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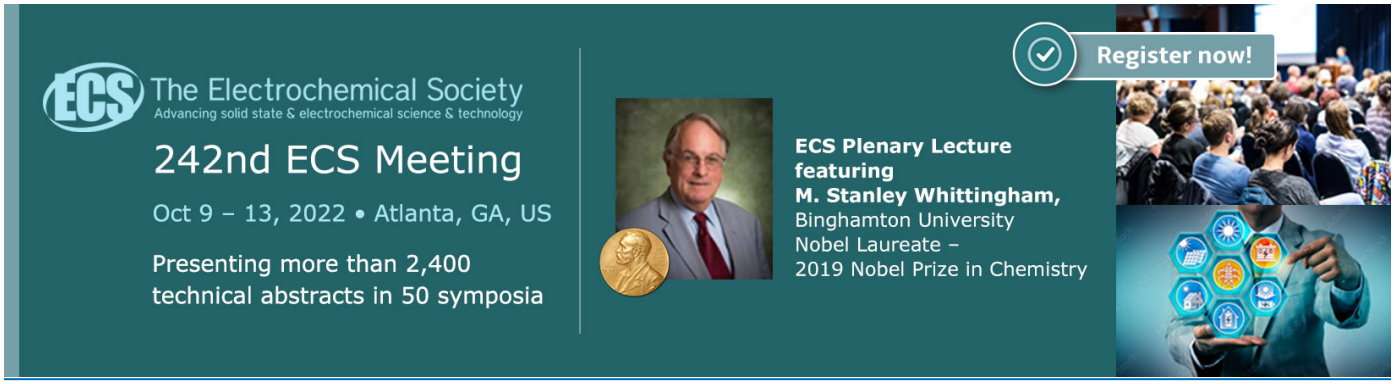

Characteristics and Function Analysis of Swimming Life Saving System Based on Machine Vision Technology

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Abstract. As an integral part of the social system, swimming life-saving activity has become a system, so it is possible to study it from the perspective of system theory. Swimming lifesaving system is composed of two elements: people and things. The elements of people include lifeguards, drowning people and swimmers, while the elements of things include environment and lifesaving appliances. These factors have the relationship of mutual influence, interaction and promotion. Swimming is a sport with poor safety coefficient. It is far from enough to blindly pursue the improvement of swimming skills, so swimming should be analyzed and explored as a system. As an integral part of the social system, swimming life-saving activity has become a system, so it is possible to study it from the perspective of system theory. Based on machine vision technology, this paper analyzes the swimming pool positioning lifesaving system, hoping to provide guarantee for people's life safety.

Keywords: Machine vision, Swimming lifesaving system, Safety

1. Introduction

Due to the limitation of human physiological conditions, it is difficult for lifeguards to maintain high concentration for a long time. In addition, the reflection of light from the surface of the swimming pool will make lifeguards dizzy, and the swimming pool is often crowded with noisy environment [1]. All the above reasons will lead to the fact that it is difficult for the rescuers to pay attention to the rescue actions of the drowning person on the water surface in case of drowning, and once the drowning person is submerged, it is more difficult to be detected [2]. Swimming is a kind of sports with poor safety coefficient. It is far from enough to blindly pursue the improvement of swimming skills, so swimming should be analyzed and explored as a system [3]. Image is an image and vivid description of objective things, an intuitive and specific form of information expression, and the most important information carrier of human beings [4]. As a part of the social system, life-saving swimming becomes a system. It is possible to study it from the perspective of system theory. A system is an organic whole with certain structure and function, which is composed of several elements of interaction and interdependence [5]. With its high-tech technology and patented unique method, the swimming pool intelligent lifesaving electronic monitoring system has solved the technical problems of swimming pool safety monitoring for a long time [6]. In today's information society, with the rapid development of network, communication and microelectronics technology and the improvement of people's material living standards, monitoring products are also experiencing a revolution from analog

to digital and network [7].

The scientific swimming pool life-saving system is based on the traditional life-saving concept, which is reformed and innovated by adjusting the responsibilities of lifeguards and the placement of life-saving equipment [8]. As a special social phenomenon, swimming lifesaving can't be fully grasped only from the technical level. We should use the method of system theory to investigate this phenomenon. From a systematic point of view, focusing on the relationship between system and elements, elements and elements, and system and environment, the swimming lifesaving activities are comprehensively and accurately investigated, thus revealing the significance of swimming lifesaving, the nature and movement law of swimming lifesaving system [9]. The swimming life-saving system is composed of two elements: human and object. Human elements include lifeguards, Drowners, swimmers and other basic elements, while object elements include environment, life-saving appliances and other basic factors. These factors interact, interact and promote each other [10]. The construction of scientific swimming pool life-saving system can make up for the loopholes and shortcomings of the traditional life-saving concept, reduce the occurrence of swimming pool safety accidents, so that people can swim happily and protect personal safety at the same time [11]. Based on machine vision technology, this paper analyzes the positioning and lifesaving system of swimming pool, hoping to provide guarantee for people's life safety.

2. Positioning Principle of Swimming Pool Positioning Project

The positioning principle of swimming pool is based on the geometric model. In space, a hyperboloid can be determined by knowing the distance difference between a point and two fixed points, and three hyperboloids can meet at a point in space theoretically. A large number of observation windows are prone to water leakage and seepage due to technical reasons. The data obtained by the system can meet the needs of coaches, athletes, referees and spectators to provide on-demand live video or related video information during competition and training. The intelligent rescue monitoring system is composed of central control host, video capture card, waterproof camera, on-site touch monitoring screen, wireless emission and alarm device, drowning accident video recording and storage system, a set of intelligent rescue software and auxiliary competition training software, paging vibration device, cable, embedded parts and on-site lifeguards [12]. Computer vision refers to the use of cameras and computers instead of human eyes to identify, track and measure objects. One of the basic tasks of computer vision is to calculate the geometric information of objects in three-dimensional space from the image information obtained by cameras, and then reconstruct and recognize objects.

There are four main characteristics in the swimming lifesaving system, which form a relatively perfect structure system. First of all, the swimming rescue system is purposeful. Its existence and operation always revolve around a goal, which is to protect the life safety of public swimmers. It only exists when it carries out purposeful activities. Once the activities stop, it will disappear naturally. As shown in Figure 1, the swimming rescue system is an open CNC system.

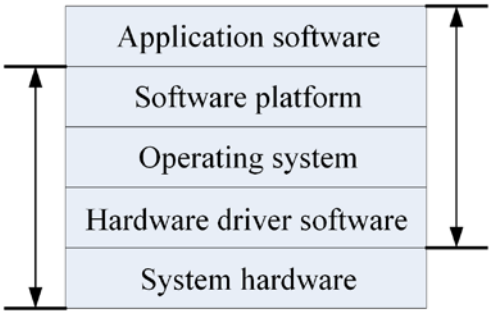

Figure 1 The open CNC system of the swimming rescue system

Reasonable arrangement of underwater photography system can provide images, data and other information for training, help athletes improve their competition performance and meet the needs of modern scientific training. Because the swimming lifesaving system is a purposeful activity for people

in mass swimming, it is decided that this activity must be different from other activities and have its own professional characteristics. As the operator of the lifesaving system, lifeguards must receive strict professional training before taking up their posts. With the development of technology and scientific training, the traditional methods can no longer meet the requirements of modern training. The hardware structure of the system adopts a computer system with high reliability and high performance, which is completely waterproof, combined with a variety of audio and video and vibration prompts, and gives specific direction guidance at the moment of danger [13]. Lifeguards and swimmers all come from the outside world, and their operation process is more restricted by the outside world. Therefore, it always needs to keep in touch with other systems, especially in the observation stage of lifeguards, and it is necessary to monitor the swimmers in their responsible areas in real time. The dynamic performance of swimming lifesaving system is mainly manifested in lifeguards' activities. The whole lifesaving system is in a relatively stable state during lifeguards' observation stage. When lifeguards find drowning people, the whole system starts to operate and is in an orderly dynamic rescue process.

3. Element Analysis of Swimming Lifesaving System

The whole swimming life-saving activity is carried out in a certain environment, which is at the outermost layer of the system. Lifeguards use observation and judgment techniques for swimmers in their own duty posts to prevent accidents. Swimming lifesaving activities are organized for swimmers and drowning people. Without them, it is impossible to organize lifesaving activities, and there is no need to set up lifeguard posts. Under the coordination of various factors, a swimming lifesaving system with complete structure is basically formed, and its characteristics are mainly manifested in the following aspects. Life-saving system has an obvious purpose, that is, to protect the life safety of swimmers. The operation and equipment construction of life-saving system are all for the purpose of protecting life safety. Swimmers are potential dangerous elements in life-saving activities, and swimmers may become drowned under certain circumstances. Once a swimmer becomes drowned, the whole life-saving system enters the operation stage from a stable monitoring state. Lifeguards must use necessary life-saving equipment for effective rescue, ranging from simple life-saving equipment such as bamboo poles, lifebuoys, life-saving boards, life-saving pipes and other advanced equipment such as motorboats and special lifeboats. With the development of modern medical equipment, rescue equipment is constantly improving. In view of the special social phenomenon of swimming activities, it is directly related to the life safety of swimmers, which determines the high quality requirements for their professional functions. The job and skills training of swimmers must meet the requirements of national professional standards.

The life-saving environment is mainly controlled by the external environment. For swimming life-saving activities, these controllable and uncontrollable environmental elements can bring favorable and unfavorable influences. Figure 2 is a human body height estimation model using reference height.

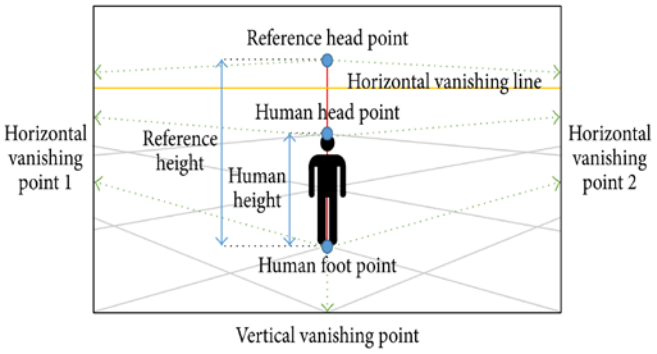

Figure 2 Human height estimation model using reference height

Randomly select input and output data and submit them to the network. Calculate the output of each neuron in the hidden layer:

$$f(t)=\sum_{j=1}^{N}\sum_{k\in Z}d_k^j\phi_{jk}(t)+\sum_{k\in Z}c_k^N\phi_{Nk}(t) \tag{1}$$

Calculate the response of neurons in the output layer:

$$E_{mi}=\sum_{i=1}^{k}(i\Delta t)\cdot\left|S_{mi}\right|^2 \tag{2}$$

Use the given output data to calculate the error of the output layer neuron:

$$\vec{E}=\frac{E_{mi}}{\sqrt{\sum_{i=1}^{k}E_{mi}}} \tag{3}$$

With the continuous improvement of the scientific and technological content of life-saving equipment, the life-saving effect has also been continuously improved. It can be said that modern swimming life-saving activities can not be separated from advanced equipment. Therefore, life-saving equipment plays an important role in the organization system of swimming life-saving activities. The operation of any system is in a certain space-time environment, and the system without the space-time environment actually does not exist. Swimming lifesaving system operates in a certain environment, and swimming lifesaving environment is also one of the elements of lifesaving activities. Lifeguards are in a relatively stable stage during observation and other stages, but once a drowning person is found, it will reflect a series of trends of life-saving activities. Lifeguards need to carry out rescue activities for drowning people in all directions, and they need to be always in a state of physical and mental tension, so as to ensure the health and physical exercise safety of swimmers. Lifeguards have the responsibility to work with managers to create and control a favorable environment as far as possible, so that the environment will have a favorable impact on life-saving activities and reduce or avoid adverse effects. All rescue measures are inferior to strengthening the intensity of prevention of activities. The function of swimming lifesaving system needs to strengthen the prevention of drowning events besides carrying out lifesaving activities for drowning people. To improve swimming safety factor, it is necessary to rely on both external and internal forces. It is not enough to rely solely on the protection of lifeguards' safety facilities. It is also necessary to improve swimmers' safety awareness.

When the main monitoring system detects someone drowning in the swimming pool, it immediately generates an alarm signal, which contains the location information of the drowning person. Serial communication refers to the use of a data signal line between peripherals and computers, on which data is transmitted bit by bit, and each bit of data occupies a fixed time length. The trend of adaptive nonlinear contraction is shown in Figure 3.

Lifeguard is a positive factor in the organization system of swimming lifesaving activities, and the whole swimming lifesaving activities must be organized and completed by lifeguards. When drowning occurs, lifeguards must take effective technical measures, actively adjust and straighten out the relationship among various elements, and rescue the drowning person to produce the best rescue effect. During swimming, as a factor of life-saving system, swimmers can witness some life-saving activities. By observing the whole life-saving activities, they can learn the necessary swimming skills and self-rescue techniques, and be aware of their own safety problems in lifeguards' explanations and suggestions, thus improving swimmers' safety awareness in the life-saving process. Due to the influence of objective factors, swimmers have less opportunities to get life-saving publicity and participate in life-saving training from the media. When swimmers participate in the activities of swimming places, they become an element of swimming life-saving system, and they can get life-saving experience during the operation of life-saving system [14]. This communication method uses fewer data lines, which can save costs in long-distance communication. After the lifeguard judges that the drowned person is injured in the spine, the injured person should be fixed and transported by means of neck cover, first aid board and other equipment. For spinal injuries, it is best to treat them effectively in water after approaching the drowning person. After that, on-site nursing was carried out

until the arrival of medical rescue personnel.

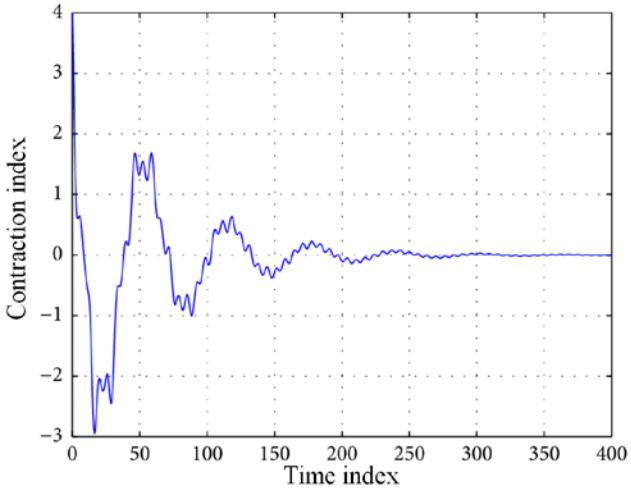

Figure 3 Image adaptive nonlinear shrinking trend

4. Conclusions

The functions of intelligent lifesaving monitoring system for swimming pool, such as lifesaving alarm, image recording and training, effectively avoid drowning death and injury accidents, and reduce huge economic compensation and negative social impact. Swimmers are potential dangerous elements in life-saving activities, and swimmers may become drowned under certain circumstances. Once a swimmer becomes drowned, the whole life-saving system enters the operation stage from a stable monitoring state. The operation of swimming lifesaving system is a process of technical operation, and technology runs through the whole operation process. Reasonable arrangement of underwater photography system can provide images, data and other information for training, help athletes improve their competition performance and meet the needs of modern scientific training. Lifeguards are in a relatively stable stage during observation and other stages, but once a drowning person is found, it will reflect a series of trends of life-saving activities. Lifeguards need to carry out rescue activities for drowning people in all directions, and they need to be always in a state of physical and mental tension, so as to ensure the health and physical exercise safety of swimmers. The dynamic performance of swimming lifesaving system is mainly manifested in lifeguards' activities. The whole lifesaving system is in a relatively stable state during lifeguards' observation stage. When lifeguards find drowning people, the whole system starts to operate and is in an orderly dynamic rescue process.

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