Study on Switch to Control Running Water Flow for the Aged

Ruican Hao¹, Huagang Liu¹, Qingsong Zhu¹, Decai Li²*

¹ School of Automotive Engineering, Beijing Polytechnic, Beijing, China
² State Key Laboratory of Tribology, Tsinghua University, Beijing, China
*lidecai@tsinghua.edu.cn

Abstract. With the growth of age, the memory, intelligence and thinking will decline for most people. To avoid the injury or life in danger resulted from forgetting to turn off the running water switch, a special switch to measure and control the running water flow for aged was proposed. Two kinds of sensors including flow sensors and distance sensors were applied in the device to guarantee that the switch should be turned off before water in the container comes out. The configuration of the device was designed to use conveniently for aged. The required flow was firstly input on the board set on the water supply line, then the switch could be turned on and the flow sensor works to measure the water flow required. Once the flow value is up to the set value on the board, the switch could be turned off by the controller in the circuit. To guarantee the safety on the sensors in the process of the measuring, another two distance sensor were chosen and set on the running water port to complete the measuring work of the water level in the container to avoid the water coming out from the container secondly.

1. Introductions
Research shows that with the age growing, most people will perform slowly on memory, intelligence, thinking, etc. Especially, when people enter the old age, they gradually show various dullness and inconvenience in their lives. For example, in family life, it often happens that forgetting to turn off the running water. Even for some kitchen water purifier, it is nearly slow and silent when water comes out. However, because it is so slow to purify the water, people often do some other things while waiting the water coming out. Then people often forget to turn off the running water while do some other things to cause lots of water coming out of the container. Then accidents such as slipping or personal injury may occur, even there is water overflowing the electrical appliances or switches causing life hazards such as electric shock.

At the same time, there are some automatic switches that can only send out water quantitatively or for some certain containers [1-2]. So it is inconvenient for people to meet different requirements to adjust the water volume for lives.

For flow measurements, it is important to measure the volume of the water which comes out from the tube [3-4]. Distance sensors are common sensor for engineering to achieve for measurement. It is important to get the certain distance value from one end to another end or one thing to another thing [5-9]. So in the device designing, the flow sensors and distance sensors are both applied to guarantee the container not be full and the environment safe.

2. Principle
The working procedure of the switch for controlling the running water was designed according to the need of people like aged. The block diagram of the procedure is shown in Fig.1.
When a certain flow of water is needed, the flow value is input into the system through the board firstly. Then the switch for running water should be controlled to be turned on for running water. Then the flowmeter set on the tube works. A judgment module should be designed to judge whether the flow value in the tube reach the input limit value. If the flow value of the running water reaches the limit value, the switch should be turned off by controller. If the flow value of the running water does not reach the limit value, the switch is kept on.

3. Structure Design

The structure of the automotive switch was designed according to the working procedure set before. The automotive switch consists of flowmeter(1), controller(2), solenoid valve(3), panel(4), first distance sensor(6) and second distance sensor(7). There is keyboard (5) on the panel. The composition parts of the designed switch are shown in Fig.2.

The flowmeter and the solenoid valve are set in the water pipeline, and the solenoid valve is between the flowmeter and outlet of the pipe. The controller including signal receiver, controlling device and electric relay is connected to the flowmeter, solenoid valve and the panel electrically respectively. Fig.3 shows the connections between parts.

The flow value of the water required is input through the board on the panel by user. The signal is received by the signal receiver of controller and transferred to the controlling device. After receiving signal from the receiver, the controlling device starts the electric relay to turn on the solenoid valve. At the same time, the flowmeter starts to measure the flow of the running water flows through the pipe. There is a judgment module to judge whether the flow reaches the limit value of the flow required. If the measured flow does not reach the limit flow input from the pane, the signal receiver and the solenoid valve work should be kept on to guarantee the water flow runs fluently. If the measured flow reaches the limit value input from the panel, the signal receiver receives the signal from the flowmeter and transfer to the controlling device, then the controlling device start the electric relay to turn off the solenoid valve to cut off the running water supply. The automatic switch works to avoid the accidents caused by forgetting to turn off the tap water switch from people like aged.
To increase the safety factor of the device, two distance sensors are considered to set at the outlet of the running water to measure the distance from the outlet end to the water surface in container. The signal output ends of the distance sensors are connected to the input ends of the signal receiver. Even if the flowmeter can’t work, the distance sensors could transmit the distance data to the signal receiver to guarantee the controller to turn off the switch through the electric relay. Thus the accidents caused by forgetting to turn off the tap water switch are avoided. At the same time, users could input the water volume on demand instead of quantitative flows by the device automatically.
Another device for alarm could be also chosen and set at the end of controlling circuit, to avoid users forgetting to turn off the running water switch. After the switch is turned off automatically, the alarm is started to inform users to take away the container with water.

For users, first, input the flow value they need on the board. Second, press the confirm button to wait. Then users could do something else instead of waiting. When alarm is started, users could take away the container with water freely.

4. Conclusions

To avoid dangers or injury from forgetting to turn off the running water switch, a new kind of automatic switch for people like aged was analyzed and designed in the paper. Flowmeters, controller, solenoid valve were applied and set as important parts of the device. Two distance sensors are chosen to be installed at the end of the outlet to measure the distance from the outlet to the surface in the container to increase the safety factor of the device. An alarm was considered to install at the end of the controlling circuit to inform users that the water discharging work is over. The device achieves the purpose of discharging water on demand. The more humanized and intimate design enables the elderly to change the amount of discharging water on demand, avoiding the embarrassment of quantitative discharging water from some devices.

Acknowledgements

Thanks for the financial support from Beijing Municipal Commission of Education Technology Plan Project (KM201910858005) and Beijing Polytechnic Science and Technology Project (2020Z172-KXZ).

References

[1] LEI Man, CHEN Hua, HUANG Daofu, etc. Design of Automatic Control Device for Water Level of High Level Water Tank[J]. Mechanical Engineer, 2017(11):50-52.
[2] Zhang Xuning. Discussion on Common Problems in Plastic Mould Design[J]. Modern Industrial Economy and Informationization, 2017,7(14):26-28+31
[3] YU Xinlong, XU Kejun, XU Wei, etc. Research on Self-adaptive Polarization Noise Cancellation System for Electromagnetic Flowmeter[J]. Process Automation Instrumentation, 2020, 41(2): 47-52.
[4] Yang Pan. Research on Installation Environment and Pressure Loss of Vortex Flowmeter with Tiny Diameter and Abnormity Cross Section[D]. Tianjin University, 2018.
[5] Pillarz Marc,von Freyberg Axel,Stöbener Dirk,Fischer Andreas. Gear Shape Measurement Potential of Laser Triangulation and Confocal-Chromatic Distance Sensors[J]. Sensors, 2021,21(3).
[6] Mohan C.,Verma H.K.. Direction and distance sensors and sensing system for elderly people[J]. Materials Today: Proceedings,2021,34(3).
[7] Kim Taehyung,Kang DongHyun,Shim Shinyong,Im Maesoon,Seo Bo Kyoung,Kim Hyungmin,Lee Byung Chul. Versatile Low-Cost Volumetric 3D Ultrasound Imaging Using Gimbal-Assisted Distance Sensors and an Inertial Measurement Unit.[J]. Sensors (Basel, Switzerland),2020,20(22).
[8] Chunhua Zhao,Simon Blackmore,Sam Wane,Michael Warbrick. Experiments and Analysis Advance R2100 Distance Sensors Used for Safety Systems of TOMI[J]. American Journal of Remote Sensing,2020,8(2).
[9] Raed S. Batbooti,Batbooti Raed S.,Mohammed Bassam A.,Jabbar Tahseen Ali. Beam deflection estimation by Monte Carlo simulation and Kalman filter based ultrasonic distance sensor[J]. IOP Conference Series: Materials Science and Engineering,2020,928(2).