are installed with first type shower drains **700** for draining off excess water **1434**. Water level sensor system **1200** inside each shower drain **700** communicates the water level information to gateway modules **1300** and then to a server **1540** via communication channels **1442**. Server **1530** is located in a control room of a hotel, or an apartment complex (condominium, a high-rise office building). Server **1540** receives sensor information from shower drain system **700**, odor sensor **1331**, light sensor **1332**, other sensor **1333** and, in turn, processes these information to issue appropriate commands. For example, if one of the shower drains **700** is dried (or low water level), server **1540** commands solenoid valve water faucet **1426** to release a certain amount of water until the water level reaches at least at the middle level. Alternatively, server **1540** can download the shower drain algorithms to gateway module **1300**. In this situation, MCU **1341** will take action in place of server **1540**. Server **1540** displays the water situation in each bathroom **1413** and shower room **1414** in house 1410 on a series of display panels **1411**. At the same time, server **1540** can send alarm to a smartphone 1412 to inform each owner.

[0092] Now referring to **FIG. 15**, a schematic diagram of a network servers **1500** in accordance with an exemplary embodiment of the present invention is illustrated. It will be noted that a network of servers **1500** can be connected as a cluster of different servers **1540-1** to **1540-N** connected and serviced by a network **1510**. Network of servers **1500**

also connects smartphones **1541-1**, **1541-2**, **1541-3**, to **1541-N** to network **1510**. Each server **1540-1** to **1540-N** collects and processes information from bathroom of a hotel, a condominium project, or a smart single resident house. Servers **1540-1** to **1540-N** are linked to one another via a communication channel **1561**. Server **1540** of the present invention is representative of other servers **1540-1**, **1540-2**,... **1540-N** and connected to edge/fog/cloud network **1510** via communication channel **1561**. In some embodiments of the present invention, all servers **1540-1**, **1540-2**, and **1540-N** may be connected together in a master-slave configuration via communication channel **1561** and one server (e.g., **15400**) can serve as a network to the other servers **15400-2** to **1540-N**. As alluded above, networks **1540-1** to **1540-N** can be data center, cloud/edge/fog, or network such as nanonetwork, body area network (BAN), personal area network (PAN), local area network (LAN), campus/corporate area network (CAN), metropolitan area network (MAN), wide area network (WAN), and mesh area networks, or any combinations thereof. Communication channels **1561** can be wireless channels such as Bluetooth, 4G, LTE, 5G, Wi-Fi, Zigbee, Z-wave, radio frequency (RF), Near Field Communication (NFC), Ethernet, LoRaWAN, or can be wired connectors such as RS-232, RS-485, USB, or any combinations thereof. Server of the present invention **1540-1**, **1540-2** and **1540-N** may use each other as a network using different communication protocols such as Message Queue Telemetry Transport (MQTT), Data Distribution Service (DDS), HTTP, TCP/IP, (Advanced Message Queuing Protocol (AMQP), Modbus, BACnet, OPCUA, or any combinations thereof. Servers **1540-1** to **1540-N** may be set up by different manufacturers having different physical connections, communication protocols, industrial standards, as well as operating parameters. They can communicate to one another via

communication channel **1561** as long as networks **15401-1** to **1540-N** can be linked together, i.e., via a common network such as an edge/fog/cloud network **1510**. Alternatively, these servers, **1540-1** to **1540-N** may use one another as an intermediary server to communicate to other servers outside of cloud network **1510**.

[0093] Continuing with **FIG. 15**, a typical server **1540** of the present invention includes a microprocessor **1511** in communication with a memory **1470** via a bus **1563**. Server **1540** also includes a power supply **1542**, a network interface **1545**, a Read Only Memory (ROM) **1543**, Random Access Memory (RAM) **1547**, a local input/output interface **1544**, a display **1551**, a keyboard **1552**, audio interface **1554**, and a pointing device driver **1553**. Power supply **1542** provides necessary voltages supplies to server **1540**. Local input/output interface **1544** enables input and output communication between microprocessor **1511**, display **1551**, keyboard **1552**, and pointing device driver **1553**.

[0094] Memory **1570** includes an Operating system (OS) **1571**, a basic operating system **1572**, a data storage **1580** which includes sensor codes **1581** and data storage **1592**. More specifically, memory **1570** stores Basic input/output system (BIOS) **1571** for controlling the internal operations of server **1540**. Memory **1470** also stores an operating system (OS) **1571** for controlling basic operations of server **1540**. Data storage **1580** illustrates examples of computer-readable storage media as well as computer-readable instructions, data structures, program modules or other household data for storage. Data storage **1580** may be allocated to store data of all bath drain systems **700** or **1100** within a hotel, resort, or a condominium project. In some other embodiments, data storage **1580** may store application specific software programs. It will be appreciated that operating

system (OS) and Basic input/output system (BIOS) **1572** may include a general-purpose operating system such as a version of UNIX, or LINUX™, or a specialized operating system such as Microsoft Corporation's Windows® operating system, or the Apple Corporation's IOS® operating system. The operating system may include, or interface with a Java virtual machine module that enables control of hardware components and/or operating system operations via Java application programs. These components are similar to generic computers that need not be described in details herein. Server **1540** further includes a sensor module **1590** which further includes water sensor algorithm **1491** and odor sensor algorithm **1592**, temperature sensor algorithm **1593**, light sensor algorithm **1594** which are in communication with data storage **1580** and microprocessor **1511**. These algorithms **1591-1594** are written in Arduino, Linux, or C++ -- codes. They are downloaded to gateway module **1300** which is configured to receive sensor information and issue appropriate commands that will be described in **FIG. 18**. In many aspects of the present invention, server **1540-1** to **1540-N** may send the information to smartphones **1541-1** to **1541-N** for action. It is noted that server **1540** may be used to handle other operations in smart home **1400**.

[0095] **FIG. 16** illustrates a schematic diagram of network of servers **1500** ("network **1500**") that includes a network **1651** connecting servers **1541-1** to **1540-M** together which service first integration group **1621-1**, second integration group **1621-2**, and N^{th} integration group **1621-N** of various sensors in accordance with an exemplary embodiment of the present invention. First integration group **1621-1** includes gateway module **1300-1**, **1300-2**..., **1300-I** connected to server **1540-1** via a local communication channel **1601**. Second integration group **1621-2** includes gateway modules **1300-1**, **1300-2**..., **1300-J** connected

to a server **1540-2** via local communication channel **1601**. N^{th} integration group **1621-M** includes gateway modules **1300-1**, **1300-2**..., **1300-K** connected to a server **1540-K** via local communication channel **1601**. First integration group **1621-1**, second integration group **1621-2**, and M^{th} integration group **1621-M** are connected and communicate to one another to a network **1651** via a network communication channel **1602**. In some embodiments of the present invention, network **1651** can be either wireless channels such as can be data center, cloud/edge/fog, or network such as nanonetwork, body area network (BAN), personal area network (PAN), local area network (LAN), campus/corporate area network (CAN), metropolitan area network (MAN), wide area network (WAN), and mesh area networks, edge, cloud, hybrid cloud, or fog network or any combinations thereof. Local communication channels **1601** and network communication channels **1602** can be wireless channels such as Bluetooth, 4G, LTE, 5G, Wi-Fi, Zigbee, Z-wave, radio frequency (RF), Near Field Communication (NFC), Ethernet, LoRaWAN. Alternatively, local communication channels **1601** and network communication channels **1602** can be wired connectors such as RS-232, RS-485, USB, or any combinations thereof, or wired such as RS-232, RS-485, USB, or any combinations thereof.

[0096] Continuing with **FIG. 16**, as non-limiting examples, first integration group **1621-1** can be a different houses (such as **1410**) in first tower of a condominium complex. Second integration group **1621-2** can be other houses in a second tower in the same condominium complex. M^{th} integration group **1621-M** can be yet other houses in a fifth tower ($M=5$) of the same condominium complex. In other embodiments of the present invention, first integration group **1621-1** can be a different rooms in a first group of hotel

buildings. Second integration group **1621-2** can be other rooms in a second group of hotel buildings. M^{th} integration group **1621-M** can be yet rooms in a fifth group of hotel buildings. In different embodiments of the present invention, first integration group **1621-1** can be houses and offices in a first smart city, second integration group **1621-2** can be houses and offices in second smart city, and M^{th} integration group **1621-M** are resident houses and/or offices in fourth smart city (where $M = 4$). Gateway modules **1300-1**, **1300-2**, **1300-I**; **1300-1**, **1300-2**, ..., **1300-J**; and **1300-1**, **1300-2**, ..., **1300-K** include – but not limited to—gateway module **1300** described in **FIG. 13** that manages the operations garage door sensors (not shown), humidity sensors (not shown), video cameras (not shown), odor sensors **1331**, water level sensors **700** and **1100**, and other smart homes sensors and detectors **1333** such as temperature and humidity sensor.

[0097] Next referring to **FIG. 17**, a method **1700** of manufacturing a shower drain that is easy to remove for cleaning and clog-free in accordance with exemplary aspects of the present invention is illustrated.

[0098] At step **1701**, inlet channels at the top of the brain drain where excess water on the floor enter are constructed. Step **1701** is realized by first type shower drain **200** and second type shower drain **800** described above. In first type shower drain **200**, inlet channels are holes **302** (see **FIG. 6**) forming decorative patterns (see **FIG. 3**). In many aspects of the present invention, step **1701** is also realized by making bottom side of panel **210** inclined at an angle Θ 20° to 30° toward inner core **230**. This inclination causes water and debris to drain toward first chamber **601** in fluid connection to second chamber **602** (see **FIG. 7**). In second type shower drain **800**, inlet channels are ditch, gutter, or edge **1101**. In many aspects of the present invention, step **1701** is also realized by

making bottom side **813** inclined at an angle Θ 20° to 30° from all sides toward inner core **910**. This inclination causes water and debris to drain toward first chamber **1111** in fluid communication with second chamber **1112** (see **FIG. 11**).

[0099] Next at step **1702**, forming a water outlet unit including at least two connecting double chambers that collect a fixed volume of water from the inlet channels and overflow both excess water and clogging debris into the sewer using the connecting tank principle. In many aspects of the present invention, step **1702** is realized by inner core **210** inserted into double layer outer core **230** in first type shower drain **200**. Also, step **1702** is realized by inner core **910** inserted into double outer core **930** second type shower drain **800** described above. In first type shower drain **200**, the connecting double chambers are hollow space **233** including first chambers **601** in fluid communication with second chamber **602**. In second type shower drain **800**, connecting double chambers are inside hollow space **833** including first chambers **1111** in fluid communication at the bottom of second chamber. With the connecting double chambers, water and debris are forced to flow into second chambers **1112** and then to hollow space **1011**. Debris can not settle to the bottom of first chamber **1111** but are forced to flow into second chamber **1112** and then into hollow space **1011** to the sewer due to the forces of water. Please refer to **FIG. 7** and **FIG. 11** for more details.

[00100] At step **1703**, shower drain is made removable if there exists a clog. That is, first water inlet module is made removable from bottom water outlet unit. In rare occasions, if there is a puddle of water, remove either the inlet channels and/or the entire shower drain from the floor to clean out collected debris. In first type (surface drain) shower drain **200**, step **1703** is carried out by removing lid **300** and inner core **400** using

a hook. Alternatively the entire of shower drain **200** can be removed by using a plier gripping at rim **232** and applying a lifting force. In second type of shower drain **800**, step **1703** is carried out by unplugging inner panel **810** using a pair of thongs, exposing waste (if any) collected at the bottom of hollow space **833**. Alternatively, the entire shower drain **800** is removed to clean or repair by using a plier gripping at rims of first panel **810** and applying a lifting force.

[00101] At step **1704**, water level sensor circuitry is installed inside the shower drain made from steps **1701-1703** and an odor sensor and other sensors are installed a gateway module. In preferred embodiment of the present invention, water level sensor circuitry is realized by water level sensor system **1200** and gateway module **1300**. Odor sensor **1331** is combined inside gateway module **1300** that monitors and manages other sensors such as light sensor **1332**, and other sensors **1333**.

[00102] At step **1705**, water source controllers and gateway modules are installed. More specifically, water source controllers communicate with water level sensor level detector and gateway module **1300** so that the turn-on or turn off of water faucets **1434** can be readily controlled. Step **1705** is realized by solenoid valve water faucets available in the market. The solenoid receives command signals from gateway module **1300** or server **1540** to turn on or turn off faucets **1434**. In non-limiting examples, when the water level inside chamber **233** and chamber **833** are dry for a preset time period. That is metal probe **1103** is not contacted with water, water level sensor system **1200** sends out a signal to gateway module **1300** and then to server **1540** informing that the water level is low. Gateway module **1300** or server **1540** commands water source controller **1441** to release water **1434** until metal probe **1102** contacts with water. In occasions when the

owner forgets to turn off water faucets **1434** or when water tubes **1433** is broken causing a flood in bathroom **1413**, water level sensor system **1200** sends out signals informing the owner, concierge, managers about the situation. If the owner forgets to turn off one of the faucets **1426**, gateway module **1300** commands water source controller **1441** to turn off that particular faucet.

[00103] At step **1706**, servers are installed to communicate with sensors and gateway modules via a network. A server can be a desktop computer installed with sensor application module **1590** that includes water sensor algorithm **1591**, odor sensor algorithm **1592**, temperature sensor **1593**, light sensor algorithm **1594**, and other sensors such as video/cameras (not shown). An example of water level sensor algorithm **1591** is disclosed in **FIG. 18**. These algorithms can be Arduino codes, Linux, C++ programming languages. Water level information from water level sensor system **1200** is sent to gateway module **1300** via 433 MHz RF signals by antenna **1224**. Antenna **1224** is conveniently placed atop of lid **300** or floor brick **1111** as shown in **FIG. 7** and **FIG. 11**. Upon receiving the water level information, gateway module **1300** reports to server **1540** awaiting for instructions. Server **1540** communicates the water level situation to the owners via smartphones **1412** and/or central control rooms with display panels **1411**. After network connection, server **1540** may download various algorithms such as **1591-1593** to gateway modules **1300**. Afterward, gateway modules **1300** can manage water sources controllers **1441** and report the data to server **1540** to store them in data storage **1582** for future use.

[00104] In summary, the entire method **1700** is realized in practice by first type shower drain **200** and second type (edge drain) shower drain **800** with all features described above.

[00105] Finally, referring to **FIG. 18**, a method **1800** of using water level sensor in accordance with an exemplary aspect of the present invention is illustrated. Method **1800** can be used to control and ensure that shower drain **200** and **800** operate properly.

[00106] At step **1801**, a bath drain system is installed in bathrooms or shower rooms of a condominium project, a hotel, office building, smart home single houses, or anywhere that needs to drain off excess water. Step **1801** is realized by shower drain **700** and shower drain **1100** equipped with water level sensor system **1200** and antenna **1224**. Water level sensor system **1200** is described fully in **FIG. 12**.

[00107] At step **1802**, water level and/or flood are detected. Water level information is transmitted to gateway module **1300** located on bathroom wall **1121**.

[00108] AT step **1803**, whether the water level is low is determined. Step **1803** is realized by third metal probe **1103**. If water does not make contact with third metal probe **1103**, then the water level is low. Water level sensor system **1200** transmits this information to gateway module **1300**. Please see **FIG. 13**.

[00109] At step **1804**, if the water level is low, then communicating this information to gateway module **1300** or server **1540** which, in turn, informs the owner via smart phones **1412**. Either the owner decides to turn on the nearest water faucet **1426** or gateway module **1300** commands water source controllers **1441** to turn on the water.

[00110] At step **1805**, whether the water level is high is determined. Step **1804** is realized by first metal probe **1101**. If water makes contact with first metal probe **1101**,

then the water level is high. Water level sensor system **1200** transmits this information to gateway module **1300**. Please see **FIG. 13**.

[00111] Next, at step **1806** whether the high water level lasts for more than a preset time T_{min} . Step **1806** is realized by 555 timer **1322** in gateway module **1300**. T_{min} can be set by selecting the value of resistors and capacitors connected to trigger pin of 555 timer **1322**. The setup of 555 timer **1322** is well-known in the art and described in the data sheet and need not discussed in full here.

[00112] At step **1807** if the water level is high for more than preset time T_{min} , then communicating this information to gateway module **1300** or server **1540** which, in turn, informs the owner via smart phones **1412**. Either the owner decides to turn off water faucet **1426** or gateway module **1300** commands water source controllers **1441** to turn off the water.

[00113] In case the water level is high but not for the preset time T_{min} , then continuing to monitor the water level. If before T_{min} is reached, the water level reduces, then continue to step **1802**.

[000107] The corresponding structures, materials, acts, and equivalents of all means or step plus function elements in the claims below are intended to include any structure, material, or act for performing the function in combination with other claimed elements as specifically claimed. The description of the present invention has been presented for purposes of illustration and description, but is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art without departing from the scope and spirit of the invention. The embodiment was chosen and described in order to best explain the principles of the

invention and the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated.

[000108] The flow diagrams depicted herein are just one example. There may be many variations to this diagram or the steps (or operations) described therein without departing from the spirit of the invention. For instance, the steps may be performed in a differing order or steps may be added, deleted or modified. All of these variations are considered a part of the claimed invention.

[000109] While the preferred embodiment to the invention has been described, it will be understood that those skilled in the art, both now and in the future, may make various improvements and enhancements which fall within the scope of the claims which follow. These claims should be construed to maintain the proper protection for the invention first described.

[000110] The foregoing description details certain embodiments of the invention. It will be appreciated, however, that no matter how detailed the foregoing appears in text, the invention can be practiced in many ways. As is also stated above, it should be noted that the use of particular terminology when describing certain features or aspects of the invention should not be taken to imply that the terminology is being re-defined herein to be restricted to including any specific characteristics of the features or aspects of the invention with which that terminology is associated. The scope of the invention should, therefore, be construed in accordance with the appended claims and any equivalents thereof.

DESCRIPTION OF NUMERALS

[0001] 100	prior-art shower drain
[0002] 101	strainer
[0003] 102	lock nut
[0004] 103	trap body
[0005] 104	opening
[0006] 105	opening
[0007] 106	inner mesh filter
[0008] 111	water flow
[0009] 121	water outflowing direction
[00010] 200	first type shower drain (surface flow)
[00011] 220	panel
[00012] 221	lateral sides of panel with height T_1 and thickness D_1
[00013] 222	spacers
[00014] 223	bottom surface of panel
[00015] 230	double layer outer core
[00016] 231	outer layer having truncated cone shape
[00017] 232	inner layer having smaller truncated cone shape
[00018] 233	reservoir between outer layer and inner layer

[00019]	234	bottom side of reservoir
[00020]	240	tailpiece
[00021]	251	lock nut
[00022]	300	lid of various drainage patterns
[00023]	301	solid background
[00024]	302	opennings of lid
[00025]	300A	lotus pattern on lid
[00026]	301A	solid background of lotus flower pattern
[00027]	302A	openings of lotus flower pattern
[00028]	300B	crab pattern on lid
[00029]	301B	solid background of crab pattern
[00030]	302B	opennings of crab pattern
[00031]	303	threaded bolt
[00032]	400	first type bath (shower) drain
[00033]	405	hollow space of inner core
[00034]	406	connector thru hole
[00035]	410	inner core
[00036]	411	cylindrical section of inner core
[00037]	412	bottom side of cylindrical section inner core

[00038]	413	lateral side of truncated cone section inner core
[00039]	414	top surface (side) of radius R_1 of truncated cone section
[00040]	440	water inlet unit
[00041]	450	water outlet unit
[00042]	451	lock nut
[00043]	501	outlet to sewer
[00044]	600	Assembled first type shower drain
[00045]	601	first (outer) chamber inside reservoir
[00046]	602	second (inner) chamber inside reservoir
[00047]	700	first type shower drain system with sensors
[00048]	701	water level inside reservoir
[00049]	711	showerroom (bathroom) wall or ceiling.
[00050]	799	excess water
[00051]	800	second type (edge flow) shower drain
[00052]	810	inner (first) panel
[00053]	811	rim of inner panel
[00054]	812	bottom side of inner panel
[00055]	813	brick ejection holes of inner panel
[00056]	820	outer (second) panel

[00057]	821	rim of outer panel
[00058]	822	spacers
[00059]	823	reservoir mouth
[00060]	831	outer layer
[00061]	832	inner layer
[00062]	833	reservoir
[00063]	835	reservoir bottom
[00064]	830	double layer outer core
[00065]	840	tailpiece
[00066]	899	edge, or gutter, or ditch
[00067]	910	inner core
[00068]	911	lateral side of inner core with radius R_1
[00069]	912	supporting foot (foot)
[00070]	913	bottom side of inner core
[00071]	915	inner hollow space of inner core
[00072]	940	water inlet unit
[00073]	940	water outlet unit
[00074]	1011	outlet to sewer
[00075]	1100	second type shower drain system with sensors

[00076]	1101	high metal probe
[00077]	1102	medium metal probe
[00078]	1103	low metal probe
[00079]	1104	electrical wire
[00080]	1111	first (outer) chamber
[00081]	1112	second (inner) chamber
[00082]	1121	bathroom (shower) wall or ceiling
[00083]	1131	brick
[00084]	1141	equilibrium water level
[00085]	1199	running water
[00086]	1200	water level sensor system
[00087]	1201	water sensor IC
[00088]	1210	power supply circuit
[00089]	1211	battery (voltage supply source)
[00090]	1212	smoothing circuit
[00091]	1213	sleep mode circuit
[00092]	1221	encoder circuit
[00093]	1222	DIP switch circuit
[00094]	1223	transmitter circuit

[00095]	1224	transmitting antenna
[00096]	1231	electrical wire
[00097]	1300	gateway module
[00098]	1300-1	first gateway module
[00099]	1300-2	second gateway module
[000100]	1300-I	I th gateway module
[000101]	1300-J	J th gateway module
[000102]	1300-K	K th gateway module.
[000103]	1301	receiving antenna
[000104]	1302	receiver circuit
[000105]	1303	DIP switch
[000106]	1304	decoder
[000107]	1321	power supply circuit
[000108]	1322	timer
[000109]	1331	odor sensor (H ₂ S)
[000110]	1332	temperature sensor
[000111]	1333	other sensors
[000112]	1341	microcontroller circuit (MCU)
[000113]	1400	shower room (bath room) equipped with shower drain system

[000114]	1410	rooms having water pipe
[000115]	1411	kitchen
[000116]	1412	laundry room
[000117]	1413	bathroom
[000118]	1414	shower room
[000119]	1421	kitchen sinks
[000120]	1422	laundry machine
[000121]	1423	washbasin
[000122]	1424	toilet bowl
[000123]	1425	bathtub
[000124]	1426	faucets
[000125]	1433	watertubes
[000126]	1441	solenoid valve water controllers
[000127]	1442	communication link
[000128]	1451	display panels
[000129]	1452	smart phones
[000130]	1500	server network
[000131]	1510	network
[000132]	1511	microprocessor (CPU)

[000133]	1540	server
[000134]	1540-1	first server
[000135]	1540-2	second server
[000136]	1540-N	N th server
[000137]	1541-1	first smartphone
[000138]	1541-2	second smartphone
[000139]	1541-3	N th smartphone
[000140]	1542	power supply unit
[000141]	1543	ROM
[000142]	1544	I/O interface
[000143]	1545	network interface
[000144]	1546	audio interface
[000145]	1551	display
[000146]	1552	keyboard
[000147]	1553	pointing device (mouse)
[000148]	1554	speakers
[000149]	1570	data storage
[000150]	1571	operating system (OS)
[000151]	1572	BIOS

[000152]	1580	memory banks
[000153]	1581	Sensor operation codes
[000154]	1582	memory
[000155]	1590	sensor application module
[000156]	1591	water level sensor algorithm
[000157]	1592	odor sensor algorithm
[000158]	1583	temperature and humidity sensor algorithm
[000159]	1594	light sensor algorithm
[000160]	1595	other sensor algorithm (e.g., camera)
[000161]	1600	communication network
[000162]	1601	local communication channels
[000163]	1602	distant communication channels
[000164]	1621-1	first integration group (e.g., first tower)
[000165]	1621-2	second integration group (e.g., second tower)
[000166]	1621-M	M th integration group (e.g., M th tower)
[000167]	1651	network links (e.g., cloud, edge, fog, hybrid cloud)

CLAIMS

What is claimed is:

1. A shower drain for draining off excess water from a floor to a sewer, comprising:
a water inlet unit configured to receive said excess water;
a double layer water outlet unit, mechanically coupled to said water inlet module to form bottom connecting chambers that contain a body of water at a predetermined height operable to force said excess water beyond said predetermined height to overflow into said sewer; wherein said double layer water outlet module further comprises an inner layer concentric with an outer layer that are both open top and close bottoms that form a reservoir; and
a water level sensor system, mechanically installed inside said water inlet unit, operable to sense different water levels inside said reservoir.
2. The shower drain of claim 1, wherein said water inlet module further comprises a lid removably coupled to an inner core configured to mechanically insert between said inner layer and said outer layer to form said bottom connecting chambers.
3. The shower drain of claim 2, wherein said inner core is a truncated hollow cone and wherein said inner layer and said outer layer each is a truncated hollow cone.
4. The shower drain of claim 3, wherein said double layer water outlet unit further comprises:

an outer panel configured to support said lid; and
an outer core further comprising said bottom connecting chambers.

5. The shower drain of claim 4, wherein said outer panel is a first cuboid having an open topside and a solid bottom side.
6. The shower drain of claim 5, wherein said bottom side is inclined at an angle between 20° to 30° toward said double layer outer core.
7. The shower drain of claim 1, wherein said water inlet module further comprises an inner panel connected to an inner core configured to mechanically insert between said inner layer and said outer layer to form said bottom connecting chambers.
8. The shower drain of claim 7, wherein said inner panel is a second open top cuboid having a first width; and wherein said outer panel whose first cuboid having a second width that is larger than said first width.
9. The shower drain of claim 6, wherein said inner layer further comprises a first truncated inverted cone layer with a first diameter and wherein said outer layer further comprises a second truncated inverted cone with a second diameter that is greater than said first diameter; said first truncated inverted cone is concentric with said second truncated inverted cone so that a reservoir is formed there between.

10. The shower drain of claim 7, wherein said first truncated inverted cone has said predetermined height of said body of water.

11. The shower drain of claim 7, wherein said second truncated inverted cone has a second height that is greater than said predetermined height.

12. The shower drain of claim 1, wherein said water level sensor system further comprises:

(a) a water level sensor integrated circuit (IC) operable to sense water levels using a first metal probe, a second metal probe, and a third metal probe placed inside said outlet water unit;

(b) an encoder integrated circuit upon receipt of an output signal from said water level sensor IC assigning a first voltage value for a high water level, a second voltage value for a medium water level, and a third voltage value for a low water level;

(c) a transmitter integrated circuit (IC) operable to modulate said first voltage value, said second voltage value, or said third voltage value to a gateway module for transmission; and

(d) a transmitting antenna, placed on top of said lid, operable to transmit said first voltage value, said second voltage value, or said third voltage value to said gateway module.

13. The shower drain of claim 1, wherein said water level sensor system further comprises a power supply circuit operable to provide voltage supply to said water level

sensor IC, said encoder IC, and said transmitter IC; wherein said power supply circuit further comprises a battery, a smoothing circuit, and a sleep mode circuit.

14. The shower drain of claim 1, further comprising a gateway module placed outside of said shower drain for detecting odorous gases originating from said shower drain, a temperature sensor, a light sensor, and a camera.

15. The shower drain of claim 14, wherein said gateway module further comprises:

(a) a receiving antenna for receiving said first voltage value, said second voltage value, or said third voltage value;

(b) a receiver circuit operable to prepare said first voltage value, said second voltage value, or said third voltage value; and

(c) a decoder integrated circuit (IC) operable to translate said first voltage value to said high water level, said second voltage value to said medium water level, and said third voltage value to said lower water level.

16. The shower drain of claim 14, wherein said gateway module further comprises:

(a) a timer, upon receipt of said high water level, operable to count for a threshold time period;

(b) a microcontroller circuit (MCU) operable to determine whether said high water level surpasses said threshold time period; wherein if said high water level surpasses said threshold time period then (i) send an alarm signal to users, and/or (ii) turn off a water source using a solenoid valve controller; and wherein if said low water level occurs then

send said alarm signal to said users, and/or (ii) turn on said water source using said solenoid valve controller.

17. A method of fabricating a shower drain, comprising:

(a) forming a water inlet module configured to receive excess water;

(b) forming a double layer water outlet module; and

(c) inserting said water inlet module into said double layer water outlet module to form a reservoir in form of bottom connecting chambers having a predetermined height that force said excess water into a sewer;

(d) providing a water level sensing system inside said double layer water outlet module for sensing water levels inside said reservoir.

18. The method of claim 17 wherein said step (a) of forming a water inlet module further comprises: (e) providing a gateway module that includes a water level receiver integrated circuit, an odor sensor circuit, a temperature sensor circuit, and a camera; wherein said gateway circuit is positioned outside of said shower drain.

19. The method of claim 17 further comprising:

i) detecting a high water level, a medium water level, and a low water level inside said reservoir;

ii) if said high water level is maintained longer than a preset time period, then sending an alarm signal to users and turning off a water source using a solenoid valve water controller in communication with said gateway module; and

iii) if said low water level is achieved, then sending said alarm signal to said users and turning on said water source using said solenoid valve water controller in communication with said gateway module.

20. The method of claim 17 further comprising:

(f) detecting a hydrogen sulfide gas from said shower drain; if said hydrogen sulfide gas is detected then sending said alarm signal to said users and turning on said water source using said solenoid valve water controller in communication with said gateway module.