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Tennis Practice on the Control Ability of the Intelligent Sensor System of the Elderly Posture

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Abstract: In today's society, the rate of population aging is getting faster and faster, and the health of the elderly has attracted much attention. It has been found that many elderly physical diseases are caused by the long-term bad habits and lack of exercise in the elderly. More and more studies have shown that proper exercise can prevent and reduce the occurrence of these diseases. With the development of smart sensor technology and the application of artificial intelligence technology, smart sensors have been used to monitor various body information data of the elderly, and play an important role in studying the influence of various sports exercises on the ability of the elderly to control their body posture. This article uses the intelligent sensor system to study the influence of tennis practice on the control ability of the elderly's body posture. This article first analyzes the knowledge of sports mechanics in tennis practice through literature research, formulates correct and comfortable tennis practice methods suitable for the elderly, and uses smart sensors to track and monitor the body posture data of the elderly. Then this paper uses a particle filter-based sensor target tracking model to monitor the elderly's fall, and uses a fourth-order Butterworth filter to evaluate the elderly's body posture control ability. Then this paper uses BP neural network to recognize and analyze the body posture of the elderly and predict the posture control ability. Finally, a comparative analysis of the effect of tennis exercises on the body control ability of the elderly is carried out through the control experiment of the elderly body posture test. Experiments show that tennis exercises can significantly improve the body control ability of the elderly, especially the lateral posture control.

1. Introduction

1.1. Background and Significance

Limb function impairment is a common disease in the elderly, such as fall injury in the elderly,

loss of limb function in stroke, and limb spasm. Studies have shown that these limb dysfunctions are related to the ability of the elderly to control their posture. For example, a fall is a sudden, unconscious change in the body posture of the elderly that causes the body support to lose balance and fall to the ground [1]. These injuries seriously affect the health of the elderly, and the time and cost of treatment will also place a heavy economic burden on the family and society. A large number of studies have shown that with the increase of age and the aging of body organs, the ability of postural control of the elderly decreases significantly, which greatly increases the risk of disease occurrence of limb function impairment in the elderly [2-3]. At present, relevant institutions have invested a lot of energy in improving the decline of the elderly's body posture control ability, and found that appropriate exercise is an effective measure to delay and improve the decline of the elderly's body posture control ability. In recent years, some scholars have studied the strategy of taking multiple steps to restore balance when the elderly are about to fall under certain disturbances, indicating that the movement training of the elderly in the front, back, left and right directions can help the elderly master balance and prevent body posture control. The various dangers brought by the decline [4-5]. Based on this, some studies have proposed to improve this problem through exercises that exercise the front, back, left, and right directions of the limbs, such as multi-directional movement training, whole-body vibration training, uniform jogging, tennis exercises, and Tai Chi. It can be seen that the research based on the influence of tennis practice on the posture control ability of the elderly is of great significance for improving the decline of the posture control ability of the elderly.

1.2. Related Research at Home and Abroad

There are many research results and improvement measures at home and abroad for the research on the body posture control ability of the elderly. For example, the following domestic discussions and research. Cheng developed a software program that uses the reaction generated by the swing or swing of the Bluetooth ball to drive objects on the computer screen. This information technology is used to improve the "mouse hand" and "keyboard hand" caused by incorrect movement or excessive force. "Rehabilitation treatment environment for wrist diseases [6]. Ji studied the hazards of the reclining posture to the occupants of the driving vehicle. He found that the reclining posture is likely to cause abdominal injuries to the occupants and may increase the risk of spine injury. The crew is very unfavorable [7]. Feng studied the effects of related nerve and muscle defects on the human body's posture control ability in space through experiments and the experimental analysis of controlling the position of the human body in space through human posture actions [8]. Zhang simulates the influence of unequal leg length on the posture of the spine and pelvis in standing and walking states, and then discusses the law of human body posture adjustment and adaptation [9]. Wang studied the emotional expression of tennis players in response to victory or defeat, and compared the processing of emotional faces and body postures recorded by behavior and ERP to identify and judge the state of athletes' victory and defeat [10].

In Western countries, according to statistics, falls and fractures of the elderly have caused huge economic losses. The main reason is the decline in the ability of the elderly to control their posture. Zelai has developed a system for correcting the bad posture of the elderly designed for indoor applications based on Kinect. It detects changes in the body posture of the elderly through the limb node data received by the sensor, and helps them correct the appropriate posture to maintain a healthy lifestyle [11]. Vitale proposed that there is a complex correlation between the neural mechanisms required for posture adjustment and cognitive dysfunction, and believes that the

neurodegenerative disease "Parkinson's disease" that is common in the elderly is related to cognitive dysfunction and abnormal posture [12]. Yasuto explored balance imbalance, a risk factor for falls in the elderly, and conducted a randomized controlled trial to evaluate the impact of current vestibular stimulation on the sensor signal COP swing in the open-eye standing posture of the elderly living in the community [13]. Doulah uses a non-EMG-based method based on inertial sensors placed on the orthosis at different positions, and a lightweight pattern recognition algorithm to recognize the transitional posture of the elderly from sitting to standing, providing the frail elderly with a transition from sitting The help of body transition posture adjustment to the station [14]. Andrea believes that loss of balance is the root cause of the risk of falls. Balance involves complex human functional systems such as somatosensory, posture, vestibular, and vision. Based on this, he proposed to evaluate the causal relationship between limb osteopathy and its impact on balance through stability examination, in order to prevent and reduce the risk of falling due to the decline of body posture control in the elderly [15].

1.3. Innovations in This Article

In this paper, aiming at the problem of the decline of the elderly's body posture control ability, appropriate exercise training methods through tennis practice are proposed to improve the decline of the elderly's body control ability and disease risk. In this study, a controlled experiment was used to analyze the influence of tennis practice on the posture control ability of the elderly, the intelligent sensor system was used to collect posture information data of the elderly, and the target location tracking method based on the sensor data particle filter was proposed to timely and effectively monitor The fall of the elderly avoids the greater harm caused by the fall of the elderly who cannot seek medical attention in time. This paper uses BP neural network to identify and analyze the body posture information of the elderly, and compares the body posture and the probability of falling between the elderly who do reasonable tennis exercises and those who do not exercise. It is found that tennis Practice does have a positive effect on improving the posture control ability of the elderly.

2. Method Application of Smart Sensors in Sports Training and Posture Control of the Elderly

2.1. Smart Sensor System

With the development of information technology, the application of sensors has been integrated into our daily lives. It helps us to monitor health, living environment and other important information, allowing us to fully understand the world around us. The intelligent sensor system is a revolutionary development in the application of sensor technology. It connects various traditional sensors through mobile information technologies such as the Internet to obtain more comprehensive, tighter and more accurate information. The most basic function of a smart sensor is to connect a sensitive element with the data processing function provided by the microprocessor, and the smart sensor system maximizes the basic functions of the smart sensor. Smart sensor systems generally include sensitive components that respond to sensor signals and data, as well as the functions of logging, processing and analyzing these response data and other data through the Internet, as well as independent self-provided energy [16-17]. The main feature of the intelligent sensor system is to provide more reliable and complete important data information to the network through the communication interface. Compared with traditional sensors, smart sensors have intelligent

performance such as self-calibration, self-evaluation of working status, self-repair of faults, compensation and measurement [18-19]. The intelligent sensor system can optimize the operation of each intelligent sensor in the system and perform data processing, and has a further understanding and improvement of the data measurement and measurement environment. The smart sensor system can also identify itself and communicate with various networks, and adjust the program of the smart sensor when necessary. In other words, the smart sensor system can monitor and correlate the data acquired by multiple sensor systems in a certain area, and is not limited to verifying the data collected by a single sensor in order to understand the more comprehensive situation of the area.

2.2. Kinetic Mechanics in Tennis Practice

The sports mechanics in tennis practice are very important for the correct posture and exercise effect of tennis. Regardless of factors such as wind speed and the angle of the opponent's ball, the impact force of tennis practice is studied separately on the force of the wrist and arm [20]. Suppose the racket length is s, the racket net length is 2m, the distance from the center of the racket grip to the end of the grip is d, the time interval from receiving the ball to the time the ball leaves the racket is t, the vertical force of the tennis ball on the racket is f, and the force of the wrist to the center of the racket grip is F. It can be obtained according to the momentum theorem regardless of the influence of gravity.

$$\begin{cases} f = \dfrac{m(v_0 + v_1)}{t} \\ fx = I\alpha \\ F + f = Ma \end{cases} \tag{1}$$

Where I represents the moment of inertia of the racket around the center of the grip, α represents the angular velocity of the racket around the center of the grip, and a is the acceleration of the displacement of the racket's center of mass. According to the law of motion of the center of mass, the following calculation formula for the acceleration of the center of mass can be obtained:

$$a = (s - 2m - d)\alpha \tag{2}$$

Combining the above formulas (1) and (2) according to the rotation law can obtain the formula for calculating the force F of the wrist on the center of the racket grip.

$$F = \frac{m(v_0 + v_1)}{t}\left[\frac{Mx(s - 2m - d)}{I} - 1\right] \tag{3}$$

In actual tennis practice, it is often encountered that the racket receiving point is just at the edge of the racket. At this time, the reaction force generated by the impact of the ball on the racket is almost perpendicular to the arm. This is the reason why people often say that tennis elbow is formed. At this time, if the force of the wrist on the center of the racket grip is F=0, the distance y from the center of the grip to the contact point can be calculated.

$$y = \frac{I}{M(s - 2m - d)} \tag{4}$$

Based on the knowledge of sports mechanics in the above tennis exercises, correct and

comfortable tennis practice postures can be designed and adjusted for the elderly, so as to obtain the effect of strengthening the body, which is helpful for the elderly's posture control, balance ability and prevention of falls.

2.3. Application of Smart Sensors in the Research of Elderly Posture Control and Tracking

(1) Mathematical prediction model of human body slipping

Falls are the most common sports injuries in daily life, especially for the elderly. Scholars have conducted research on the causes of such sports injuries for a long time. The relatively early human slip prediction model was a mathematical prediction model between the slip resistance of the shoe-ground interface and the actual slip by the British physicist Hansen in the 19th century [21]. This model uses the coefficient of friction between the ground and the sole to study the cause and process of human slips, and it is also the basic idea of most human slip prediction studies. Its logistic regression model is as follows:

$$p = \frac{e^{(\alpha_0 + \alpha_1 COF_{diff})}}{1 + e^{(\alpha_0 + \alpha_1 COF_{diff})}} \tag{5}$$

Where p represents the probability of slipping α_0 and α_1, respectively representing the regression constant and coefficient of the mathematical model, and COF_{diff} represents the safety threshold of the corresponding friction coefficient. This model can predict the probability of a human body slipping based on the friction factor of the human body slipping. Accordingly, people can take appropriate protective measures to reduce the probability of slipping.

(2) Intelligent tracking and positioning of the elderly falling

With the application of smart sensors, models for predicting falls for the elderly have also begun to incorporate the detection technology of smart sensors. For the factors that cause the elderly to fall, in addition to the friction with the shoes and the ground, this article monitors and analyzes the posture control of the elderly and finds that the decline of the elderly's postural control ability is another factor that causes the fall. For the location tracking of the elderly falling, this paper uses the particle filter as the basis to track the target. The central idea of particle filtering is to use discrete random sampling points, that is, particles approximately represent the random variable probability density function of the system, and use the average value of the sample to replace the integral operation [22-23]. This method can be used to obtain the minimum variance estimate of the sample particle state. The particle set collected and filtered in the particle filter is weighted and recursively propagated according to the Bayesian criterion. The so-called Monte Carlo method is to express the posterior distribution in the form of a particle set, thereby turning the form of integration into the form of summation.

$$\hat{p} = (X_{0:m} \mid Y_{1:m}) = \frac{1}{n} \sum_{i=1}^{n} \xi_{0:m}(dX_{0:m}) \tag{6}$$

The random sample set collected from the posterior probability distribution is $\left\{X_{0:m}^{(i)} \mid i = 1,....n\right\}$, and $\xi(dX_{0:m})$ is the Dirac-Delta function. According to the nature of the probability density function, the mathematical expectation of the sample set of the density function f_t from t+1 to n can be calculated.

$$E\left[f_t(X_{0:t})\right] = \int f_t(X_{0:t}) p(X_{0:t} \mid Y_{1:t}) dX_{0:t} \tag{7}$$

For this sampling method, a limited set of discrete samples can be used to roughly represent the posterior probability distribution. According to the knowledge of the theorem of large numbers in mathematical statistics, as the number of particles n increases until it tends to infinity, the integral form $E[f_t(X_{0:t})]$ of its mathematical expectation can be approximately transformed into the summation form $E[f_t(X_{0:t})]_{sum}$. The Bayesian importance sampling principle The basic idea is to first select a known reference distribution that is easy to sample, and then extract samples from this reference distribution, and approximate it by weighting and summing the particle set or signal data sampled from the reference distribution. The test distribution $p(X_{0:t} | Y_{1:t})$. Then the Bayesian mathematical expectation summation form of its probability density function is shown in the following formula, where $h_t(X_{0:t})$ is the normalized weight function, and $X_{0:t}^{(i)}$ is the sample obtained by sampling from the reference distribution.

$$\begin{cases} h_t(X_{0:t}) = \dfrac{p(Y_{1:t} | X_{0:t}) p(X_{0:t})}{p(X_{0:t} | Y_{1:t})} \\ E[f_t(X_{0:t})]_{sum} = \sum_{i=1}^{n} f_t(X_{0:t}^{(i)}) h_t(X_{0:t}^{(i)}) \end{cases} \tag{8}$$

(3) Monitoring and evaluation of elderly posture control ability

For the monitoring of the elderly's body posture control ability, this paper collects the experimental data of the elderly's dynamic and static posture through smart sensors, and uses a fourth-order Butterworth filter for filtering analysis. The principle of this filtering method is to use the data collected by the sensor and the data processing software to calculate the maximum distance of the COP signal of the smart sensor in the front and back and left and right directions of the elderly experimental equipment, the 95% coverage area of the COP signal, and the average speed of the COP signal distance transmission. Data indicators to evaluate the posture control ability of the elderly [24].

$$S_{AB} = \frac{1}{N} \sum_{i=1}^{N} A(i) * B(i) \tag{9}$$

Where A is the covariance of the distance of the sensor COP signal in the front-rear direction and the left-right direction, and A(i) and B(i) are the distance of the i-th COP signal in the front-rear direction and the left-right direction, respectively. Then its maximum distance calculation method is as follows:

$$D = \sqrt{S_A{}^2 + S_B{}^2 - 4 * (S_A{}^2 * S_B{}^2 - S_{AB}{}^2)} \tag{10}$$

In the above formula, S_A and S_A respectively represent the standard deviation of the distance of the COP signal in the front-rear direction and the left-right direction. The calculation method of the maximum value Max and the minimum value Min of the distance of the sensor COP signal in the front, back, left and right directions is as follows:

$$\begin{cases} Max = \sqrt{2 * (S_A{}^2 + S_B{}^2 + D)} \\ Min = \sqrt{2 * (S_A{}^2 + S_B{}^2 - D)} \end{cases} \tag{11}$$

The 95% COP area represents the coverage area with 95% confidence in the evaluation of the COP signal data of the force plate sensor. In other words, it contains about 95% of the sensor COP signal trace. Its calculation formula is as follows:

$$S_{cop} = \pi * Max * Min \tag{12}$$

Through these data and relevant research standards, the ability to control the body posture of the elderly can be evaluated.

$$v(i) = \frac{\left| d_{cop}(i+1) - d_{cop}(i) \right|}{T}, \quad \bar{V} = \frac{1}{N-1} \sum_{i=1}^{N-1} v(i) \tag{13}$$

2.4. The Application of Neural Network in the Analysis of Elderly Posture

After the smart sensor collects the elderly posture detection data, this paper uses neural network to identify and analyze the elderly posture. According to the related research of face recognition technology, this paper chooses BP neural network in artificial neural network to realize this function. The algorithm used by the BP neural network is the error back propagation algorithm, which is the BP algorithm. It is currently the most successful algorithm [25]. For a BP neural network, if the set of random variables is $\{a_1, a_2, ...a_n\}$, a_i represents the node in the network structure, and $F_n(a_i)$ represents all the parent nodes of a_i. Then its joint distribution is defined as follows:

$$P(a_1, a_2, ...a_n) = \prod_{i=1}^{n} P(a_i \mid F_n(a_i)) \tag{14}$$

In the joint probability space, each state can be represented by the product of conditional probabilities, that is, the probability of each variable in a certain state. After understanding the neural network structure, network learning is limited to parameters. Maximum likelihood method and Bayesian estimation are two commonly used parameter learning methods for complete model learning of data sets. After the network model is determined, the maximum likelihood function of the parameter α and the data set S can be obtained according to the data sample:

$$\log L(\alpha \mid S) = \log \prod_{i=1}^{n} P(d_i \mid \alpha) = \sum_{i=1}^{n} \sum_{j=1}^{p_i} \sum_{k=}^{qi} n_{ijk} \log(\alpha_{ijk}) \tag{15}$$

3. Tracking Research on the Influence of Tennis Practice on Elderly Posture Control

3.1. Research Object

There are a total of 80 elderly volunteers who volunteered to participate in the experiment, including 25 elderly people who exercise irregular daily exercises, 26 elderly people who jog and exercise daily, and 29 elderly people who practice tennis. In order to ensure the safety of the experiment and eliminate interference. This experiment requires that the subjects' eyesight is above the normal level, and there is no history of neurological diseases, skeletal muscle system diseases, vestibular system diseases, diabetes and cardiovascular system diseases within half a year, and they do not drink alcohol or take painkillers during daily time. , Sleeping pills, anti-inflammatory drugs, antipyretic analgesics and no history of falling within six months. The elderly in this experiment were between 65 and 80 years old. This experiment uses a controlled experiment method. In addition to the basic tennis practice group and the control group, there is also a jogging group for the elderly, so that the posture control of the elderly group who does not exercise, tennis exercises and jogging exercises can be paired. Comparative analysis to study the effect of tennis practice on the control ability of the elderly's body posture. After screening according to these conditions, the elderly subjects who meet the above conditions were divided into an irregular exercise control

group of 20 people, an elderly jogging group of 20, and an elderly tennis practice group of 20. A total of 60 elderly subjects were all are male.

3.2. Experimental Design

This research collects information about the elderly's body posture control ability and related research results through literature research and questionnaire surveys, and proposes a research experiment on the influence of tennis exercises on the control ability of the elderly's posture intelligent sensor system. This experiment is divided into four steps. First, collect information and ask tennis players about the knowledge of sports mechanics in tennis practice and the correct practice methods to develop tennis practice methods suitable for the elderly. Then, there will be three groups of elderly subjects who agree to participate in the experiment: tennis practice group, jogging exercise group and irregular exercise control group. Among them, the tennis practice group and the jogging exercise group require the elderly to insist on regular tennis practice or jogging exercise for at least 3 months without other sports exercises, at least 4 times a week, at least 1 hour each time. The control group was the elderly who did not exercise regularly. Then, through the smart sensor system and various smart sensor equipment, the subjects are subjected to posture control ability monitoring experiments, and the target location tracking research and posture recognition analysis are carried out on the phenomenon of the elderly falling. Finally, the BP neural network is used to perform posture recognition analysis and posture control ability evaluation and prediction on the subjects and the elderly on the experimental data. A comparative analysis of the experimental results of the three groups was carried out to study the influence of tennis practice on the body posture control ability of the elderly, and put forward some suggestions to improve the decline of the body control ability of the elderly.

3.3. Experimental Method

(1) Literature research method

In the preparatory work of this research, firstly, by consulting related literature, we first understood the situation of elderly posture control and related research on posture control intelligent sensor system, as well as the knowledge of sports mechanics in tennis practice. Based on this, a tennis practice method suitable for the elderly is formulated to achieve the effect of exercise exercise and improve the decline of the elderly's postural control ability. This requires in-depth study and a full understanding of the relationship between motion system and posture control in the specific implementation process, and you can consult experienced tennis players and related medical workers.

(2) Statistical methods

This experiment uses two-factor repeated measurement statistics to analyze the statistical relationship between the dependent variable and the independent variable on the static standing posture data of the elderly. Among them, group, eyes closed, and different perspectives are independent variables, and the monitoring data of COP variables are dependent variables. The data under the dynamic posture completion task uses a three-factor repeated measurement statistical method to analyze the statistical relationship between the dependent variable COP and the independent variables such as the group, average distance, and opening size. The statistical results show that there is a significant difference between the two, indicating that the experimental data is valid, and further univariate analysis and the analysis and prediction of the elderly's posture control ability can be carried out. All statistical analyses were performed using SPSS 22.0 software, and the

significance level α=0.05.

4. Discussion

4.1. Analysis of Intelligent Sensor Monitoring System for Elderly Posture

After passing the questionnaire survey, this study selected 60 elderly people from the community as the research objects. The basic requirement for sample selection is that they are over 65 years old and do not exercise regularly in daily life. All elderly subjects were randomly assigned to a tennis practice group, an experimental control group, and a jogging training group. Two groups of tested elderly people need to have a certain understanding of the experiment process, have no major diseases, and voluntarily participate in the experiment and fill out the experiment consent form. As can be seen from the table below, the elderly who participated in the training were between 66 and 76 years old and had no major diseases.

Table 1. Basic situation of elderly subjects

Test index	Elderly control group	Elderly tennis group	Elderly jogging group	Average
Number	20	20	20	20
Age(year)	72.36±4.12	70.26±4.56	71.46±4.22	71.33±4.25
Height(cm)	168.22±7.26	167.37±6.54	170.25±7.66	169.12±6.53
Weight(kg)	66.54±12.34	68.76±13.44	68.37±11.25	67.67±12.44
BMI(kg/m²)	22.35±3.97	25.19±4.33	23.86±3.87	24.13±3.66

For the recognition and detection of elderly postures, this article uses a smart sensor system that combines several smart sensor technologies with the Internet. After the sensor collects the corresponding data, it is uploaded to the Internet through the network communication port and then assisted by powerful cloud computing and artificial intelligence technology. Analyze and process these data. The main principle of these technologies is the application of BP neural network in data processing. The flow of this experiment is shown in Figure 1. The intelligent sensor firstly uploads the collected information of the elderly to the intelligent sensor system platform, and groups them according to whether the elderly have tennis practice or other regular exercise. Then the subjects were tested for various information indicators, including electromyography, kinematics and sensor cop advanced processing indicators.

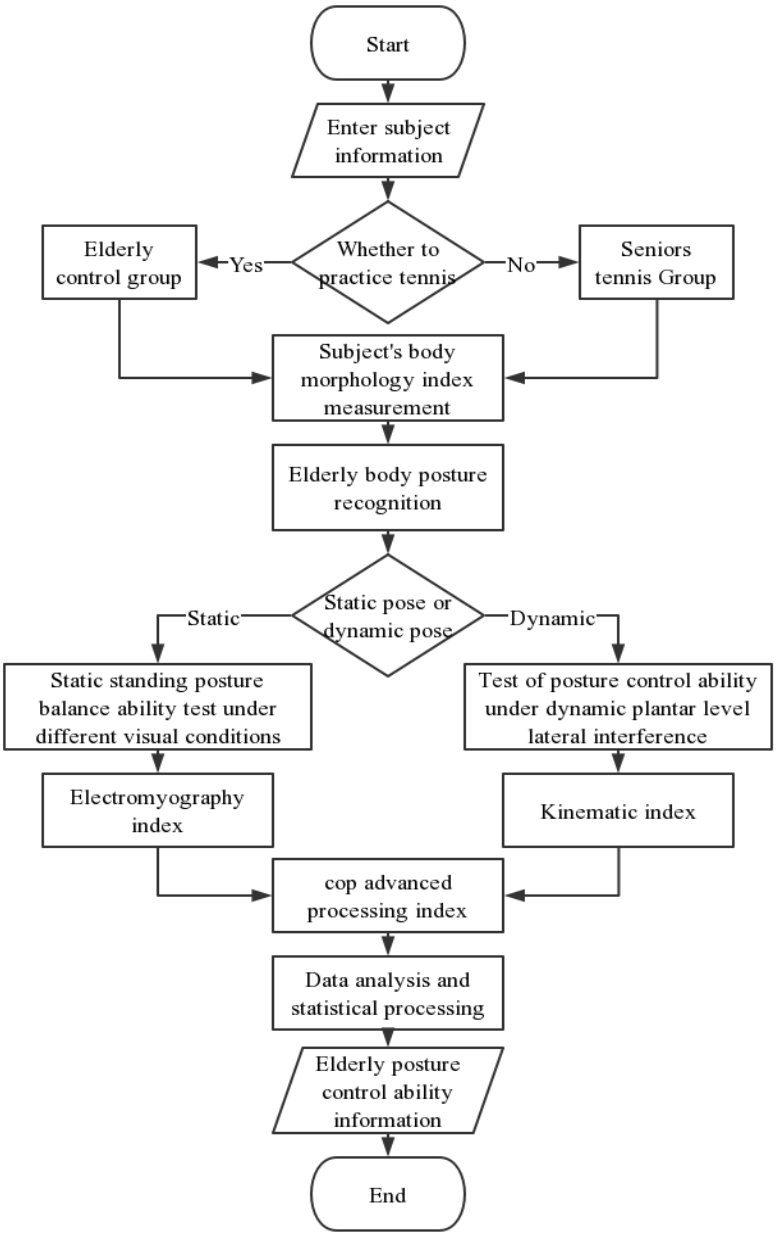

Figure 1. Experimental flowchart of detection of elderly posture control ability

4.2. Analysis on the Prediction Model of the Old People's Falling Posture

Falls are a common injury disease that threatens the health of the elderly in life. Through this predictive model, it is possible to detect the fall of the elderly in time and give an early warning to help the elderly who fall to seek medical treatment in time.As the test detection time increases, the prediction accuracy continues to improve, the error continues to decrease, and the final error drops to 0.1 or less.

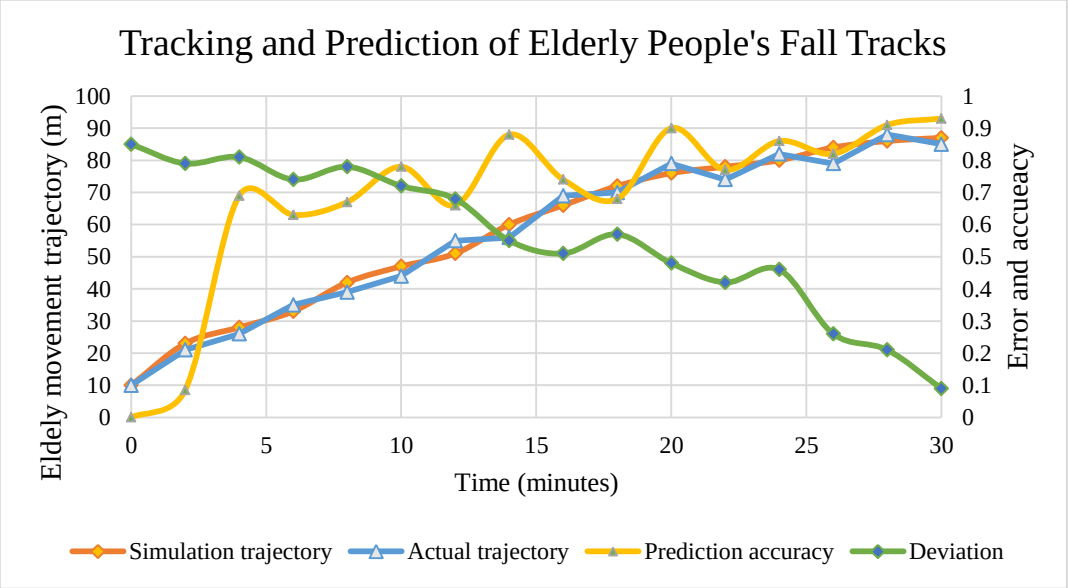

Figure 2. Tracking and Prediction of Elderly People's Fall Tracks

4.3. Analysis of Posture Control of the Elderly in Tennis Practice

This article analyzes the body posture control ability of the elderly in the experiment by testing the completion of static standing and dynamic posture of the elderly. The main monitoring indicators are total displacement TD, total average speed TAS, total movement area TMA, lateral amplitude LA, lateral movement speed LMS, lateral movement range LMR.The test results are shown in Table 2 below.

Table 2. Comparative analysis of advanced processing indexes of COP in elderly posture

Index	Elderly control group	Elderly tennis group	TSC	TSO	P
TD(mm)	0.87±0.33	0.69±0.12	1.55±0.72	0.66±0.13	0.003
TAS(mm/s)	160.27±23.98	156.13±25.64	180.55±56.94	139.64±35.74	0.016
TMA(mm²)	28.62±18.67	18.64±12.54	180.54±88.74	20.16±18.97	0.005
LA(mm)	48.75±18.61	55.41±18.97	96.13±41.22	35.26±14.58	0.308
LMS(mm/s)	42.56±20.66	45.97±9.48	25.91±14.33	14.83±10.74	0.022
LMR(mm)	261.44±144.37	199.98±35.26	360.13±254.34	166.46±28.83	0.208
FBA(mm)	36.23±28.43	30.95±18.62	47.83±17.68	39.87±16.97	0.036
FBMS(mm/s)	49.56±17.87	44.12±9.33	152.16±95.64	46.46±22.88	0.027
FBMR(mm)	350.24±100.25	292.64±50.13	675.88±330.76	284.26±44.70	0.007

Based on the body posture data of the elderly collected by sensors, this paper analyzes the inclination angle and complexity of the four common body postures of the elderly, such as standing, sitting, squatting, and falling. Easy to collect. As shown in Figure 3, this plays an important role for the smart sensor system to recognize the posture of the elderly.

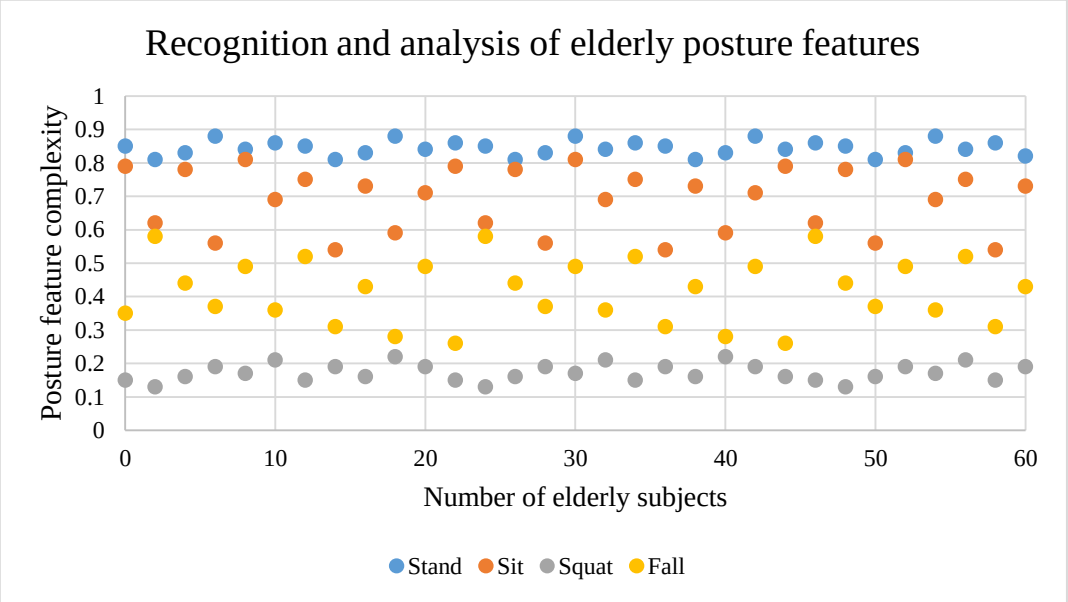

Figure 3. Recognition and analysis of elderly posture features

4.4. The Impact of Tennis Exercises on the Physical and Motor Functions of the Elderly

This paper uses the electromyography indicators monitored by smart sensors to reflect the status of the elderly's limb function and motor function, and compares and analyzes the effects of exercise exercise on the elderly's postural control ability through the comparison and analysis of the electromyography indicators of the three elderly experimental groups. As shown in Figure 4, the electromyography index of the tennis practice group of the elderly is better than the other two groups, which shows that tennis practice has a positive effect on improving the body posture control ability of the elderly.

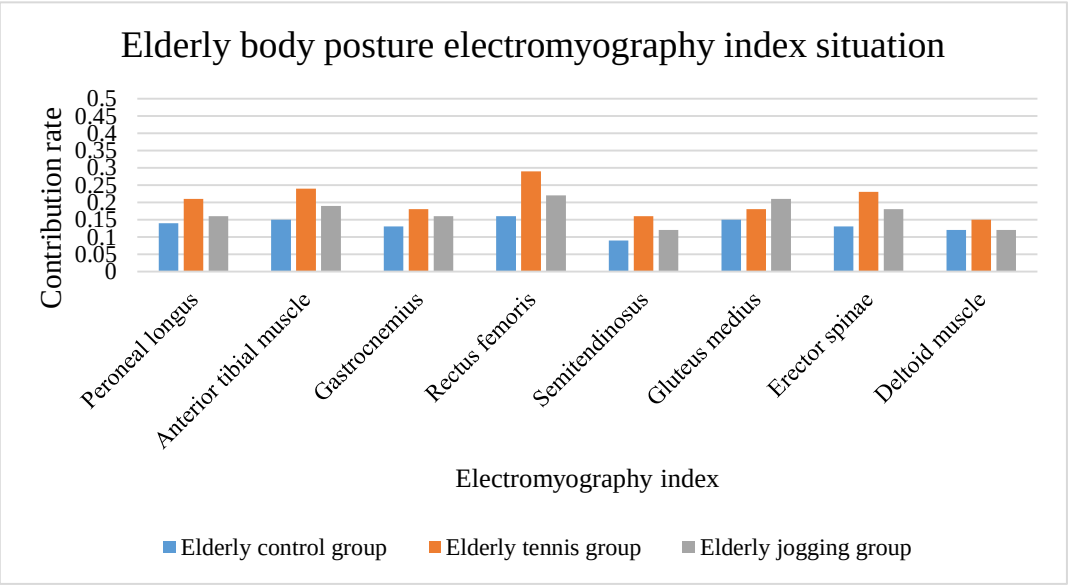

Figure 4. Elderly body posture electromyography index situation

5. Conclusion

This article analyzes the current situation of the rapid aging of the population in today's society and the increasingly severe medical situation of the elderly. After investigation and statistics, neurological and limb function diseases such as falls, strokes, and fractures account for the largest proportion of elderly diseases. According to relevant medical research and knowledge of sports mechanics, it is found that this is caused by the significant decline in body control ability as the elderly age. Studies have shown that proper exercise can effectively improve this situation. Therefore, this paper proposes a research on the influence of tennis training on the control ability of the elderly posture intelligent sensor system. The influence of body posture control ability. It is hoped that reasonable sports interventions such as tennis exercises can be used to delay the decline of the elderly's body posture control ability and the weakening of their balance ability, and reduce the risk of falls for the elderly.

Through experiments, this research has reached some conclusions. First, the main reason for the decline in posture control ability of the elderly is that with age, the corresponding muscle response of the limbs and trunk of the elderly not only delays the reaction time, but also reduces the contraction rate, which makes its posture adjustment ability obvious decline. Second, regular exercise training can improve the static and dynamic posture control capabilities of the elderly. However, different exercise methods have different effects on exercise, and tennis exercise has a greater impact on this aspect. Third, the experimental results show that in the static standing posture and dynamic posture completion experiments, the indicators of jogging exercise and tennis exercise are more prominent than those of the elderly group who exercised irregularly. However, compared with tennis practice, jogging exercise has no obvious effect on the function of upper limbs and posture control of the elderly. This shows that tennis exercises can have the effect of whole-body vibration exercises, and are better than jogging exercises for improving the decline in body posture control ability of the elderly. Fourth, the application of intelligent sensor system and BP neural network can accurately and efficiently collect the body posture control data of the elderly, and the accuracy of the assessment and prediction of the posture control ability of the elderly is also high. This study analyzes the impact of tennis practice on the body of the elderly. The influence of postural control is helpful.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

References

[1] Zheng L , Lu L , Jiang X , et al. Laparoscopy-assisted versus open distal gastrectomy for gastric

cancer in elderly patients: a retrospective comparative study. Surgical Endoscopy, 2016, 30(9):4069-4077. https://doi.org/10.1007/s00464-015-4722-8

[2] Chen C C , Hong D J , Chen S C , et al. Study of Multimedia Technology in Posture Training for the Elderly. Engineering, 2016, 05(10):47-52. https://doi.org/10.4236/eng.2013.510B010

[3] Yan Y , Liu X , Li J , et al. Walking Posture Control of Transmission Line Single Arm Inspection Robot. IOP Conference Series Materials ence and Engineering, 2017, 224(1):012-019.

[4] Muhla F , Clanché F, Rose C , et al. Biomechanical and human behavior assessment using virtual reality to challenge balance and posture for the elderly and patients with Parkinson's disease. Comput Methods Biomech Biomed Engin, 2017, 20(1):141-142.

[5] Seo J W , Kim D H , Yang S T , et al. Comparison of joint kinematics and pedaling force in the young and the elderly. Journal of Physical Therapy ence, 2016, 28(8):2245-2248. https://doi.org/10.1589/jpts.28.2245

[6] Cheng K , Chen D , Zhang Z , et al. Jumping Robot With Initial Body Posture Adjustment and a Self-righting Mechanism. International Journal of Advanced Robotic Systems, 2016, 13(3):127-132. https://doi.org/10.5772/64200

[7] Ji P , Huang Y , Zhou Q . Mechanisms of using knee bolster to control kinematical motion of occupant in reclined posture for lowering injury risk. International journal of crashworthiness, 2017, 22(3-4):415-424.

[8] Feng S S M , Chung L M Y , Bae Y H , et al. Neuromuscular Processes in the Control of Posture in Children with Developmental Coordination Disorder: Current Evidence and Future Research Directions. Current Developmental Disorders Reports, 2018, 5(1):43-48. https://doi.org/10.1007/s40474-018-0130-9

[9] Zhang H F , Lino J , Ji M , et al. [Effect of simulating leg length inequality on spinal and pelvic posture in the elderly]. Zhonghua Yi Xue Za Zhi, 2017, 97(39):3062-3067.

[10] Wang L , Feng W , Jia L , et al. Emotional processing of winning and losing facial expression and body posture. Acta Psychologica Sinica, 2018, 50(8):892-904.

[11] Zelai S D U , Begonya G Z S . Kinect-Based Virtual Game for the Elderly that Detects Incorrect Body Postures in Real Time. Sensors, 2016, 16(5):704-712. https://doi.org/10.3390/s16050704

[12] Vitale C , Falco F , Trojano L , et al. Neuropsychological correlates of Pisa syndrome in patients with Parkinson's disease. Acta Neurologica Scandinavica, 2016, 134(2):101-107. https://doi.org/10.1111/ane.12514

[13] Yasuto I , Mitsuhiro M , Naofumi O , et al. Effect of noisy galvanic vestibular stimulation in community-dwelling elderly people: a randomised controlled trial. Journal of NeuroEngineering and Rehabilitation, 2018, 15(1):63-74. https://doi.org/10.1186/s12984-018-0407-6

[14] Doulah A , Shen X , Sazonov E . Early Detection of the Initiation of Sit-to-Stand Posture Transitions Using Orthosis-Mounted Sensors. Sensors, 2017, 17(12):3301-3316. https://doi.org/10.3390/s17122712

[15] Andrea B , Marcello C , Paolo L , et al. Effects of Osteopathic Treatment on Postural Equilibrium Evaluated through a Stabilometric Platform: A Randomized and Controlled Study. Journal of Functional Morphology & Kinesiology, 2017, 2(2):18-22. https://doi.org/10.3390/jfmk2020018

[16] Park E , Reimann H , Sch?Ner G . Coordination of muscle torques stabilizes upright standing posture: an UCM analysis. Experimental Brain Research, 2016, 234(6):1757-1767.

[17] Verrusio W , Gianturco V , Cacciafesta M , et al. Fall prevention in the young old using an

exoskeleton human body posturizer: a randomized controlled trial. Aging Clinical & Experimental Research, 2016, 29(2):1-8.

[18] Avelar I S , Soares V , Barbosa R C , et al. The influence of a protocol of aquatic exercises in postural control of obese elderly. Revista Andaluza de Medicina del Deporte, 2018, 11(2):69.

[19] Suzuki Y , Kawai H , Kojima M , et al. Construct validity of posture as a measure of physical function in elderly individuals: Use of a digitalized inclinometer to assess trunk inclination. Geriatrics & Gerontology International, 2016, 16(9):1068-1073. https://doi.org/10.1111/ggi.12600

[20] Tseng H W , Wu R Y , Wu Y Z . An Efficient Cross-Layer Reliable Retransmission Scheme for the Human Body Shadowing in IEEE 802.15.6-Based Wireless Body Area Networks. IEEE Sensors Journal, 2016, 16(9):1-1. https://doi.org/10.1109/JSEN.2016.2523461

[21] Gabel C P , Rando N , Melloh M . Slacklining and stroke: A rehabilitation case study considering balance and lower limb weakness.. World Journal of Orthopedics, 2016, 7(8):513-518. https://doi.org/10.5312/wjo.v7.i8.513

[22] Scholes C J , Lynch J T , Ebrahimi M , et al. Gait adaptations following multiple-ligament knee reconstruction occur with altered knee kinematics during level walking. Knee Surg Sports Traumatol Arthrosc, 2016, 25(5):1-11. https://doi.org/10.1007/s00167-016-4104-3

[23] Baig M M , Gholamhosseini H , Connolly M J . Falls risk assessment for hospitalised older adults: a combination of motion data and vital signs. Aging Clinical & Experimental Research, 2016, 28(6):1-10. https://doi.org/10.1007/s40520-015-0510-5

[24] Reif K . Nuclear Arms Control Choices for the Next Administration. Arms Control Today, 2016, 46(10):7-9.

[25] Upton S , Renshaw T L . Immediate Effects of the Mindful Body Scan Practice on Risk-Taking Behavior. Mindfulness, 2019, 10(1):78-88. https://doi.org/10.1007/s12671-018-0948-6