

SYSTEM AND METHOD FOR OPERATING A FAUCET

Field of Invention

The present invention relates to a system and method for operating a faucet. In particular, this system and method is suitable for, but not limited to, operating a faucet for dispensing water.

Background Art

The following discussion of the background to the invention is intended to facilitate an understanding of the present invention only. It should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was published, known or part of the common general knowledge of the person skilled in the art in any jurisdiction as at the priority date of the invention.

A conventional hydropower automatic water faucet system 100 as shown in Fig. 1 comprises various components such as a water supply 114, a hydropower generator 112, a rechargeable battery 108, a sensor 104, a processor 106, a solenoid valve 110 and a water faucet 102. The conventional hydropower automatic water faucet system 100 operates on electrical power generated from the hydropower generator 112 when water flows through the system. The kinetic energy from the water flow is converted to electrical energy by the hydropower generator 112 and stored in a rechargeable battery 108. The energy stored in the rechargeable battery 108 is then used to power the sensor 104 and operate the solenoid valve 110. When the sensor 104 detects the presence of an object, it is operable to send a signal to the processor 106. The processor 106 then processes the input signal and further transmits an electrical pulse or signal to switch the solenoid valve 110 from a closed state to an open state. When the solenoid valve 110 is switched open, water will flow through the hydropower generator 112 to the water faucet 102 and charges up the rechargeable battery 108.

As the system 100 has a renewable means of generating power through the hydropower generator, cost is reduced and energy is conserved. However, there are various shortcomings to this system. If the usage of the automatic water faucet is less frequent, for example in a hospital emergency ward, the rechargeable battery 108 may not be charged up frequently due to little water flows through the hydropower

generator 112. Eventually, the energy stored within the rechargeable battery 108 may be drained away and the automatic water faucet system 100 will stop operating without any warning.

Further, an inherent disadvantage of the rechargeable battery 108 is that its life span deteriorates with every charge-discharge cycle. As time progresses, the rechargeable battery 108 will reach a state where it loses its ability to store any energy and hence fail. Consequently, the automatic water faucet system 100 will stop operating without any warning as mentioned in the preceding paragraph. In places where the operation of water faucet is crucial, example hospital, downtime of the water faucet is not acceptable. Hence, a more robust system is required to ensure reliable operation of the automatic water faucet system 100.

Therefore, there exists a need for a better solution to ameliorate the aforementioned problems.

Summary of the Invention

This invention seeks to provide a system and method for operating a faucet. In particular, this system and method is suitable for, but not limited to, operating a faucet for dispensing water.

The invention seeks to at least provide a backup power supply and alert mechanism.

In accordance with a first aspect of the invention there is a water faucet system comprising a sensor for detecting an object, a processor arranged in communication with the sensor and a solenoid valve to switch the solenoid valve from a first state to a second state when the object is detected to allow flow of water through a water faucet, the sensor and solenoid valve arranged to be powered by a primary power source, a secondary power source arranged in communication with the processor, wherein the processor is configured to monitor a first parameter of the primary power source and switches to the secondary power source for powering the sensor and solenoid valve when the first parameter of the primary power source reaches a pre-determined threshold. Advantageously, switching to the secondary power source provides a backup power source to the primary power source to allow continuous operation of the water faucet system when the primary power source is depleted. Further, the backup supply allows the secondary power source to sustain the power

demand of the water faucet system until the primary power source is recharged or when the primary power source is replaced. Notably, while the water faucet system of the present invention may integrate with the backup power supply (i.e., the secondary power source) and a warning system (i.e., the processor is operable to monitor whether the parameter of the primary power source reaches a pre-determined threshold), the form factor of the water faucet system is not compromised as in some embodiments the backup power supply (e.g., including a battery pack and adapter) can be modularized so that the backup power supply does not have to be placed together with the solenoid valve, for example underneath the basin. The backup power supply can be placed somewhere else, such as the ceiling near the power socket, to adapt to any space or spatial constraints.

In some embodiments, the water faucet system further comprises a voltage comparator arranged in communication with the processor to compare a voltage of the primary power source as first parameter with a voltage reference as the pre-determined threshold. In some embodiments, the water faucet system further comprises a hydropower generator for charging the primary power. Advantageously, energy is conserved as kinetic energy from the flow of water may be converted to electrical energy for powering the sensor and the solenoid valve. Further, the hydropower generator allows the primary power source to be recharged when the secondary power source is sustaining the power demand of the water faucet system.

In some embodiments, the processor is further operable to monitor a second parameter of the primary power source, wherein an alert is triggered when the second parameter of the primary power source reaches a second pre-determined threshold.

In some embodiments, the second parameter is a number of charge and discharge cycle of the primary power source.

In some embodiments, the alert is triggered when the sensor detects the presence of an object.

In some embodiments, the processor is operable to switch from the primary power source to a secondary power source when the second pre-determined threshold is reached.

In some embodiments, the secondary power source is modularized.

In some embodiments, the sensor is an infra-red sensor.

In accordance with a second aspect of the invention there is a method for operating a water faucet to dispense water, comprising the steps of: monitoring a parameter of a primary power source, wherein the primary power source is used for supplying power to a solenoid valve and a sensor for controlling water flow to a water faucet, and switching from the primary power source to a secondary power source when the parameter of the primary power source reaches a pre-determined threshold. Advantageously, switching to the secondary power source enables continuous operation of the water faucet when the primary power source is depleted. Further, the backup power source may sustain the power demand of the water faucet system until the primary power source is recharged or replaced.

In some embodiments, the method for operating the water faucet further comprises the step of using a voltage comparator to compare a voltage of the primary power source as first parameter with a voltage reference as the pre-determined threshold before switching from the primary power source to a secondary power source.

In some embodiments, the method for operating the water faucet further comprises the step of monitoring a second parameter of the primary power source, wherein an alert is triggered when the second parameter of the primary power source reaches a second pre-determined threshold. Advantageously, the alert would prompt the operator to replace the primary power source when it loses ability to be recharged.

In some embodiments, the second parameter is a number of charge and discharge cycle of the primary power source.

In some embodiments, the alert is triggered when the sensor detects the presence of an object. Advantageously, the alert mechanism is more energy efficient as it is selectively triggered only when the operator is detected to be in the vicinity.

In some embodiments, the processor is further operable to switch from the primary power source to a secondary power source when the second pre-determined threshold is reached.

In some embodiments, the secondary power source is modularized.

In some embodiments, the sensor is an infra-red sensor.

Other aspects of the invention will become apparent to those of ordinary skilled in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

Brief Description of the Drawings

- 5 The present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 shows a water faucet system that is hydropowered.

Fig. 2 shows a water faucet system that is hydropowered further comprising a backup power supply and an alert mechanism for monitoring the lifecycle of a rechargeable
10 battery storing energy from the hydropower generator.

Description of Embodiments of the Invention

- Throughout the specification, unless the context requires otherwise, the word “comprise” or variations such as “comprises” or “comprising, will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any
15 other integer or group of integers.

Furthermore, throughout the specification, unless the context requires otherwise, the word “include” or variations such as “includes” or “including” will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

- 20 In accordance with various embodiments of the invention as shown in Fig. 2, there is a water faucet system 200 for controlling the flow of water through a water faucet 202 from a water source 204. The water faucet 202 is connected to the water source or supply 204 through a fluid conduit, such as a water pipe 206. A solenoid valve 208 is positioned or located along a portion of the water pipe 206 to control the flow of water
25 through the water pipe 206 to the water faucet 202. The solenoid valve 208 may operate in or between at least two states: an open state (or first state) and a closed state (or second state), wherein the open state allows flow of water from the water source 204 through water faucet 202 and the closed state stops the water flow through the water faucet 202. In various embodiments, the command to effect or change the
30 state of the solenoid valve 208 may be switched through a control signal or electrical

pulse that is transmitted from a processor 210. In various embodiments, the open state of the solenoid valve 208 may be adjusted to increase or decrease the flow rate of water. In other words, the 'degree of openness' of the open state may be implemented. This may be realized in embodiments incorporating a plurality of open states, each of the plurality of open states corresponding to a particular flow rate of water. In various
5 embodiments, the solenoid valve 208 may also be electrically connected to the processor 210 such that the solenoid valve 208 receives electrical power from the processor 210.

In various embodiments, the processor 210 may be operable to receive and process
10 an input signal from a sensor 212 before transmitting the control signal to the solenoid valve 208 for switching the state of the solenoid valve 110. In various embodiments, the sensor 212 may also be electrically connected to the processor 210 such that the sensor 212 receives electrical power from the processor 210. The sensor 212 may be an infra-red (IR) sensor operable to detect the presence of an object that is emitting
15 IR radiation such as a hand 213 of a person who uses the water faucet 202. The processor 210 may be programmed such that the detection of IR radiation through the sensor 212 would trigger the solenoid valve 208 to switch from the closed state to the open state, allowing water to flow through the water faucet 202 for washing the hand 213. When the hand is moved away from the water faucet 202, the level of IR radiation
20 that is detected by the sensor 212 falls below a threshold value (or a floor parameter) and the processor 210 correspondingly switches the solenoid valve 208 to the closed state to stop the water flow through the water faucet 202.

In various embodiments, the processor 210 may be powered by a rechargeable battery 214. The rechargeable battery 214 may be charged by a hydropower generator
25 216 that is located along the water pipe 206. When the solenoid valve 208 switches to the open state and water flows through the water pipe 206, the hydropower generator 216 generates power that is subsequently stored in the rechargeable battery 214.

In various embodiments, the processor 210 may be operable to compare an electrical voltage (or a first parameter) of the rechargeable battery 214 that is indicative of the
30 amount of energy stored in the rechargeable battery 214 with a first pre-determined threshold value (or a first floor parameter) using a voltage comparator 218. In various embodiments, the voltage comparator 218 may be an op-amp voltage comparator and

the first pre-determined threshold may be in the form of a voltage reference V_{ref} . If the voltage of the rechargeable battery 214 is determined to be lower than the first pre-determined threshold value or first floor parameter (i.e. the voltage reference V_{ref}), the processor 210 may instead draw power from a backup or secondary power source 220. In various embodiments, the backup or secondary power source 220 may be either a DC source (e.g. conventional battery) or AC source.

In various embodiments, the backup power supply (e.g., which may include a battery pack and/or adapter) may be modularized so that it does not have to be placed together with the solenoid valve, for example underneath a basin. The backup power supply may be placed somewhere else, such as the ceiling near the power socket, to adapt to any space or spatial constraints.

In various embodiments, the backup power source 220 will sustain the power demand of the processor 210, including the power demand of the sensor 212 and solenoid valve 208, until the rechargeable battery 214 is recharged after a few cycles of water flowing through the hydropower generator and the electrical voltage of the rechargeable battery 214 increases above the first pre-determined threshold or first floor parameter.

In various embodiments, the rechargeable battery 214 may have a limited number of charge-discharge cycles before its storage performance deteriorates such that it is unable to store sufficient energy for powering the processor 210. As such, the processor 210 may be operable to keep track of the number of charge-discharge cycles (or second parameter) of the rechargeable battery 214. Following which, the process may compare the number of charge-discharge cycles to a second pre-determined value or a second ceiling parameter and transmits an electrical signal to an alert mechanism 222 when the number of charge-discharge cycles has reached the second pre-determined value or the second ceiling parameter in order to output a warning signal (sound or light). In various embodiments, the processor 210 may be operable to keep track of the number of cycles of the water flowing through the water faucet system 200 (or third parameter). If the number of cycles of the water flowing is above a third pre-determined value or a third ceiling parameter, the processor 210 transmit a signal to the alert mechanism 222 in order to output a warning signal (sound or light). Advantageously, the alert mechanism 222 alerts the operator that the lifespan

of the rechargeable battery 214 has ended and should be replaced. In various embodiments, once the lifespan of the rechargeable battery 214 ends or the warning signal is sent, the backup power source 220 is activated to sustain the power demand of the processor 210, including the power demand of the sensor 212 and solenoid valve 208, until the rechargeable battery 214 is replaced.

The present invention will now be described in greater technical detail relating to the operation of the water faucet system 200. In various embodiments of the invention, there is a method for powering the water faucet system 200 using a primary power source and secondary power source. The primary source may correspond to the rechargeable battery 214 in Fig. 2 and the secondary source may correspond to the backup power supply 220 in Fig. 2. During operation of the water faucet system 200, the processor 210 may be programmed to monitor an electrical voltage (or a first parameter) of the rechargeable battery 214 (primary power source) at pre-determined intervals and compare it to the first pre-determined threshold value or first floor parameter using the voltage comparator 218. When the voltage of the rechargeable battery 214 is determined to be lower than the first pre-determined threshold value or first floor parameter, the processor 210 switches to draw power from the backup or secondary power source 220. Consequently, the sensor 212 and the solenoid valve 208 which are electrically connected to the processor 210 will be powered by the backup or secondary power source 220. When the electrical voltage of the rechargeable battery 214 is recovered or increased above the first pre-determined threshold value or the first floor parameter through at least one charging cycle by the hydropower generator 216 when water flows through the water pipe 206, the processor 210 may be programmed to switch back to drawing power from the rechargeable battery 214.

In various embodiments of the invention, there is a method for triggering an alert when the lifespan of the primary power source has deteriorated. The processor 210 may be programmed with a counter for monitoring a number of charge and discharge cycles (or a second parameter) of the rechargeable battery 214. When the number of charge-discharge cycles reaches the second pre-determined threshold value or the second ceiling parameter, the processor 210 may transmit an electrical signal to the alert mechanism 222. In various embodiments, the alert mechanism 222 may be in the form of LEDs. For example, the illumination of the red LED may indicate an alert that the

lifespan of the rechargeable battery 214 has deteriorated and require replacement. In various embodiments, the processor 210 may switch the power input to draw power from the backup or secondary power source 220.

Even though the rechargeable battery lifespan has ended, the alert mechanism may
5 continue to operate by receiving electrical energy from the backup power supply 220. In various embodiments, the electrical signal to the alert mechanism 222 may be transmitted when the sensor 212 detects the presence of the object or hand 213. Advantageously, the alert mechanism is more energy efficient as it is selectively triggered only when the operator is detected to be in the vicinity.

10 It should be further appreciated by the person skilled in the art that variations and combinations of features described above, not being alternatives or substitutes, may be combined to form yet further embodiments falling within the intended scope of the invention. In particular,

- 15 • The sensor 212 may be either an active motion sensor or a passive motion sensor. Examples of active motion sensors are: ultrasonic sensor, microwave sensor and tomographic sensor. One example of passive motion sensor is a passive infrared sensor.
- The rechargeable battery 108 may be any one of the following: Nickel Cadmium (NiCd) battery, Nickel-Metal Hydride (NiMH) battery, Lead Acid battery, Lithium
20 Ion battery and Lithium Polymer battery.
- The alert mechanism 222 may not be limited to only visual alert. The alert mechanism 222 may also be a speaker which emits a characteristic sound when the alert is triggered.
- In various embodiments, a capacitor may be in-build to the circuitry. When the
25 backup power supply 220 lifespan has ended, the stored energy in the capacitor will supply energy to alert mechanism to sound out (beep twice) or light up (blink twice) when the sensor detects the object presence (someone using the faucet).

Claims

1. A water faucet system comprising:

a sensor for detecting an object;

a processor arranged in communication with the sensor and a solenoid valve
to switch the solenoid valve from a first state to a second state when the object
is detected to allow flow of water through a water faucet;

the sensor and solenoid valve arranged to be powered by a primary power
source;

a secondary power source arranged in communication with the processor;

wherein the processor is configured to monitor a first parameter of the primary
power source and switches to the secondary power source for powering the sensor
and solenoid valve when the first parameter of the primary power source reaches a
pre-determined threshold.

2. The water faucet system of claim 1, further comprises a voltage comparator
arranged in communication with the processor to compare a voltage of the primary
power source as first parameter with a voltage reference as the pre-determined
threshold.

3. The water faucet system of claim 1, further comprising a hydropower generator for
charging the primary power when water flows through the water faucet.

4. The water faucet system of any one of claims 1 to 3, wherein the processor is further
operable to monitor a second parameter of the primary power source, wherein an alert
is triggered when the second parameter of the primary power source reaches a second
pre-determined threshold.

5. The water faucet system of claim 4, wherein the second parameter is a
predetermined number of charge and discharge cycle of the primary power source.

6. The water faucet system of any one of claims 4 or 5, wherein the alert is triggered
when the sensor detects the presence of an object.

7. The water faucet system of any one of claims 4 to 6, wherein the processor is operable to switch from the primary power source to the secondary power source when the second pre-determined threshold is reached.

5 8. The water faucet system of any one of claims 1 to 7, wherein the secondary power source is modularized.

9. The water faucet system of any one of claims 1 to 8, wherein the sensor is an infrared sensor.

10

10. A method for operating a water faucet to dispense water, comprising the steps of: monitoring a parameter of a primary power source, wherein the primary power source is used for supplying power to a solenoid valve and a sensor for controlling water flow to a water faucet; and

15 switching from the rechargeable primary power source to a secondary power source when the parameter of the rechargeable primary power source reaches a pre-determined threshold.

20 11. The method of claim 10, further comprising the step of using a voltage comparator to compare a voltage of the primary power source as first parameter with a voltage reference as the pre-determined threshold before switching from the rechargeable primary power source to a secondary power source.

25 12. The method of any one of claims 10 or 11, further comprising the step of: monitoring a second parameter of the primary power source, wherein an alert is triggered when the second parameter of the primary power source reaches a second pre-determined threshold.

30 13. The method of claim 12, wherein the second parameter is a number of charge and discharge cycle of the rechargeable primary power source.

14. The method of any one of claims 12 or 13, wherein the alert is triggered when the sensor detects the presence of an object.

15. The method of any one of claims 12 to 14, further comprising the step of switching from the primary power source to a secondary power source when the second pre-determined threshold is reached.

5 16. The method of any one of claims 10 to 15, wherein the secondary power source is modularized.

17. The method of any one of claims 10 to 16, wherein the sensor is an infra-red sensor.

10