Research on Remote Martial Arts Motion Capture Based on Health Information Dissemination in Social Media

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Abstract- This study discusses the remote martial arts motion capture research based on social media, and introduce the application of martial arts motion capture technology, including teaching, training and competition. The paper also discusses the development status of Chinese wushu distance education, Including the challenges in teaching quality, curriculum, teachers and technical support. In order to solve these problems the article puts forward a series of measures, including strengthening the standardization construction, curriculum and teaching materials construction, teachers construction and technical support update. In addition, the paper also introduces the principle, data preprocessing, feature extraction and optimization method of remote martial arts motion capture technology based on intelligent terminal. Based on intelligent terminal, the remote martial arts motion capture evaluation system is developed. The necessary tools include human posture recognition tool, motion evaluation tool and multi-view motion capture system. The influencing factors of the experimental results include motion capture accuracy, motion recognition rate, user experience, system stability and evaluation accuracy. The system has the application value and significance of realizing technology digitization, providing movement evaluation, promoting distance teaching, promoting the popularization of martial arts and expanding the application in other fields.

Keywords-social media; remote; martial arts motion capture; Information dissemination

1. INTRODUCTION

Under the influence of special situations such as the COVID-19 pandemic, the dissemination of information on social media has received widespread attention around the world, and the dissemination of health information is particularly important. As an important part of traditional Chinese culture, the spread of martial arts has also been impacted and influenced by the Internet[1]. Chinese martial arts as a popular sport, its body perception attributes make it difficult to spread remote, but the motion capture system can make up for this shortcoming. Internationally, the motion capture technology application in sports training, competition has been widely recognized, but in China, Some experts believe that online martial arts education

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takes online courses as the core, supplemented by the collaborative guidance of online teachers, and gradually enables online students to complete the meaning construction of martial arts knowledge[2]. In the field of robotics and human-computer interaction, industry and academia alike have identified a need to implement systematic design procedures towards bridging the gap between resources amassed through multi-disciplinary technologies and intelligent applications in sensing.

However, this technology has not yet established an effective model in physical education and training, and it still needs to be further promoted. In order to meet the challenges of the information society and break the limitations of traditional wushu education, it is urgent to conduct in-depth research on wushu distance education[3]. With the continuous progress of technology and the continuous expansion of application fields, it is expected that the application of motion capture technology in the promotion of Chinese martial arts will be more and more extensive in the future.

2. SYSTEM REQUIREMENT ANALYSIS AND OUTLINE DESIGN

2.1 The goal of Remote Wushu motion capture system

Martial arts motion capture technology is based on the micro inertial sensor, biomechanical model and sensor fusion algorithm of advanced technology, through multiple inertial measurement units to accurately measure the key joint motion acceleration, orientation, Angle and other data, and synthesize human movement data. In principle, the common motion capture technology is mainly divided into mechanical and acoustic.

Motion capture systems can be found in many types ranging from acoustic, magnetic, optical and prosthetic based systems**[4]**.In the aspect of teaching, motion capture technology can be effectively applied to the analyses of technical details in wushu, such as posture, gait, and action, etc., to help coach and students better understand and master martial arts techniques. In training, by using motion capture techniques, the coach can be more precise analysis of athlete's action, timely find problems and correct, so as to improve training effect. At the same time, athletes can also practice repeatedly at any venue and time through simulation training.

In the aspects of athletics, motion capture technology can be used to extract the key technique in the martial arts game data, such as speed, power and Angle, provide more fair and objective basis for competition. Principles of remote Wushu motion capture technology based on intelligent terminal[5].

2.2 The principle of remote martial arts motion capture technology based on intelligent terminal

The application of sensor technology in martial arts motion capture mainly includes accelerometer, gyroscope and magnetometer[6]. The main function of these sensors is that the accelerometer is used to measure the acceleration of the object in all directions, so as to reflect the motion state of the object; The gyroscope is used to measure the angular velocity and angular displacement of the object, so as to reflect the rotational motion of the object[7]. Magnetometers are used to measure the strength and direction of the Earth's magnetic field, thus providing a reference for attitude estimation. Among them, the output of the accelerometer formula is:

$$a\ x = a * x \text{ and } a\ y = a * y, a\ z = a * z.$$

Among them, a x, a, y, a z respectively the accelerometer in the x, y, z axis on the output signal, a for factors of the sensitivity of the accelerometer x, y, and z respectively objects in space along the x, y, z axis acceleration. Gyro output of the formula is:

$$x = B * x \text{ omega, omega} = B * y, y\ z \text{ omega} = B * z.$$

Among them, the x, y, z respectively omega gyroscope in the x, y, z axis on the output signal, B says gyroscope sensitivity factor, x, y, and z respectively objects in space along the x, y, z axis angular velocity.

Magnetometer output of the formula is:

$$m * x\ x = C, m, y = C * y, m\ z = C * z.$$

Among them, the m x, m, m y z respectively magnetometerinthe x, y, z axis on the output signal, C says the sensitivity factor of the magnetometer, x, y, and z respectively geomagnetic field in the space component along the x, y,zaxis.

2.3 Data preprocessing: the processing of the raw data by filtering, noise reduction, normalization and other methods

In the remote martial arts motion capture technology based on intelligent terminal, motion recognition is in the core

position, mainly relying on machine learning or deep learning technology to achieve[8].

These methods can be divided into two categories: one is video recognition methods, which aims to extract and classify spatio-temporal features; The other is attitude estimation, which mainly focuses on obtaining skelet on information for retraining.

For data preprocessing part, we first adopt the low-pass filter on the accelerometer and gyroscope data filtering, to eliminate the high frequency noise. The transfer function of

The filter is:

$$H(s)=e-\alpha s1+\alpha sH(s) = \frac{e^{-\alpha s}}{1 +\alpha s}H(s)=1+\alpha se-\alpha s,$$

where H(s) represents the transfer function of the filter, s represents the complex frequency, and α represents the parameter of the filter.

Then, we use the high-pass filter to the magnetometer data noise reduction, to maintain the low frequency signal. High-pass filter transfer function

H (s) = (1 - beta s1 beta s) H (s) = \ frac {1 - \ beta (s)}} {1 + \ beta s H (s) = 1 + beta s1 - beta s, high-pass filter transfer function H (s) said, beta said filter parameters.

Finally, we will process the data into a unified coordinate system and units, in order to follow-up feature extraction and recognition. The normalization formula is as follows: $x'=(x-mean)stdx' = \frac{(x-mean)}{std}x '=std(x-mean)$.

where x' represents the normalized data, x represents the original data, mean represents the mean value of the data, and std represents the standard deviation of the data.

2.4 Feature extraction: the calculation method of joint Angle, limb length, velocity and other features

In wushu remote action recognition, feature extraction

mainly involves the elements of joint Angle, limb length, movement speed and movement recognition. Lightweight multi-person 3D motion capture system in unconstrained environment, the system is easy to assemble, requires only a small number of(4 ~ 6) ordinary cameras or cameras, and is suitable for general indoor and outdoor environments. (Yang, W, 2021)[9] In this process, machine learning methods and deep learning methods should be combined. Specifically, machine learning methods use support vector machines (SVM), decision trees and other classification algorithms to classify features. Where, the classification decision function of SVM is f(x) = w * x + b,f(x) represents the classification decision function, w represents the weight vector, b represents the bias term, and x represents the feature vector. The goal of SVM is to solve for optimal w and b to maximize the distance of classification boundaries. Deep learning uses convolution neural network(CNN), recurrent neural network (RNN) and other network structures to identify features end-to-end[10].

The basic structure of CNN consists of convolution layer,

pooling layer and fully connected layer. The local feature is extracted and the parameter number is reduced by multi-layer convolution and pooling operation. RNNS process time series data by introducing hidden states that capture long-term dependencies in time series.

For the calculation of joint Angle, we through analyzing the data of the accelerometer and gyroscope. Specifically, the formula for calculating the joint angle is angle = atan2(y, x), where Angle represents the joint Angle, and x and y represent the acceleration value of the accelerometer and gyroscope on a certain axis, respectively.

Body length calculation is based on the joint Angle and the human body proportion relationship. Limb length calculation formula is good.

Figure 1 shows a flowchart using Plant UML that illustrates how deep learning can be used for martial arts remote action recognition. Specifically, it includes data acquisition, low-pass filtering, high-pass filtering, feature extraction, and action recognition.

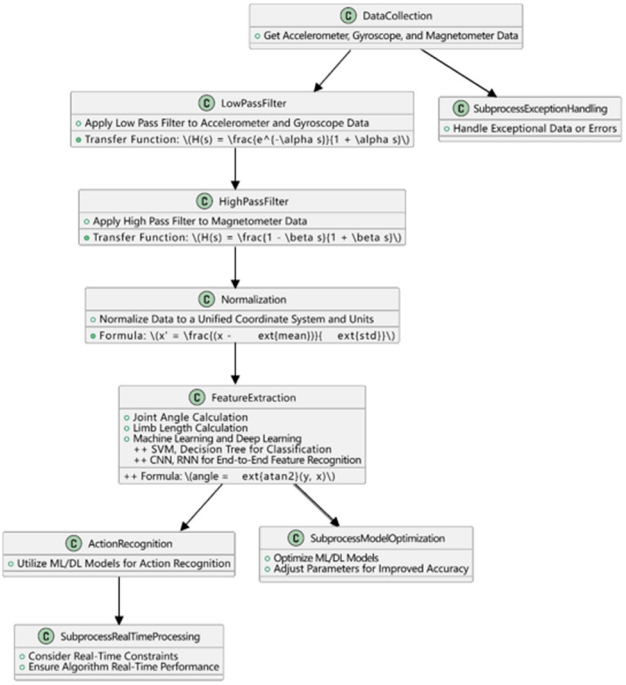

Fig. 1 Flowchart of Wushu Remote Action Recognition

3. OPTIMIZATION METHOD

3.1 Software testing tools

For remote martial arts in the intelligent terminal motion

capture evaluation system of software testing process, we may use the following tools:

1)Motion capture tools: The main function of this type of tool is to capture and record the martial arts movements performed by the user. According to different motion capture systems, it can be divided into three types: non-calibrated optical motion capture system based on computer vision, optical calibrated optical motion capture system and inertial motion capture system. These tools are able to comprehensively record the user's movement trajectory, key movements of the limbs and torso, and other data[11].

2)The body posture recognition tool: this tool mainly

using machine learning technology, through the analysis of the unmarked of cameras capture action, will be detected by

human activities is expressed as correspond to specific actions of wave characteristics and extract the signals to the computer terminal.

3)Action evaluation tool: this kind of tool is responsible for capturing to evaluate and score the action, evaluation of the technical level of the user is given.

4)The motion capture system multiple points of view: Based on the acquisition of motion-related data, functional action patterns and motion techniques are evaluated, and multi-objective feedback training methods are established. (Yang, W, 2021)**[12]**

Such systems usually adopt sequential matching strategies. Firstly, each view Angle is independently detected and connected to the human body, and then multi-view

correlation and pose solving are performed on the human body. Finally, time domain tracking is carried out. All of these tools in the software testing phase play an important role, to help improve the system functionality, stability, and the user experience.

3.2 Influencing factors of experimental results of remote martial arts motion capture evaluation system based on intelligent terminal

Motion capture accuracy: whether the system can accurately and real-time capture various martial arts actions performed by users. This needs to be assessed by comparing the actual actions to those identified by the system.

Action: speech recognition system can correctly identify

users perform martial arts movement. This needs to be assessed by the number of movements correctly identified by the statistical system and the total number of movements.

User experience: users in the motion capture system is used for martial arts and feel how to evaluation. This can be obtained through questionnaires, user feedback, etc.

System stability: in the long run or when handling large amounts of data is stable, the existence of caton, collapse and so on.

Evaluation of accuracy: the system of the evaluation results (such as the action to complete the degree, technical level, etc.) are accurate, whether can reflect the user's martial arts skills.

System response speed: whether the capture and evaluation of user action quickly, whether it can meet the needs of real-time feedback.

4. Conclusions

The research of remote martial arts motion capture can realize technology digitization, provide movement evaluation and promote remote teaching. Based on human posture recognition technology, the system uses motion capture and bone tracking technology to monitor the movement trajectory of the subject, so as to calculate the key movements of the body and trunk of the subject in real time, and complete the digital automatic collection and calculation of the technology of the subject. The system can accurately evaluate the martial arts actions performed by users, give an evaluation of the technical level, and help users better understand their technical status and conduct targeted training.

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