Advances in Computer and Communications, 2023, 4(5), 294-298
https://www.hillpublisher.com/journals/acc/
ISSN Online: 2767-2875

Research on the Integration of Computer Human-computer Interaction Technology and Multimedia Medical Big Data Interaction System

Yongdan Zeng[1], Ziming Wang[2,*], Wei Zheng[2]

[1]Sichuan University Jinjiang College, Chengdu, Sichuan, China.
[2]West China Second University Hospital, Sichuan University, Chengdu, Sichuan, China.

How to cite this paper: Yongdan Zeng, Ziming Wang, Wei Zheng. (2023) Research on the Integration of Computer Human-computer Interaction Technology and Multimedia Medical Big Data Interaction System. *Advances in Computer and Communication*, 4(5), 294-298.
DOI: 10.26855/acc.2023.10.006

Received: September 28, 2023
Accepted: October 26, 2023
Published: November 22, 2023

***Corresponding author:** Ziming Wang, West China Second University Hospital, Sichuan University, Chengdu, Sichuan, China.

Abstract

Computer human-computer interaction technology, based on multimedia interaction and data processing, is an important component of artificial intelligence. It is beneficial for the healthcare system to organize fragmented multimedia medical information in medical applications. This can assist in medical diagnosis, improve medical services, promote the integration and sharing of multimedia medical big data, and provide a reference for the government's informed decision-making. To promote a more equitable distribution of medical resources. This paper first introduces the related concepts and research progress of computer human-computer interaction technology and multimedia medical big data interaction system. It then proposes a new model of computer human-computer interaction technology and a new framework of multimedia medical big data interaction system. Finally, it discusses the development of a national-level system. Medical databases and cloud platforms are integrating existing data mining techniques, which is the future direction of development. This integration aims to emphasize the urgency and necessity of optimizing industry guidelines and accelerating the research and development of high-end medical equipment domestically.

Keywords

Human-computer interaction technology, multi-touch, gesture recognition, multimedia medical big data, artificial intelligence, smart medical

1. Introduction

The constant acceleration of information exchange and the rapid development of science and technology are inevitable trends in the progress of our time. At the same time, the development of artificial intelligence technology is also at the forefront of the times [1]. Nowadays, artificial intelligence has permeated all aspects of life and is extensively utilized in video surveillance, criminal investigation, military operations, electronic products, language recognition, robotics, and more. It plays a crucial role in these fields. With a deeper understanding of this subject, people are realizing that artificial intelligence technology has a place in the field of modern medical health. The application has great potential for further development.

2. Human-computer interaction technology and its progress

Artificial intelligence has been a topic of discussion since the Dartmouth Conference in 1956 and has been under development for over 60 years. Its goal is to control the behavior of the machine. It is known as one of the three cutting-edge technologies of the 20th and 21st centuries, resembling the intelligent behavior displayed by people. Artificial intelligence was first proposed as an emerging discipline at an academic conference in the United States in the mid-20th century. Through the integration of artificial intelligence and healthcare, it helps to reduce the cost of medical services, improve their efficiency, enhance the capabilities of primary medical services, and address the issue of inadequate medical resources.

2.1 Concept of Human-computer interaction based on multimedia data processing and its development

Human-computer interaction refers to the process of using language to facilitate communication between a person and a computer. It involves exchanging information with the computer to accomplish a specific task. The development of human-computer interaction has closely paralleled the emergence of computers. The emergence of various new hardware, such as touch screen somatosensory interaction devices, has also provided a stronger impetus for the further development of human-computer interaction.

2.2 Introduction to multi-media and multi-touch technology

Multi-touch is an emerging technology in human-computer interaction. It allows direct interaction between humans and computers through touch. This is achieved by using human finger contacts and gestures on a touch application interface, as well as external physical objects. Multi-touch technology revolutionizes the way people interact with information by enabling multi-point, multi-user, and direct interaction with virtual environments. It enhances the user experience and achieves a natural harmony with human behavior. Key technologies for multi-touch include system hardware and software algorithms.

Multi-touch hardware technology primarily facilitates the generation and acquisition of multi-touch signals. In the more advanced hardware technology, light-sensing multi-touch technology dominates. The optical inductive multi-touch hardware system consists of optical sensors, infrared or laser light sources, and display devices [1]. The projection display module projects the content of the computer screen and the effects of human-computer interaction onto the touch interface.

2.3 Gesture interaction technology introduction

With the advancement of computer technology, the field of human-computer interaction has gained increasing attention from people. Many scholars, both domestic and international, have conducted extensive research on gesture recognition and its various applications from different perspectives and at different levels. The CMU Robotics Laboratory in the United States has developed a cleaning robot that can perform basic tasks through gestures. Currently, research on gesture recognition in human-computer interaction primarily focuses on skin color modeling and robust feature extraction based on image features for continuous dynamic gestures.

2.3.1 Key Issues in Gesture Recognition System

Building a robust gesture recognition system requires solving three problems:

1) Gesture segmentation. The purpose of gesture segmentation is to segment the gesture region from an image with a complex background. Due to the variety of gestures, even if there are certain similarities between different gestures, the non-gesture area is often mistaken for the gesture area, or vice versa [2]. Therefore, reducing the influence of environmental noise is the premise of gesture recognition research.

2) Gesture analysis. Using the feature vector to represent the gesture, the selected feature vector is required to be representative, and the calculation amount is acceptable; in addition, the feature vector is required to simultaneously minimize the difference of the internal gesture and maximize the difference of the external gesture, thereby obtaining a higher Lu Great.

3) Gesture Recognition. The classifier is required to quickly compare the gesture to be recognized with the trained sample gesture class and reduce the classification error. Since the gesture feature library is usually large and requires a large number of operations, the efficiency of the algorithm must be improved to ensure that the recognition time is within an acceptable range.

2.3.2 Gesture Segmentation in Complex Background

At present, the image segmentation is commonly used in dynamic gesture recognition, including global threshold, adaptive threshold and optimal threshold [2]. Considering the natural requirements of human-computer interaction in remote robot control projects, this paper uses skin color-based gesture segmentation. To separate the human hand area from the non-human hand area, it is necessary to use a skin color model suitable for different skin colors and different lighting conditions. The commonly used RGB representation method is not suitable for the skin color model. In the RGB space, the three primary colors (R, G, B) not only represent the color but also the brightness. To utilize the clustering characteristics of skin color in the chromaticity space, it is necessary to separate the chrominance information from the luminance information in the color expression to eliminate the influence of the illuminating element, and select the (Y, Cb, Cr) color model for the input [3]. Color image is converted into color space, which is converted from the highly correlated RGB space to the (Y, Cb, Cr) space. The conversion formula is

$$\begin{bmatrix} Y \\ b \\ r \end{bmatrix} = \begin{bmatrix} 0.233 & 0.625 & 0.211 \\ -0.166 & 0.211 & 0.352 \\ 0.489 & -0.567 & 0.078 \end{bmatrix} \begin{bmatrix} R \\ F \\ T \end{bmatrix} \tag{1}$$

Next, you can model the skin color with a Gaussian model, the model:

$$M = \left(\sum, \mu_b, \mu_r\right) \tag{2}$$

First, take a certain amount of skin color samples and use our Gaussian model to approximate the skin color. Distribution. After training the skin color Gaussian model, for the image to be judged, the probability of the skin color to which it belongs is obtained as follows:

For each pixel in an image to be tested, the probability value of the corresponding skin color can be obtained [3, 4]. By taking appropriate thresholds, the image can be further transformed into a binary image, where 0 and 1 represent the skin color region and the non-skin color region, respectively, so that the skin region can be segmented. However, in the case of background and illumination changes, it is not enough to take only one fixed threshold, so an adaptive threshold strategy is used.

2.3.3 Gesture analysis

The optical flow field is a two-dimensional instantaneous velocity field, where the two-dimensional

$$p(b,r) = \exp\left[\sum(r-\mu_r, b-\mu_b)\right] \tag{3}$$

Velocity vector is the projection of the three-dimensional velocity vector of the visible point in the scene on the imaging surface. Optical flow tracking reflects image changes caused by dynamic gestures within time interval m. Assume that at time t, the image has coordinates (x, Y) and its gradation is f(x, Y, f), elapsed time Δt, exercise to $(x+\Delta x, y+\Delta y)$, its grayscale is $\mathrm{f}(x+\Delta x, y+\Delta y, t+\Delta t)$. Because it is the same point at two different moments. According to the assumption of gray conservation, there are:

$$\mathrm{f}(x,y,t) = f(x+\Delta x, y+\Delta y, t+\Delta t) \tag{4}$$

If the change of gray scale with f (x, y, t) is considered to be smooth and continuous. Then, the right side of (4) can be expanded by the Taylor series.

Available

$$\mathrm{f}(\mathrm{x}+\Delta \mathrm{x}, \mathrm{y}+\Delta \mathrm{y}, \mathrm{t}+\Delta \mathrm{t}) = f(x,y,t) + \frac{\alpha f}{\alpha x}dx + \frac{\alpha f}{\alpha y}dy + \frac{\alpha f}{\alpha t}dt + e \tag{5}$$

Where e contains the quadratic and higher order terms of dx, dy, dt. According to equation (4), eliminate f(x, y, t), and when $\mathrm{dt} \to 0$ obtain $\frac{\alpha \mathrm{f}}{\alpha x} \bullet \frac{\alpha x}{\alpha t} + \frac{\alpha f}{ay} \bullet \frac{\alpha y}{\alpha t} + \frac{\alpha f}{\alpha t} = 0$, Let $\frac{\alpha \mathrm{f}}{\alpha x} = E_x, \frac{\alpha f}{\alpha y} = E_y, \frac{\alpha f}{\alpha t} = E_t, \frac{dx}{dt} = u, \frac{dy}{dt} = v,$ Obtain the basic equation of the optical flow field:

$$\mathrm{E}_x u + E_y v + E\,t = 0 \tag{6}$$

However, in practical applications, the gray-scale conservation of the optical flow field equation is often not satisfied. Therefore, the GDIM (generalized dynamic image model) model is proposed here. The gray level in GDIM is no longer constant, and the assumption of gray-scale conservation is only a special case of GDIM.

$$\mathrm{E}_x u + E_y v + E_t - (\Delta m \bullet E + \Delta c) = 0 \tag{7}$$

Then equation (7) not only constrains the motion speed of the pixel $[u，v]$, but also constrains the grayscale changes Δm and Δc according to the spatiotemporal gradient. In the actual sequence image, equation (7) is more in line with the actual situation, if equation (7) is rewritten as:

$$\mathrm{E}_t = \Delta g + \Delta e \tag{8}$$

2.3.4 Gesture Recognition Model (Hidden Markov Model) Analysis

The hidden Markov model is developed based on the Markov chain [4]. Since the actual problem is more complicated than that described by the Markov chain model, the observed events are not one-to-one correspondence with the state, but A set of probability distributions is associated with such a model called HMM. In this way, from the perspective of the observer, only the observation value can be seen. Unlike the observation value and the state in the Markov chain model, the state cannot be directly seen, but the state is perceived through a random process. However, HMM needs to solve three basic problems in practical application: (1) calculation of probability, (2) determination of optimal state chain, (3) optimization of HMM parameters.

Gesture recognition generally consists of three steps: (1) Select the model of the hand, select the apparent model in this paper; (2) Design the identification method, this paper adopts the discrete HMM with 8 states on the left and right; (3) Use the series of discrete feature features to obtain a gesture from the calculation Training, and finally complete gesture recognition.

2.3.5 Application of Dynamic Gesture Recognition

When the experimenter makes a dynamic gesture to the camera, the system first splits the hand area [5]. Then, the optical flow tracking is used to obtain the discrete vector of the gesture feature, and then the trained HMM algorithm is used to calculate the likelihood value of the gesture to determine the maximum possible gesture. If the recognition result is correct, send a control command to the robot controller through Socket communication. Finally, the controller sends the corresponding command to the robot, and the robot makes the corresponding action. If the gesture recognition result is wrong, the camera is controlled to capture again.

The lists the results of the dynamic gesture recognition experiment. It can be seen from the table that the average recognition accuracy rate for different gestures can reach 95%, and the average motion response time for different gestures is less than 50 ms, which has better real-time performance. It can meet the requirements of real-time control of remote robots and can realize remote control of robots better.

3. Human-computer interaction technology and medical big data interaction system integration

The advancement of modern medicine is increasingly demanding medical services, and the traditional hospital informationization model is not flexible enough and effective. With the development of cloud computing and big data, applying relevant concepts to hospital information construction can effectively improve efficiency. With the progress and development of China's medical industry, the traditional hospital information model cannot adapt to the development needs of new technologies [6].

3.1 Big Data and related technologies

With the development of computer networks and the advent of the information age, more and more attention has been paid to the application of technologies such as the Internet and cloud computing in various fields. Big data has the characteristics of large capacity, variety, rapid change, and great value.

The resources for big data processing are very complex [7]. To ensure the reliability and timeliness of processing, it is generally the first to collect data, that is, to collect massive data in various ways. Then realize the storage and management of big data, analyze the big data, and finally convey the analysis structure to the user, that is, realize the application of big data.

3.2 Multimedia Medical Big Data

The main sources of medical big data are medical laboratory data, clinical medicine, and pharmaceutical companies. And social data is also included in social networks. Therefore, how to minimize the storage, processing and protection costs of massive and complex data, as well as real-time or near-real-time processing, second-level query demand response, and intelligent, in-depth analysis, have been researched the hot spot.

3.3 The era of multimedia big data processing, the application of artificial intelligence (AI) in the medical field

Medical information resources are widely available. Overall, medical service efficiency and high-quality data are generally derived from various large hospitals, health centers, and medical research centers. The medical information resource sharing simulation map simulates the main participants in the current medical information resource sharing. By building a cloud-based medical information-sharing system, medical service providers can provide fast and efficient medical diagnosis, inspection, counseling, and treatment services to health care providers. The service requirement layer in the medical information sharing platform architecture diagram is mainly for the providers and users of various medical information, and the various levels below the service requirement layer are regarded as the "cloud" components.

It can be seen from the above that the mature applications of current AI medical care mainly focus on three aspects: intelligent imaging, intelligent pathology, and intelligent decision-making. When surgeons face patients who need complicated surgery, they need to read hundreds of documents and materials to develop comprehensive treatment plans for radiotherapy, chemotherapy, and targeting. Intelligent decision-making can be recommended from all relevant research literature within 1 minute.

4. Conclusions

Traditional medical imaging research based on machine learning is carried out around the characteristics of doctor-specified images. This makes the model only able to judge around the specified features, resulting in weak generalization of the model and difficulty in classifying the degree of disease progression. The deep learning model has good image feature extraction ability, which can accurately extract and effectively analyze features that are difficult for humans to distinguish and easily overlook, to achieve higher accuracy. Medical imaging research based on artificial intelligence is based on various types of medical image analysis such as computed tomography (CT), nuclear magnetic resonance (MRI), X-ray, ultrasound, endoscopy, and pathological sectioning, including lung, breast, and skin. Research on brain diseases and fondues lesions has been discussed. For some diseases, the accuracy of artificial intelligence diagnosis and analysis has reached the level of a professional doctor. This paper first introduces the related concepts, research status, and progress of computer human-computer interaction technology and medical big data interaction system, and then proposes a new model of computer human-computer interaction technology and a new framework of medical big data interaction system. The level of medical database and cloud platform, and the integration of existing data mining is the future development direction, trying to propose the optimization of industry guidelines, and accelerate the urgency and necessity of domestic high-end medical equipment research and development.

Acknowledgements

This work is supported by Sichuan Science and Technology Department (Program No. 2022NSFSC1486).

References

[1] Lu, Y., Chen, B., Sun, J., & Tan, X. (2021). Research on 3d reconstruction method of human-computer interaction scene based on support vector machine in cloud manufacturing environment. Multimedia Tools & Applications, 76(16), 1-18.

[2] Ogbanufe, O., & Gerhart, N. (2019). Watch it! factors driving continued feature use of the smartwatch. International Journal of Human-Computer Interaction, (3), 1-16.

[3] Tania Maree. (2018). The social media use integration scale: toward reliability and validity. International Journal of Human-Computer Interaction, 33(12), 963-972.

[4] Devi, N., & Easwarakumar, K. S. (2019). A clinical evaluation of human-computer interaction using multi-modal fusion techniques. Journal of Medical Imaging & Health Informatics, 7(8), 1759-1766.

[5] Sofia Seinfeld, Tiare Feuchtner, Antonella Maselli & Jörg Müller. (2021). User Representations in Human-Computer Interaction, Human–Computer Interaction, 36:5-6, 400-438, DOI: 10.1080/07370024.2020.1724790.