INTELLIGENT TEXTILES FOR MARTIAL ARTS(Oral Presentation)

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ABSTRACT

Martial arts have become very popular among the young population and even children, especially over the past 10-15 years. This interest has created a research field for researchers and manufacturers about martial arts' clothing and equipment, especially in terms of intelligent textiles. This study has been conducted in order to present intelligent textile products for martial arts' equipment and clothing. For this purpose, we have analyzed and presented different martial art divisions' equipment and clothes and the existing electronic systems.

Key Words: Martial arts, smart garments, intelligent textiles.

1. INTRODUCTION

There are many kinds of martial arts that are universally accepted. However, only boxing, judo, taekwondo, freestyle wrestling and Greco-roman wrestling take part in the Olympic games [1]. There are also other martial art divisions which have federations and competitions around the world, namely muay thai, karate, sumo wrestling, wushu, kickboxing, aikido, jiu-jitsu. Practice of martial arts has many benefits like the development of discipline, respect, strength, coordination, balance, and flexibility [2].
As result of the rising interest in martial arts, intelligent textile applications in martial arts' equipment and clothing are emerging. Many academic/research institutions as well ascompanies, have carried out research and development activities worldwide, with noticeable outcomes either in the form of commercial products or research publications [3]. Additionally, the development of intelligent products for martial arts provides more accurate

judging, improves coaching and participant health monitoring and enhances the entertainment of spectators [4].

2. INTELLIGENT TEXTILE APPLICATIONS

2.1. Electronic Scoring Systems

The World Taekwondo Federation (WTF) emphasized the requirement for an electronic scoring system in the game to assist the match officials (Figure 1) [4]. The WTF began to promote the inclusion of electronic body protectors (EBP) in their competitions after the Athens Olympic Games in 2004 [5]. In Taekwondo, points are scored after a punch or kick to the thorax or head. These are recorded by four judges placed around the match arena, with decisions being made purely based on visual inspection and the officials' judgment [4].

The first system used in competition was developed by Adidas. This system was working according to power and contact and it didn't have a sock with sensors. Since it would score with the knee or even a clash of pads, it was a poor system. LaJust, the second system, used the contact of the sock and the contact areas on the pad. It was also an extremely hard system to score on and had many issues including mobile telephone interference. A cheating incident was determined at the Asian Games in 2010, where Taiwanese athlete Yang Shu Chun was disqualified for having an additional sensor in her sock. In order to prevent cheating, the athletes are getting checked for an additional sensor before they enter the competition arena [7]. According to Abley (2017), the best electronic scoring system available today is Daedo. It scores in all areas of the pad as would a standard hogu. It also only scores if correct contact and power is used.

The DaedooEBP works with Bluetooth™ wireless technology and registering 5 hits per second, instantaneous presentation of the energy of the blow, electronic definition of minimal impact for a valid score, high amplitude and secure transmission (from more than 100 m and encrypted to prevent interference). Electronic sensors on footwear and gloves allow points to be scored when the body protectors are hit [5].
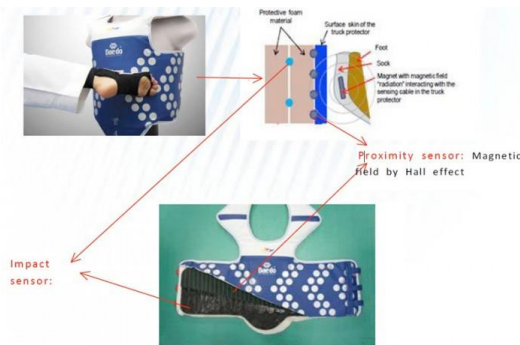
Figure 1. Daedo electronic body protectors for Taekwondo [6].

McLoughlin et al. (2013),have designed an intelligent vest, a protective head gear and a boxing glove for amateur boxers [8]. As a starting point of the product development process, they have conducted a questionnaire study with 22 amateur boxers in order to determine the opinions of participants about misjudgments in competitions and the intelligent textile integrated boxing equipments. Since only 2,7% of the fights that the participant had in their careers ended by knock-out, proper judgment is very important for participants. At the same time, 73,6% of participants stated that they would wear the intelligent equipment during competition even if it is uncomfortable. Afterwards, they designed an electro-conductive textile formed circuit. The imbedded ammeters in the vest and headgear record the change in current and send the data to the Central Processing Unit (CPU), which broadcasts the data to a computer.

2.2. Punch Tracker Equipments

A new type of products to track the training use sensors attached to boxing gloves. The principle, patented by Victor Xavier Navas, uses accelerometers adapted to be worn on the hand or wrist of a user (Figure 2). The accelerometers are operatively coupled to a processor capable of calculating the user's hand position based on data from the accelerometers [9].
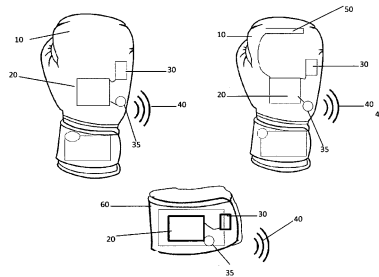
Figure 2. Boxing glove with accelerometers [9].

Commercial systems using this principle are now on the market or in pre-order, such as the Hykso[10] and the Corner equipments[11], indicating several parameters related to the athlete's performance (Figure 3).These punch tracker equipments allow athletes to view their punch output in real time and track their hands' movement 1000 times per second to detect the number, the type, and the velocity of all their punches.

Figure 3. Punch tracker equipments [10, 11].

Besides sensors attached to boxing gloves, there are also researches about punching bags. One pre-commercial product, Impact Wrap, is a canvas sleeve that fits over regular heavy bags between 12 and 18 inches in diameter (Figure 4).Impact Wrap counts the strikes and measures the impact of punches [12].

Figure 4. Impact Wrap punching bag [13].

2.3. Performance Tracking Systems

Biometric measurement clothing takes an important role for evaluating and tracking the performance of athletes by monitoring biometric data and vital signssuch as heart rate, breathing rate, activity intensity, steps, muscle effort and calories burned. Several companies produce biometric clothing such as Athos [14], OM Signal [15] and Hexoskin [16]. According to the manufacturer, the Athos base layers track muscle effort, muscle target zones, muscle fatigue, heart rate and breathing patterns, helping athletes to understand how their muscles are contributing to the movement (Figure 5).
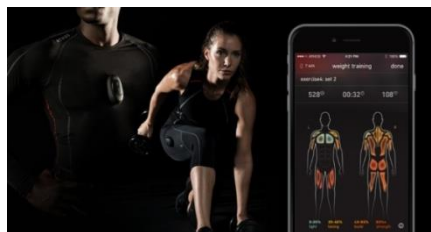

Figure 5. Athos sweat-wicking base layers [14].

OM Signal's shirt tracks heart rate, breathing rate, breathing volume, movement (including steps and cadence), movement intensity, heart rate variability and calories burned [15]. Hexoskin products measure breathing rate (RPM), minute ventilation (L/min), heart rate maximum, resting heart rate, heart rate recovery, maximum rate of oxygen consumption,activity intensity, peak acceleration, steps and cadence [16]. All these smart products display the biometric data and vital signs through their apps.

3. CONCLUSION

In this study, intelligent textile applications for martial arts were evaluated, such as equipments for preventing misjudgment of referees in competitions and equipments for tracking the training and the performance of athletes. Some of these products are in developing and pre-order process, while others are already on the market. Although the products mentioned in this study exist, it is still a research field for researchers and at the same time it is a niche market for companies that deal with high-tech products.

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