

Programmable Rotary Actuators

Field of Invention

[001] The present invention relates to programmable rotary actuators. These rotary actuators are useful for turning knobs to turn off/on gas or electric supply to stoves or for turning handles to unlock doors, in particular, to enhance home safety for senior citizens.

Background

[002] In USA, it was reported that more than one third of reported home fires were caused by unattended cooking; in Singapore, unattended cooking is the second highest cause of residential fires. Such unattended cooking may be the result of distractions, forgetfulness, or inadvertently falling asleep. A similar problem arises in a home of an elder person who may need urgent attention, and unlocking an entrance door may be a first step a caregiver needs.

[003] It can thus be seen that there exists a need for a new programmable actuator to turn off/on a stove or to turn a handle to unlock an entrance door. In addition, the programmable actuator is preferred to contain some communication capability to provide a reminder or an alert to the user, and so on, or remotely to another person/caregiver.

Summary

[004] The following presents a simplified summary to provide a basic understanding of the present invention. This summary is not an extensive overview of the present invention, and is not intended to identify key features of the present invention. Rather, it is to present some of the inventive concepts of this invention in a generalised form as a prelude to the detailed description that is to follow.

[005] The present invention seeks to provide programmable rotary actuators for turning knobs to turn on or off stoves. These rotary actuators can also be configured to turn door knobs or handles to unlock entrances to homes of senior/disabled citizens who may need external help. Preferably, these rotary actuators have two-way communication functions to

allow them to perform smart or intelligent tasks (including home automation), fall detection or safety monitoring.

[006] In one embodiment, the present invention provides various embodiments of programmable rotary actuators for cooking stove, door handle, or adjustment knob on some home appliances. In one embodiment, the programmable rotary actuator comprises: an adjustable gripper, which comprises a pair of clamping members being spaced apart to fit onto a knob of a stove or a handle/knob of a door; a drive stem connects the adjustable gripper to a gear-motor assembly, wherein controlled operation of the associated motor actuates the adjustable gripper; a hollow housing for supporting the gear-motor assembly and related controls, wherein two opposite sidewalls of the hollow housing has an open slot on each sidewall through which the adjustable gripper can be manipulated by a user's finger and thumb for clamping onto the knob or handle; a setting knob connected to the end of the drive stem opposite the adjustable gripper; and a control panel with a monitor screen and some operation buttons for program setting or adjusting the gear-motor controls.

[007] In another embodiment, the programmable rotary actuator comprises a conical joint disposed coaxially with the drive stem, so that the drive stem is dis-connectable from the gear-motor assembly when a force is pushing on the setting knob during setting of the programmable rotary actuator and when the force is released, the conical joint springs back and connects the drive stem to the gear-motor assembly, and controlled operation of the gear-motor assembly operates on the drive stem and connectively actuates the adjustable gripper.

[008] In yet another embodiment, the programmable rotary actuator in a kit comprises: an adjustable gripper assembly, which comprises a pair of clamping members being spaced apart to fit onto a knob of a stove or a handle of a deadbolt on a door; a drive stem for connecting the adjustable gripper to a gear-motor assembly, wherein controlled operation of the gear-motor assembly actuates the adjustable gripper; a hollow housing for supporting the gear-motor assembly and related controls, wherein two opposite sidewalls of the hollow housing has an open slot on each sidewall through which the adjustable gripper can be manipulated by a user's finger and thumb for clamping onto the knob or handle; a setting knob for connection to an end of the drive stem opposite the adjustable gripper; a control panel with a monitor screen and some operation buttons for program

setting or adjusting the gear-motor assembly and related controls; and a battery for powering the gear-motor assembly and related controls.

[0009] Preferably, the programmable rotary actuator comprises a motion sensor and a wireless communicator. The motion sensor and wireless communicator allow fall detection or safety monitor; thus, these enhance home safety and smart/intelligent home automation.

Brief Description of the Drawings

[0010] This invention will be described by way of non-limiting embodiments of the present invention, with reference to the accompanying drawings, in which:

[0011] FIG. 1A illustrates a programmable rotary actuator according to an embodiment of the present invention; FIG. 1B illustrates an exploded view of the rotary actuator shown in FIG. 1A, whilst FIG. 1C illustrates a rear view of the rotary actuating mechanism shown in FIG. 1B;

[0012] FIGs. 2A-2C illustrate programmable rotary actuators according to variations of the actuator shown in FIGs. 1A-1C; FIG. 2D illustrates a rotary actuator with an adjustable drive stem according to another variation; and FIG. 2E illustrates a rotary actuator with a drive stem adapted to connect with a spindle of a stove knob;

[0013] FIGs. 3A-3G illustrate a programmable rotary actuator according to another embodiment of the present invention; and

[0014] FIG. 4 illustrates a programmable rotary actuator for turning a handle of a deadbolt according to yet another embodiment of the present invention.

Detailed Description

[0015] One or more specific and alternative embodiments of the present invention will now be described with reference to the attached drawings. It shall be apparent to one skilled in the art, however, that this invention may be practised without such specific details. Some of the details may not be described at length so as not to obscure the invention. For ease of reference, common reference numerals or series of numerals will be used throughout the figures when referring to the same or similar features common to the figures.

[0016] FIG. 1A shows a programmable rotary actuator 100 for turning a knob 10 on a stove or a handle 14 on a door. FIG. 1B shows an exploded view of some components configured inside the programmable rotary actuator 100, whilst FIG. 1C shows a rear view. The knob 10 may be that of a gas or electric stove 12, and the handle 14 may be that of a door knob or a handle of a deadbolt on a door 16. As seen from FIGs. 1A and 1B, the programmable rotary actuator 100 has a hollow housing 110. A front or top face 112 of the housing 110 has a setting knob 120 and an electronic panel 170; the rear or bottom face 113 of the housing 110 is open, whilst two opposite side faces 114 have an open slot 116 on each side face. An adjustable gripper 130 for attaching the programmable rotary actuator 100 onto the knob 10 or handle 14 is operable by a user's finger and thumb manipulating the adjustable gripper 130 through the pair of open slots 116. In use, the electronic panel 170 allows the user to program the rotary actuator 100 for application on the knob 10 and/or handle 14 or others applications. The use of the programmable rotary actuator will become clearer with the following description.

[0017] Referring to FIG.1B, the adjustable gripper 130 is made up of two T-shaped members 131 being arranged to slide cooperatively so that the two T-shaped members form a pair of clamping members 132. The pair of clamping members 132 are kept in a closed position (ie, retracted) by a tension spring 134. Preferably, a non-slip pad 133 is disposed on an inside surface of each of the clamping member 132, so that the two cooperating non-slip pads 133 allow the user to apply the pair of clamping members onto the knob 10 without slipping. The non-slip pad 133 may have a step collar so that the gripper 130 can be located concentrically with the knob 10. The non-slip pad 133 may be made of rubber (such as synthetic rubber), polymer or a heat resistant material, which may be adhesively attached onto the clamping member 132 or snapped on into a groove. In other embodiments, the clamping members 132 may be arcuate and matches substantially with the cylindrical edge of the knob 10; if no non-slip pad 133 is used, the inside faces of the clamping members 132 may be ribbed or knurled to provide positive engagement with ribbed or knurled edges typically formed around the knob 12.

[0018] Also as seen from FIG. 1B, a drive stem 140 extends from the adjustable gripper 130. A driven gear 145 is located near a distal end of the drive stem 140. Preferably, the driven gear 145 is connected to the drive stem 140 by a conical joint 146, which is located

between the centres of the driven gear 145 and drive stem 140, with the smaller end of the conical joint being orientated towards the setting knob 120. The conical joint 146 thus allows the user to push the setting knob 120 to depress the knob 10 to turn ON the stove 12, after which, the spring inside the knob 10 would reset the drive stem 140 to its non-activated/home position; in a variation, the interfacing surfaces of the conical joint 146 may be splined for more positive engagement. The length of the drive stem 140 depends substantively on a depth of the housing 110 and arrangement of the driven gear 145 meshing with a drive gear 147. Depending on the desired gear ratio or rotational direction of the gripper 130, an idler gear 149 may be disposed between the drive and driven gears. As seen more clearly from FIG. 1C, the drive gear 147 is mounted on a shaft of a motor 150. Preferably, the motor 150 is mounted on a circuit board 155. The circuit board 155 is connected to the electronic panel 170, with the electronic panel including a monitor screen 172 and some up-down and select buttons 174, 176. In other embodiments, the circuit board 155 includes other switches, connectors, timing circuit, encoder, wireless communicator, motion sensing circuit, etc. to allow for calibration, parameter settings, trouble shooting, setting of alerts or warning to a user's mobile device 20, setting of alert notification to an external caregiver, and so on. Preferably, two motion sensors 180 are provided and they are located so that their detection beams are directed at different directions; in use, only one of the motion sensors need to be active. For eg., when the motion sensor 180 detects that no person is around or near the stove, and the cooking time has elapsed, the wireless communicator sends an alert message to the user's mobile device 20 and/or mobile device 30 of a caregiver; depending on the application program, the motor 150 turns the knob 10 to cut off gas/electric supply to the stove 12 after a set time has elapsed.

[0019] In FIG. 1B, a part of the stove 12 is shown. When the programmable rotary actuator 100 is mounted onto the knob 10, a part of the housing 110 comes into contact with or near to an exterior of the stove 12. Preferably, the housing 110 is connected to the exterior of the stove by a detachable connector 190, which provides a resisting torque during operation of the motor 150. Preferably, the detachable connector 190 may be a tacky tape, an adhesive tape, Velcro, suction cup, or similar removeable means. In addition, the detachable connector 190 provides mounting stability of the rotary actuator 100 onto the stove. When the detachable connector 190 is not used, it is possible to locate weights 195 at a lower part of the housing 110, so that the weights provide the necessary resisting or stabilising torque when the motor 150 operates.

[0020] FIGs. 2A-2C show three programmable rotary actuators 100a according to variations of the above embodiment. As shown in FIGs. 2A-2C, the housing 110 is similar to the above embodiment except that a flexible member 118, 118a or extension member 118b extends from a lower part of the housing 110. Preferably, batteries 105 are located inside the flexible member 118, 118a; with the flexible member 118, 118a, the batteries are located away from the source of heat at the stove; for eg., the flexible member 118, 118a allows the batteries 105 to droop or bent over a front, side or distal edge of the stove 12, thus keeping the batteries 105 away from the heat source. Similarly, with the extension member 118b, the batteries 105 are located in a box, with the box being disposed over an edge of the stove 12. When the flexible member 118 or extension member 118b is able to droop or bend over the front, side or distal edge of the stove 12, the detachable connector 190 may become redundant.

[0021] The above programmable rotary actuator 100, 100a is suitable to be programmed to turn the knob 10 or handle 14, for eg., to adjust the heat/flame of a stove 12 or to turn OFF the electric or gas supply in a semi-automatic mode of operation. For safety consideration, to turn a knob 10 to an ON position to supply electricity/gas, the knob 10 has to be depressed before turning. FIG. 2D shows another embodiment of the programmable rotary actuator 100b in which part of the drive stem 140b employs a threaded sleeve 141 connected concentrically to an electric brake/clutch 142; this embodiment provides for a fully-automatic mode of operation. A portion of the drive stem 140b that engages with the threaded sleeve 141 is matchingly threaded, so that by turning the motor 150, the length of the drive stem 140b becomes adjustable. Thus, by activating the electric brake/clutch 142, the length of the drive stem 140b can be adjusted without turning the gripper 130; in this way, turning the drive stem 140b provides a depressing force on the knob 10; after a desired length of the drive stem 140b is reached, the electric brake/clutch 142 is deactivated and the motor 150 can then turn the knob 10 accordingly to adjust the electric or gas supply to the stove 12, as programmed by the user. The conical joint 146, threaded drive stem 140b/ threaded sleeve 141 and electric brake/clutch 142 are also useful during initial settings and adjustments of the rotary actuator 100b when configuring its use on a stove 12.

[0022] FIG. 2E shows a drive stem 140c of the above rotary actuator, which is used with the knob 10 removed from the stove 12. The drive stem 140c terminates, for eg., with a connector 130a having a slot (instead of a gripper 130) for engagement with a spindle 11 of the knob 10. In this embodiment, the open slot 116 on the housing 110 becomes useful as a view or inspection port or window when engaging the connector 130a with the knob spindle 11.

[0023] FIG. 3A shows a programmable rotary actuator 200 for a stove according to another embodiment. As shown in FIGs. 3A and 3B, the rotary actuator 200 is made up of a control box 210 that houses at least a drive gear 248, associated motor 250, circuit board 255, motion sensor 180, control mechanisms and gear train 247, and a matching ring gear 248a. Part of the drive gear 248 extends out of the control box 210 and is engageable with the ring gear 248a. Configured inside the ring gear 248a is an adjustable gripper assembly 230; the adjustable gripper assembly 230 has two clamping members 232L, 232R, which are additionally held in a grip position by two springs S2 (S2 are not shown in the figures but holes 234b for locating S2 are shown in FIGs. 3F and 3G); the gripper assembly 230 is actuated to open by a finger and a thumb pressing on a pair of buttons 236L, 236R. These pair of buttons 236L, 236R are held in place by a stirrup member 242 formed on a top portion of the inverted cup. After setting of the rotary actuator 200, the pair of buttons can be locked or protected by a locking cap 238, with locking cap 238 being snapped over the stirrup member 242 and two web members 239 formed inside the locking cap 238 prevent movements of the pair of buttons 236L, 236R. Construction of the ring gear 248a is more clearly shown in FIGs. 3C-3F, with a sectional view being shown in FIG. 3G.

[0024] As seen from FIG. 3A, the ring gear 248a is mounted over a knob 10 on a stove 12 with the aid of the gripper 230. In one embodiment, the control box 210 is mounted to slide on a guide 219 with some quick release buttons (which are not shown). The slide guide 219 is mounted on a part of the stove 12 near the knob 10 and the position is set so that in use the drive gear 248 meshes with the ring gear 248a; to disconnect the drive gear 248 from the ring gear 248a, the quick release buttons located near the base of the control box are depressed and the entire control box 210 can be slide out (to the left as seen in FIG. 3A).

[0025] In another embodiment of the programmable rotary actuator 200, a thickness of meshing of the drive gear 248 and the ring gear 248a is selected so that to disconnect the gear meshing, the entire ring gear, gripper assembly 230 and knob 10 are depressed in

direction V as shown by an arrow in FIG. 3A and disengages with the drive gear 248; once the depressing force is released, the knob 10 springs back with the ring gear 248a meshing again with the drive gear 248.

[0026] An advantage of the above two embodiments is that the thickness T of the ring gear 248a is provided to accommodate to different heights of the knob 10, so that the ring gear 248a and gripper assembly are usable on most stoves; thus, utility of the rotary actuator 200 becomes more universal.

[0027] FIG. 3F shows an exploded view of the gripper 230. Slide motion of each of the button 236L, 236R is guided by a groove 237a and a mating projection formed on a top face of an inverted cup which substantially form the ring gear 248a on the cylindrical wall. Two compression springs S1 (not shown) are located between the buttons 236L, 236R, for eg., by locating holes 234a; these springs S1 return the buttons 236L, 236R to the respective home positions after a pair of pressing forces acting on the buttons are released; these springs also provide tactile feel on the buttons. A lower portion of each button 236L, 236R is connected to a respective slide bar 231L, 231R; a distal end of each of the slide bar is connected to a respective clamping member 232L, 232R. These slide bars 231L, 231R are guided to slide by a centre guide bar 235. As seen in FIG. 3F, part of the lower portion of each of the button that is away from the associated slide bar 231L, 231R has a notch 237; the notches 237 are provided for clearance with heads of screws used in connecting the opposite slide bars to the respective buttons. In use, when a pair of depressing forces act on the button 236L, 236R, the buttons are moved inward to each other and the respective slide bars 231L, 231R push the clamping members 232L, 232R to open. When the pair of depressing forces are released, the springs S1 return the buttons to their home positions, thereby allowing the clamping members 232L, 232R to close and to grip onto the knob 10. To assist the clamping members 232L, 232R to additionally grip onto the knob 10, springs S2 are located between the associated clamping member 232L, 232R and an inside cylindrical wall of the ring gear. The springs S2 are not shown in the figures, but the locating holes 234b for the springs are shown in FIGs. 3F and 3G.

[0028] FIG. 4 shows a use of the above programmable rotary actuator 300 for turning a handle/knob 14 of a deadbolt on a door 16, albeit shown without the hollow housing 110. In this embodiment, the programmable rotary actuator 300 uses the flexible member 118. Flexibility of the member 118 allows the rotary actuator to work within a range of

distances between the rotary actuator and a surface of the door, without having to reconfigure the length of the drive stem 140 with every change in application on different doors; this allows a rotary actuator 300 to be configured for two or more applications on different doors after some initial settings and adjustments, thereby giving this rotary actuator 300 a big advantage over known actuators. In use, the rotary actuator 300 may be programmed to unlock the deadbolt at a predetermined date and time; this is useful when a senior citizen is at home and a caregiver has an appointment for a visit. In another use, the motion sensor 180 may be programmed to detect a fall and an alert can be sent to a mobile device 30 of a caregiver.

[0029] While specific embodiments have been described and illustrated, it is understood that many changes, modifications, variations and combinations thereof could be made to the present invention without departing from the scope of the present invention. For eg., the rotary actuator can be applied to turn on a water heater or water tap as part of a wider home automation system; this may be useful if a resident is disable. In another use, the rotary actuator can be applied to turn ON or adjust the knob of a hifi set, radio, lamp brightness control and allied appliances when a resident is on vacation, so as to give an impression that a home or house is occupied.

CLAIMS:

1. A programmable rotary actuator comprising:
 - an adjustable gripper, which comprises a pair of clamping members being spaced apart to fit onto a knob of an appliance or a handle/knob of a door;
 - a drive stem connecting the adjustable gripper to a gear-motor assembly;
 - a hollow housing for supporting the gear-motor assembly and related controls, wherein two opposite sidewalls of the hollow housing has an open slot on each sidewall through which the adjustable gripper can be manipulated by a user's finger and thumb for clamping onto the knob or handle;
 - a setting knob connected to an end of the drive stem opposite the adjustable gripper; and
 - a control panel with a monitor screen and some operation buttons for program setting or adjusting the gear-motor assembly and related controls to operate the programmable rotary actuator.
2. The programmable rotary actuator according to claim 1, further comprising a conical joint disposed coaxially with the drive stem, so that the drive stem is disconnectable from the gear-motor assembly when a force is pushing on the setting knob during setting of the programmable rotary actuator and when the force is released, the conical joint springs back and connects the drive stem to the gear-motor assembly, and controlled operation of the gear-motor assembly operates on the drive stem and connectively actuates the adjustable gripper.
3. The programmable rotary actuator according to claim 2, wherein interfacing surfaces of the conical joint are splined to provide positive engagement.
4. The programmable rotary actuator according to any one of claims 1-3, further comprising a flexible member extending from an edge of the hollow housing.
5. The programmable rotary actuator according to claim 4, wherein a battery for operating the rotary actuator is disposed inside the flexible member.

6. The programmable rotary actuator according to claim 4 or 5, wherein a detachable connector is located on the flexible member or on an extension part of the hollow housing to provide a resisting torque when operating the gear-motor assembly.
7. The programmable rotary actuator according to any one of claims 1-6, wherein the drive stem proximal to the adjustable gripper is threaded and is journaled through both a threaded sleeve and a coaxial electric clutch or brake.
8. The programmable rotary actuator according to any one of the preceding claims, further comprising a motion sensor.
9. The programmable rotary actuator according to any one of the preceding claims, further comprising a wireless communicator, which is programmable to send a reminder or alert to a mobile device according to execution of a program set by the user.
10. A kit for configuring a programmable rotary actuator comprising:
 - an adjustable gripper, which comprises a pair of clamping members being spaced apart to fit onto a knob of a stove or a handle of a deadbolt on a door;
 - a drive stem for connecting the adjustable gripper to a gear-motor assembly, wherein controlled operation of the gear-motor assembly actuates the adjustable gripper;
 - a hollow housing for supporting the gear-motor assembly and related controls, wherein two opposite sidewalls of the hollow housing has an open slot on each sidewall through which the adjustable gripper can be manipulated by a user's finger and thumb for clamping onto the knob or handle;
 - a setting knob for connection to an end of the drive stem opposite the adjustable gripper;
 - a control panel with a monitor screen and some operation buttons for program setting or adjusting the gear-motor assembly and related controls; and
 - a battery for powering the gear-motor assembly and related controls.
11. The kit according to claim 10, further comprising a motion sensor.

12. The kit according to claim 10 or 11, further comprising a conical joint located coaxial with the drive stem, wherein the conical joint is engageable or dis-engageable between the drive stem and the gear-motor assembly.