Study on Application of Sanda Electronic Protective Gear and Motion Analysis Based on Sensor Theory

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Abstract
Along with the development of sensor technology, electronic equipment has been widely used. Electronic support is different from the traditional protective equipment, has the characteristics of intelligence, automation and high speed. In this paper, the author study on application of electronic protective gear in sanda competition. The referee's human intervention is effectively reduced by the electronic equipment, which makes the sanda game fairer. After the use of electronic equipment, there is no obvious change in the characteristics of technology application. 65.7% of the athletes agree that PSS improves the accuracy of the game, but because the electronic protective clothing is heavier than the ordinary protective clothing, most of the athletes are not accustomed to the use of electronic protective clothing. On the basis of this, we put forward some relevant suggestions.

Key words: Electronic protective gear, Sanda, Wireless sensor, Sensor chip, Athletes

1. INTRODUCTION
The use of electronic devices, electronic equipment and other electronic equipment, sensor equipment. At present, the PSS recognized that Taekwondo electronic gear, which is different from the traditional protective equipment, electronic equipment and its use mainly by acting on the gear used to detect and identify the purpose, in turn, for example by PC software, display equipment and auxiliary equipment and other timely and effective to detect information for analysis, judgment, and through the software system has been rapid in accordance with set rules for processing, recording and display(Qi, 2014; Jugong, 2015). The research and design of power electronic protector will enable the traditional Sanda competitions in a qualitative change, the intelligence, automation, high speed. Training or game use will effectively reduce the workload of the coaches, and the user's training or game results will be intuitive display and record, to provide users with an intuitive reference data (Xiaoyu, 2015). When using the game, the referee can effectively reduce the human intervention, so that the game is more fair and more concentrated in the game, while increasing the competition of the ornamental. Similar to the development of Taekwondo project, research and design of Sanda electronic protector will lay the technical foundation for the popularization and development of China's Sanda and events in the world.

The use and development of Taekwondo has electronic protector for nearly 10 years, even on the stage of the Olympic Games, for the dissemination of Taekwondo projects in the world and popularization has made tremendous contributions(Hongwei, 2015). On the contrary, a long history of Sanda project but have not been able to squeeze in the international competition of formal design and development of Sanda, electronic protector is scanty, almost no substantive breakthrough(Ma, 2013). On this background, this paper in reference to many of the advantages and disadvantages of Taekwondo electronic gear, according to the current rules of sanda competition, proposed and designed the overall plan of Sanda electronic protector, which guide the pressure were designed signal acquisition, transmission and processing of various parts, Sanda electronic protective gear design and development and puts forward some suggestions.

2. THE SENSOR AND THE ELECTRONIC PROTECTOR OF SANDA

2.1 Wireless sensor system
In view of the process of project development and popularization of the Taekwondo and principle of the electronic gear design and use, including the relationship between the two, this paper design the electronic gear as the basis of sanda. On this basis, combined with the current rules of Sanda Competition in the State Sports General Administration and the relevant rules, and on-the-spot investigation, visited the sports college athletes, coaches, referees, according to their needs and experience in the daily training and competition, taking this as the background, proposed a design scheme of Sanda electronic gear system(Sabella, 2010). Obviously, due to the characteristics and rules of the sanda competition principle, Sanda electronic gear used in the process should be similar to the run boxing electronic protector, first need to effectively contact, according to the effective contact position judgment need to give a score or more scores for many times the effective contact of the electronic equipment in this process in itself should not disturb or minimize its disturbance. Because of Sanda Competition Rules and tactics is rich, can each use of a variety of boxing, kicking, footwork, one level is uneven,
the effect is different, so full of intelligent protector by itself to determine the score obviously unrealistic, the technical difficulty is remarkable, so consider the actual situation and draw on the advantages of existing road boxing electronic protector, Sanda electronic gear system using a PSS intelligent picking and identifying effective contact with comprehensive treatment of the handle and the handle side referee work.

The design principle and working principle of the electronic gear above, Sanda final system planning mainly include: protective clothing, protective gear, sensor module circuit components, wireless transmit / receive module, the handle, data concentrator and PC software etc.. Among them, according to the current rules of the game gear Sanda appropriate lighter and thinner traditional Sanda suits, including: head guard, protective coat guard . Gear sensor components correspond to the need to use a lightweight, thin, the device can timely adjust the shape according to the use of, or after the transformation has the above characteristics of the device. Protective circuit components corresponding to sensors, the signal collected to make the appropriate treatment. But it is clear that the sensor module and circuit components of these two parts need to consider how to layout in the traditional internal gear, and the need to solve the high temperature resistance, acid and alkali corrosion resistance, impact resistance and other problems, the reliability of each sensor, circuit component reliability, the reliability of the cable, the sensor assembly between how to work at the same time and how to work independently for each part of nursing head, protective clothing, pants, and somehow connected together, does not damage the user and will not affect the use effect when in use . Because the electronic gear in the use process, a variety of useful signal through the sensor to obtain components must be timely and correct treatment, and out of the site and the events of the practical considerations, both players may not match data line with long, neither beautiful nor reality. Therefore, the use of a wireless transmission / reception module, the collection of information from both sides of the sensor component of the user in a timely manner to the subsequent part for further processing. And this part also considering the competition may occur in the direct hit, touch, as far as possible the module miniaturization, special position and embedded in the use of protective clothing. The same needs to consider the high temperature, impact resistance, corrosion resistance and other factors, and the antenna must be as small as possible.
In order to be more timely and accurate for the collected signal and the corresponding information to deal with, simply rely on the software function is obviously not reliable. Therefore, collecting and processing of two sets of equipment respectively through the wireless transmission module the information sent back, the referee and the referee side handle output information, then the information transmitted through the protocol package to the host computer software for further analysis and processing. The data concentrator part corresponds to the end of the received signal by the sensor module, wireless transmission module and acquisition by passing back at the same time receiving each referee handle transferred back decision information, and the other end is connected to the PC part. The PC software mainly according to the receiving protocol data packets received from slave unpacking and processing. The pressure in the process of using the user score, fouls, penetration etc. with decision each side referee and the referee will handle data by data concentrator according to the agreed protocol good to send to the host computer software system, real-time display, processing and storage etc..

2.2. Sanda gear

In accordance with the relevant provisions of the State Sports General Administration, national and provincial Sanda Competition Rules of the game are: brace retaining head, protective clothing, leggings board, guard, ferret, mouth guard. These basic equipment use, less cannot participate in the competition, but also must match the security clearance, the seal can use in the game. But from the current domestic competitions in the field of view, less use of protective equipment, a team that will play against the effects of brace and when the level reaches a certain level, the basic equipment for participants no protection, and protection and no real sense to play its role. At the same time, due to a scoring area to allow the attack Taekwondo competition including the torso and head of the electronic gear trunk technology has been mature and large investment, head of electronic helmet is under development, so, at present the use of electronic protectors Taekwon do scores for ruling trunk by the electronic gear and objective score the head of the referee scoring with subjective scoring. The emergence and application of electronic protector has changed Taekwondo match tactics, characteristics and rules of the game of the corresponding gear. The traditional training system is not valued defense training and physical training again attention; opportunity to create, capture more speed and precision, continuous steering, cross kick, back kick, hit head tactics such as the game tactics. Therefore, related to the use of personnel at home and abroad to do the research of tactics, in order to maximize the ability of athletes in the electronic gear on the basis.
The working principle of the electronic gear are inductive, with the induction chip, through pressure principle, when the induction chip sensor chip and electronic protector of different level athletes set foot on contact, and reach before they set for threshold, effective induction chip and through the wireless transmission module data will be transmitted to the computer the software for further processing. Adidas company has a single tree gorge, using the hydraulic principle, by hitting the brace on the strength of the athletes as criteria, namely, different levels of the game process, every stroke pressure exceeds threshold pressure generated in order to determine the score. But the hydraulic protector for elbow and shoulder hit the interference factors but can not be resolved. There are two kinds of working principle of the electronic gear both are developed, more installation with different ID number of chips in the electronic foot instep and foot, for judgment and recognition such as back kick, kick boxing road technology pressure technology is applied to practice.

3. ELECTRONIC PROTECTOR GEAR

3.1. Sensor design

According to the design principle of Sanda electronic protector, method of sensor module adopts embedded in the equipment, so the initial strong, soft piezoelectric film as sensor body. But obviously directly to the piezoelectric thin film is embedded in the equipment used is unrealistic, will do not move or disturbance, and susceptible to salt corrosion, if the use of piezoelectric thin film surface is in coincidence to judge is not hitting the area too accurate, and the equipment itself must have a certain strength, not bent. Otherwise, not only will be distorted and easy to damage the piezoelectric thin film. Furthermore, because the impedance of the piezoelectric film is directly proportional to the area of the film, the impedance of the film is very large, and the signal acquisition and processing of the follow-up circuit is not convenient. In summary, by considering all kinds of actual fighting, the electronic gear with final sensor using piezoelectric film from the area as the main body, double buffer material attachment and adhesive strength, a sensor force measuring module, and flexible...
shielding material wrapped in the periphery of the module, in order to prevent 50Hz interference, which constitute the whole measurement force sensor.

E-Touch piezoelectric thin film as a special piezoelectric sensing, its working principle is also the theoretical basis of the piezoelectric effect. Due to the action of the external force to produce a charge, so similar to the charge source. When the surface of the thin film electrode is charged, it can also be a capacitor.

Figure 5. Wireless sensor design

3.2. Wireless transmission

Wireless module generally refers to the use of radio technology and DSP technology, to achieve high performance professional data transmission radio modular products. At present the common wireless module can be divided into H classes; a class is mainly used in simple remote control and data transmission of the ASK super heterodyne module; the other is through the wireless transceiver module, MCU wireless data transceiver, a wireless transceiver module of this kind of general FSK, and a GFSK modulation mode; is easy to use, mainly used to directly through the serial port to send and receive data of the wireless data transmission module.

Figure 6. Wireless module

Currently on the market more popular and mature technology of wireless module is: 315/433M and 2.4G wireless module. And the selection of wireless module is mainly based on the use of the environment and the module's own technical indicators, such as: communication mode, frequency, frequency stability, transmit power, communication interface, radio frequency output power, etc.. As a new wireless communication technology ZigBee: Based on EE802.15.4 standard, the wireless network protocol for wireless communication of short distance, low cost, low power consumption, low transmission rate, between Wireless Markup technology and Bluetooth technology, according to the EE802.15.4 standard pressure, consume little energy, has the relay way through radio waves. And the coordination of thousands of tiny nodes transmit the data, to achieve communication. ZigBee wireless network is similar to the CDMA and GSM mobile communication network,
run a few hundred meters until a few kilometers away from the land, and can support unlimited expansion. But the difference is that the network is mainly built for industrial automation control and data transmission, in addition has the characteristics of easy operation, low price, each node in the ZigBee network not only can be used as monitoring objects but also can automatically transfer to other nodes to transmit the data, and can achieve the signal coverage of the wireless node connect.

**Figure 7.** ZigBee wireless network

4. THE USE OF ELECTRONIC EQUIPMENT IN ATHLETES UNDER THE NEW RULES

4.1. Comparison of the electronic gear and common gear

Change the electronic gear and common gear principle in scoring: first, the definition of Taekwondo score is used to allow the “technology, accurate and powerful hit scoring points scored”. In the “allow” technology “accurate” no difference in “strong”, the difference is larger, the use of ordinary gear, completely rely on manual scoring, to determine whether the beating was scored by the side judge on the basis of experience; the use of electronic induction protector, according to body weight level and gender differences set different efforts standard, by electronic sensors in measuring electronic induction gear beating, automatically determine whether the score. Second, the use of ordinary gear game, all valid points (including 1 points, 2 points and 3 points), only by the side of the referee record; all points must be judged independently by the side of the referee, and through electronic instruments will be published in the scores shown on the scoreboard. If you are unable to use the electronic instrument, the referee must immediately record the score on the score sheet and publish it after the 1 game. The use of electronic induction protector game, scoring the trunk, by electronic sensors in the automatic induction gear scoring; scoring hit head and boxing, by using electronic scoring device or side referee score instant score.

The electronic gear and common gear with the change in the referee: the use of electronic induction protector, are generally required to set up 1 referee and 2 side referee; the use of ordinary gear, are generally required to set up 1 referee and 4 side referee. The focus of future research, research and reform will be placed in protective gear for the entire game and scoring system, the competition rules. This just confirms the Taekwondo competition theory, when the technological development reaches a certain height, will inevitably be modified by including the score, rules, in order to adapt to the development of technology, in turn, once the technology to adapt to the rules, the rules must be modified.
4.2. Impact on athletes

This research through the questionnaire survey of athletes wear and wear of the electronic gear set foot in the game, that the electronic gear than ordinary gear weight accounted for 92% of respondents think small, accounted for 54%, accounted for 91% of that thick, heavy that accounted for 62%; that wearing foot not used accounted for 74% think, foot sleeve and foot wear ordinary feeling similar accounted for 52%, that wearing foot wear ordinary shoes, similar to the feeling of 57%. Through the analysis that the electronic gear is arranged inside the sensor, in order to protect the sensor is not hit by external force in the game and damage in the outer layer of electronic protector special materials used, the protector, compared to ordinary hard thick and heavy. The Taekwondo Athletes in the use of electronic protector competition than ordinary gear match physical exertion. Why not used his legs set athletes in peacetime training, competition is always barefoot, while the foot set is required to use the electronic gear game, so it is natural not used. Through the survey data can be seen, instead of foot set effect is not ideal for foot protection and road shoes in daily training, too high cost of using electronic protector foot sleeve and the wear phenomenon is serious.

Table 1. Psychological effects of feedback

<table>
<thead>
<tr>
<th>Answer</th>
<th>Enhance</th>
<th>Justice</th>
<th>Feel nervous</th>
<th>Like the electronic gear</th>
<th>The same result</th>
</tr>
</thead>
<tbody>
<tr>
<td>sure</td>
<td>82.1%</td>
<td>22.4%</td>
<td>52.6%</td>
<td>27.2%</td>
<td></td>
</tr>
<tr>
<td>negative</td>
<td>15.7%</td>
<td>36.5%</td>
<td>23.9%</td>
<td>50.6%</td>
<td></td>
</tr>
<tr>
<td>unchanged</td>
<td>5.4%</td>
<td>40.2%</td>
<td>17.3%</td>
<td>28.3%</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Effect of PSS on the score race

<table>
<thead>
<tr>
<th>Answer</th>
<th>Abdominal easy</th>
<th>Easy rib</th>
<th>back</th>
<th>Armguards</th>
<th>Increased difficulty</th>
<th>Accuracy improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>sure</td>
<td>51.4%</td>
<td>62.1%</td>
<td>0</td>
<td>0</td>
<td>65.7%</td>
<td>61.2%</td>
</tr>
<tr>
<td>negative</td>
<td>39.00%</td>
<td>27.5%</td>
<td>100%</td>
<td>100%</td>
<td>35.4%</td>
<td>33.5%</td>
</tr>
<tr>
<td>unchanged</td>
<td>15.6%</td>
<td>4.6%</td>
<td>0</td>
<td>0</td>
<td>4.2%</td>
<td>12.3%</td>
</tr>
</tbody>
</table>

Comprehensive analysis shows that, first, the electronic gear game players hit the rib score more easily than the belly, through video game statistics also proved this point, analysis of the reasons may be caused by electronic protector scoring principle. The principle of the electronic gear is scores of players with foot sleeve "induction zone" hit "body sensor", and pressure sensor by scoring. When the athletes wearing the electronic gear, the ribs in support ribs, easier to reach than the belly "score intensity coefficient sensor". In second, the electronic gear game hit back and armguards not score, score is not hit back because the electronic gear back without placing "sensors", how will hit the score. Third, using the electronic gear scoring difficult, quasi requirements for hit parts of higher, no increase of beating and sound request. To analyze the reasons for the strike back and armguards not score, then players in defense of the torso easier, thereby increasing the difficulty of PSS score, score only set foot recognition induction zone "and" sensors "gear contact is reached the intensity coefficient setting, which requires more accurate hit it, to combat voice as long as the efforts of no great importance, hit to efforts to set in advance can score coefficient.

5. CONCLUSIONS

Figure 8. Electronic protector competition
Under the new rules using the electronic gear to increase fairness of competition, to a certain extent solved the problem of referee controversy. The use of electronic equipment under the new rules, the application of general feature did not change significantly, only is the main scoring techniques, kicking technique score was significantly improved. The use of electronic equipment under the new rules, the athletes in the competition to increase the defensive ability to strengthen the batter trunk, and hit the head of the enthusiasm of the athletes. Under the new rules of electronic protectors after using the fourth game, enhanced active attack and head striking victory consciousness, increase the winning technology, horizontal kick position is weakened.

REFERENCES


