Research on the Design of the Swimming Pool Precipitation Warning System in Colleges and Universities

Chen Zhi, Chen Wenta

Nanchang Institute of Technology, Nanchang, China

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Abstract: In the setting of physical education disciplines in colleges and universities in China, it is necessary to set up the swimming class with high efficiency, which is mainly related to the educational philosophy of colleges and universities and the awareness of students' prevention of flooding, not to mention the design importance of water protection and early warning system. . In view of this, this paper takes the design results of the muddy water warning system as the theoretical content to explain its research status and future research plan, and analyzes the design of the drowning system in combination with the hardware use requirements and standards of the drowning system. The importance of colleges and universities.

1. Introduction

With the gradual strengthening of people's awareness of flood prevention and the rise of the current fitness boom, more and more people are involved in the process of swimming and fitness, but in the setting of teaching disciplines in China's universities, there are fewer schools for swimming teaching. It is mainly related to the development concept of the school, the planning of the school and the importance attached to swimming teaching. Even in the colleges where swimming lessons are set, the swimming teachers only guide and supervise the occurrence of the drowning incidents. However, due to the tight teaching of the courses and the large number of students, the teachers cannot accurately judge the occurrence of drowning phenomena and events, so the process of teaching In the middle, the corresponding drowning warning system should be developed to provide a basis for accurately judging students' drowning phenomenon. The research in this paper mainly takes the research results of the drowning alarm system in the swimming pool as an example, and analyzes the monitoring methods and approaches of the drowning warning, such as sonar monitoring, porTable monitoring devices and real-time video monitoring. The hardware of the drowning warning system is proposed. The design provides theoretical support for improving the working efficiency of the early warning system, preventing the occurrence of drowning events, and adapting to the current occurrence of waterlogging prevention in college swimming teaching.

2. Brief introduction of research results of swimming pool drowning warning system

2.1 Sonar monitoring

The sonar monitoring principle utilizes the relevant electrical components in the underwater information search and rescue system, combined with the signal transmitting and receiving devices, to achieve the function of accurately determining the position of obstacles. In the judgment of the drowning state, it is not only necessary to use sonar monitoring to provide the accurate drowning position of the drowning person, but also to accurately determine whether the swimmer is drowning in combination with a certain drowning judgment standard and basis. However, due to the large weakness of the sonar monitoring device, for example, it is necessary to rely on the amount of air inside the body during the swimming process to determine whether there is excess water filling in the body, but in this case, the signal system may Will not work, or even lose the function of signal transmission. In addition, the underwater installation part of the sonar monitoring system is more difficult. In the process of connecting the signal processing equipment, it is necessary to combine

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the echo extraction related information to analyze the cable structure at the bottom of the swimming pool to achieve safety restrictions. In the process of using sonar equipment, it is necessary to use the voltage of several hundred volts for the control of sonar system, so as to realize the generation and reasonable application of sonar pulse signal.

According to safety regulations, the water pressure of the entire pool should not exceed 12 or 24 volts, but the standard of this voltage is set according to the conditions of different countries. The sonar equipment is the standard for the whole pulse signal generation. However, if the human body is located between the sonar and the wall, the monitoring method of the sonar is feasible, but if the human body is close to the wall, it will encounter echoes, noise, etc., which will result in monitoring. The drowning signal is not accurate.

2.2 Carrying the monitoring device

Carrying it with you is the simplest monitoring device for drowning water. It can be a waterproof watch, a belt, etc., and the relevant drowning monitoring device is placed in it to accurately determine the swimmer's accurate swimming position, and according to the corresponding floating effect, Or implant a corresponding microphone system, etc., to accurately determine the heartbeat, breathing sound, etc. of the monitor, and then select an effective and appropriate timing, accurately determine the time interval of the entire measurement, and determine whether the water is drowning, and the entire system Install and use specifications for rational analysis to reduce false positives.

2.3 Video real-time monitoring

In the early real-time video monitoring process, the waterproof camera device was placed at the bottom of the pool, which can accurately determine the swimmer's status and movement in the pool, but lacked certain warning and alarm devices. If it is not discovered in time, it is difficult to make rescue measures in the first place. In addition, due to certain restrictions on the swimming pool space in the school, the camera device at the bottom of the swimming pool is often blocked due to the large number of people. Therefore, according to the corresponding research results, the pre-replacement system can be analyzed to enhance the monitoring of drowning.

3. Structural design analysis of video swimming water monitoring system in college swimming pool

3.1 Video Hardware Design Section

The underwater cooperative sound beacon is the core of the underwater part of the positioning system. Its main function is to regularly detect the state of the swimmer, to ensure that the sound signal can be fired manually or automatically when a drowning situation occurs, in order to rescue.

According to the design's own requirements, the main hardware should ensure portability and reduce the weight of the portable device. At the same time, the size of the design hardware such as the voice beacon should match the habits used and carried by the swimmer. Waterproof performance is good, the waterproof level should meet the standard requirements, and it can work normally in the swimming pool above 10m water depth. In the requirements of standby time, the time should be reasonably analyzed, and the daily standby time should be no less than 8 hours to meet the design requirements of different time periods. Finally, the corresponding signal should be triggered manually and automatically to effectively prevent the occurrence of the drowning state. At the same time, it can be combined with the swimmer's awake state and the drowning state to switch the signal at any time, and can automatically trigger the signal and issue an alarm.

The construction of the hardware framework should be composed of the system parts such as battery, single chip and sensor. The structure of the structure is shown in Figure 1.

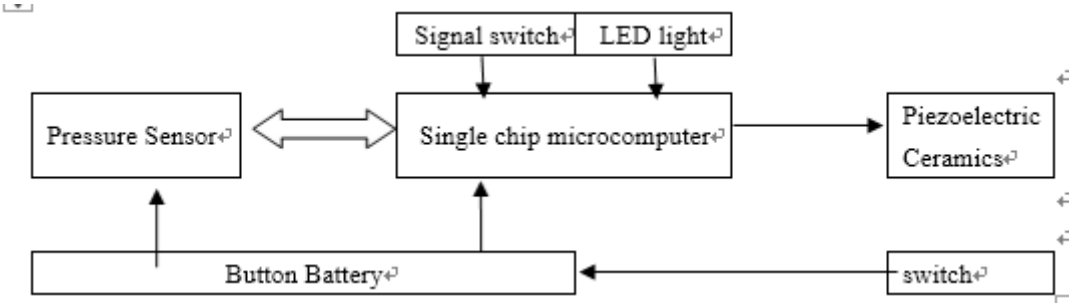

Figure 1 composition of the structure of the framework

As shown in the above figure, the entire structural diagram is mainly analyzed from the power switch. The button battery can supply power normally and continuously, and accelerate the work efficiency of the power switch and button battery with the stability of the overall sound system. . Secondly, the button battery mainly supplies the pressure sensor and the power of the single chip, so that it can maintain normal work. The MCU collects the signal transmitted by the pressure sensor, extracts the effective anti-flooding information, and transmits the signal to the signal switch and the LED lamp, and combines with the piezoelectric ceramic system to complete the warning of the drowning warning.

3.2 Component selection

3.2.1 Piezoelectric ceramic ring

The piezoelectric ceramic ring can fully combine signal pulses to convert electrical signals and convert them into sound signals. The principle of its work is to add an excitation electric field to the two electrodes of the power plant to achieve mechanical deformation and convert the electrical signal into a sound signal. Since the bottom of the pool generally contains 4 corners, how to achieve the corresponding signal system in each corner becomes an important criterion for monitoring the current acoustic signals in the drowning warning system. The piezoelectric ceramic structure generally adopts a hollow ring, and realizes the directivity acoustic signal according to the radial vibration of the ceramic. In addition, due to the design in the whole packaging process, the embedded voltage of some circuits is constantly added in a certain space requirement. Great use. For example, the larger the diameter of the piezoelectric ceramic, the smaller the voltage; the smaller the diameter, the larger the voltage.

3.2.2 Button battery

The button battery is mainly capable of providing continuous power, ensuring the continuous and stable operation of the entire power system, and at the same time combining the relationship between the capacity and the volume of the battery, and increasing the stability of the internal structure of the sound mark, thereby realizing the embedded structure of the circuit board. Use functionalization. The maximum capacity of the button battery is CR2032 (CR stands for lithium manganese, which is internal electrolyte; 20 units is mm, indicating its diameter; 32 units is 0.1 mm, indicating its thickness), and its nominal capacity is 210 mAh.

3.2.3 MCU

As the core unit of underwater acoustic beacon, the single chip microcomputer greatly determines the power consumption of the entire beacon. Beacons must be mass-produced, so the price of the MCU is of course as low as possible. When developing low-power water acoustic equipment, we commonly use TI's 430 microcontroller. But the advent of STMicroelectronics' ultra-low-power microcontroller family based on the STM8 core has broken TI's monopoly in the low-power microcontroller market. The current MSP430F5XX series of 430 microcontrollers has the lowest power consumption. STMicroelectronics' STM8L15X series of ultra-low-power microcontrollers are the most widely used in their low-power families. The power consumption of TI's MSP430F5XX series and ST's STM8L15X series are shown in Table 1.

Table 1 MCU power consumption comparison analysis Table

Operating mode(3V,25℃)	MSP430F5XX	STM8L15X
Operating mode	165uA/MHz	90uA/MHz
Standby mode	2.5uA	1uA
Hold mode	1.5uA	0.9uA
Shutdown mode	0.1uA	0.4uA

According to the above Table data analysis, in the operation mode, the MSP430F5XX is 165uA/MHz, which is obviously higher than the 90uA/MHz of the STM8L15X. Therefore, in combination with the signal pulse requirement in the off state, other working requirements of the entire STM8L15X, such as standby. The parameters of the mode, hold mode and corresponding shutdown mode are significantly higher than the MSP430F5XX.

3.2.4 Pressure sensor

In the choice of pressure sensor, it is often combined with different use conditions and environment to select the appropriate type of sensor for data transmission. In the design of the drowning system of college swimming pool, the main sensor model is NX6652C, its main features and The characteristic is: under the condition of absolute pressure, the measurement range is mainly 0~14bar, and the measurement accuracy can reach 1.2mbar. Therefore, under the condition that the underwater measurement depth is certain, the underwater depth should be fully combined. The factory parameters of the pressure sensor are used to implement the verification parameters of the software compensation pressure.

At the same time, the pin function of the pressure sensor is also related to its number, pin name, etc., and no additional connection is required. As shown in Table 2 below.

Table 2 pressure sensor NX6652C pin function comparison Table

Pin number	Pin naming	Pin function
1	SCLK	SPI communication clock
2	VSS	Reference ground
3	PV	Negative programming voltage (not connected)
4	PEN	Programming enable (not connected)
5	VDD	power supply
6	MCLK	Master clock (mainly used for ADC sampling)
7	DIN	SPI data input
8	DOUT	SPI data output

3.3 Design elements of the inference module of the drowning event

3.3.1 Assessment of student swimming status

The drowning person can basically be divided into active drowning and passive drowning. The underwater swimming state of the drowning person is relatively simple because of the amount of water. Among them, there are four main characteristics in the identification of whether there is drowning in the swimming process.

(1) First of all, combined with the details of the movements of the arms and legs, it can be seen that they are squatting or squatting next door, and they try their best to let the mouth out of the water to breathe.

(2) The self-control of the limbs is reduced, but the whole body can be floated within 60s of the water surface through strenuous struggle.

(3) In the water, the body of the drowning person can be vertical, and it is impossible to effectively distinguish the movement of the object after losing consciousness.

3.3.2 Integrating drowning rules with state mechanisms

According to the drowning rules, different three swimming states can be integrated to effectively

distinguish between normal swimming, abnormal state and possibly drowning state, and combined with different judgment rules, the system is used to maintain the predetermined time for analysis. , which triggers an alert.

4. Conclusion

In summary, the drowning warning system for college students swimming in the university system should fully integrate the school's own development status and needs. According to the hardware and software design of the entire drowning system, the drowning state of the drowning person can be judged more quickly and accurately. And through the video image analysis method to accurately position the water trapper, and then start the rescue in the first time, to provide important theoretical support for preventing college swimming and drowning events.

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