Intelligent Wheelchair System：Non-contact Heart Rate and Body Temperature Measurement

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Abstract

With the continuous development of society and human civilization, people, especially the disabled and the elderly, need more and more to use modern high technology to improve their lives and improve the comfort of life. Therefore, this paper introduces a single-chip microcomputer-based non-contact body temperature and facial recognition-based heart rate measurement method and applies it to the intelligent wheelchair system. Monitor the vital signs of the elderly, and give early warnings in time when abnormal values occur, so that family members or caregivers can rescue them in time.

Keywords: Smart wheelchairs，Non-contact，heart rate，Body temperature measurement

1. Introduction

Population aging has become a global phenomenon. China's elderly population is huge, the aging rate is fast, and the problem of elderly care and daily care for the elderly is becoming increasingly severe. Wheelchairs are indispensable means of daily life for the elderly and people with lower limbs, and a cost-effective, comprehensive and reliable intelligent wheelchair can not only improve the quality of life of the disabled and the elderly, but also reduce the burden on caregivers. Smart wheelchairs. Research plays an important role in the development of elderly care projects in China [1]. Since the development of the first intelligent wheelchair in the United Kingdom in the 80s of the 20th century, the United States, Japan, France and other countries have also carried out research on intelligent wheelchairs [2], [3], [4], [5], [6]. The research on intelligent wheelchairs in China started late, but in recent years, some research results have been achieved. The research of intelligent wheelchairs based on visual tracking [7], autonomous driving [8], electromyography [9], head [10], multi-sensor fusion [11], and voice [12] has also been progressing, but these wheelchairs are still in the laboratory stage, which are expensive, and their safety and real-time performance cannot meet the demand. Therefore, this study takes the above problems as the starting point, and carries out the system improvement design on the basis of the existing wheelchair machinery to meet the current needs.

2. Infrared body temperature measurement

Based on the stm32 microcontroller, the B-1 infrared temperature measurement module is used to complete the non-contact body temperature measurement. The physical diagram is shown in Fig. 1.

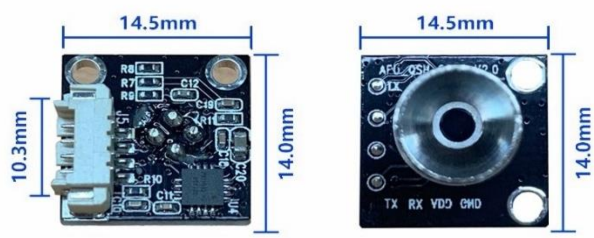

Fig. 1 Photographs of the B-1

The module has a built-in 24-bit high-precision AD conversion chip, and its working principle is that when the object is higher than absolute zero (-273℃), it will radiate infrared energy outward, and the infrared sensor receives the infrared light reflected back by the object, and obtains the induced temperature data through the high-precision program algorithm in the CPU.

Table 1 Temperature measurement results

Temperature	1	2	3	4
Measure the temperature/℃	36.7	36.2	37.3	35.9
True temperature/℃	36.8	36.0	37.1	36.2

3. Non-contact heart rate measurement

3.1 Technical principle

There are two commonly used methods to measure heart rate in clinical practice: electrocardiogram (ECG) and optical volume scanner (PPG) PPG is a method of detecting blood volume pulses (BVP) in human blood tissues using photoelectric means, such as fingertip pulse oximeters, exercise bracelets, etc

Remote photoplethysmography (RPPG): Diffuse and specular reflections of light after passing through the skin, both of which can be captured by the camera. According to Lambert-Beer's law, the strength of a substance's absorption of a monochromatic light is related to the concentration of the absorbent substance and the thickness of its liquid layer. Since the periodic beating of the heart causes the same periodic change in the concentration of blood in the blood vessels and capillaries, it leads to a periodic change in the concentration of light absorbed by the blood, so that the intensity of the diffuse reflected light received also changes periodically, that is, the pulse wave information.

When the heart contracts, the concentration of blood increases, the human skin absorbs more light and reflects less light; When the heart stretches, the concentration of blood decreases, the human skin absorbs less light, and the reflected light increases [13]. The schematic diagram is shown in Fig. 2.

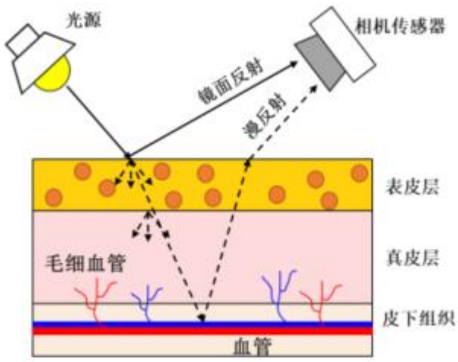

Fig. 2 Schematic diagram of the principle

3.2 Data set

This experiment uses a UBFC dataset of a total of 10 RGB videos, recorded in an indoor environment, including light changes and head movements, with a pixel resolution of 640x480. At the same time, the fingertip oximeter was used to synchronously record the real BVP signal and heart rate value as label data.

3.3 Test results

According to the distribution of the Bland-Altman diagram, the blue scatters are basically within the red dotted line and around the black dashed line. According to the distribution of the Fig. 3 scatter plot, the distribution of the sample points of the predicted value and the true value is basically around the straight line y=x, which indicates that the consistency between the predicted value and the true value is good. Fig. 4 shows that the experimental consistency is good

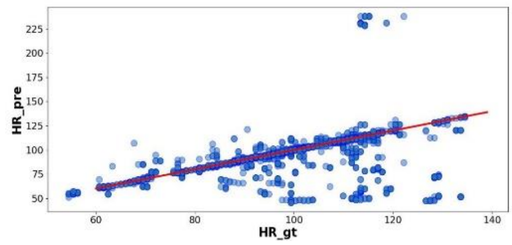

Fig. 3 Scatter plot

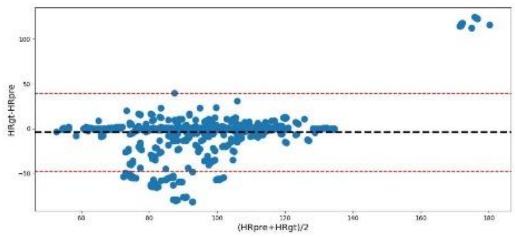

Fig. 4 Bland-Altman

4 Experimental analysis

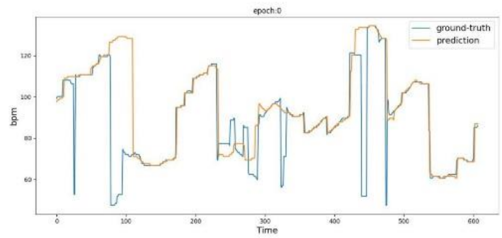

Fig. 5 Comparison chart

Fig. 5 shows that the true value curve is in good agreement with the predicted value curve. Table 1 shows that the error between the measured and true values of body temperature is within acceptable limits.

5 Conclusion

In addition to the non-contact heart rate and body temperature measurements presented in this article, a smart wheelchair system is a highly intelligent device that integrates a variety of sensors, controllers, and actuators to help improve the quality of life for the elderly and people with disabilities with reduced mobility. At the same time, the human-computer interaction module enables users to easily communicate with the wheelchair. In the future, with the continuous development of technology, smart wheelchairs will be able to provide convenient and safe travel solutions for more people in need.

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