ABSTRACT

Military boxing, a kind of Chinese martial arts, is widespread and health beneficial. In this paper, the authors introduce a military boxing learning system realized by 3D motion capture, Web3D and 3D interactive technologies. The interactions with the system are natural and intuitive. Users can observe and learn the details of each action of the military boxing under different views and scales by translating, rotating and zooming the 3D human body models. Smartphones also can be used as the input/output device in the system, which provides natural interactive operations by voice and sensor technologies. The evaluation test has shown that the learning effect of the system is better than via traditional video. The system can be extended to Tai-Chi, gymnastic exercises and other routines.

INTRODUCTION

Chinese martial art (Kongfu) is a proud heritage of Chinese history and culture. It is popular in the world and renowned as a gymnastic routine benefiting people physically and mentally. Chinese martial arts include boxing, sword-play, stick-play, etc. Widely spread in both the army and schools, military boxing is one kind of the Chinese martial arts. Almost all the university students learn it. An online military boxing learning system is useful in the instruction.
Web3D technology has already been applied in many fields, such as medical science (Helge et al., 2009, Bharti et al., 2002), construction (Brian & John, 2010), engineering (Liarokapis et al., 2004), physics (Taha et al., 2007, Angelov et al., 2007), and arts (Chan et al., 2011). It makes education process attractive. Today popular Web3D technology includes VRML, JAVA3D, WEBGL, SHOUT3D, and O3D. Those render engines provide rich APIs for developers to create interactive 3D applications which can run in browsers. Chittaro (2007) summarized the function of Web3D Technologies in learning, training and education, and outlined its main advantages. In general, the 3D online education techniques provide a wide range of experiences, some of which are impossible to try in the real world because of distance, cost, danger or impracticability. Also, three dimensional graphics are used, which allows for more realistic and detailed representations of topics, and offer more viewpoints and more inspection possibilities compared to 2D representations. Moreover, users can analyze the same subject or phenomenon from different point of views. Most of these education systems focus on static learning objects.

The 3D motion capture technology has the advantage that the traditional key-frame method cannot compare with. Applying motion capture in animation characters produces vivid motion pictures. It is time saving than traditional animation (Xiao-ting et al., 2011). With the development of motion capture technology, many institutions and high schools have already captured motion data of Chinese martial arts. Such as in “The Digital Cultural Heritage Program” (2012) of NUS, digital media technologies bring cultural heritage to live. This project has captured 3D motion data of Shaolin Kongfu. And many martial art training systems have been developed in training and learning. Komura et al. (2006) proposed a martial art training system based on the motion capture system. Users wear head-mounted display and practice defense/offense with the virtual coach. Chua et al. (2003) presented a VR motion training system for practicing Tai-Chi. The avatar of the Tai-Chi learner and his/her master

is rendered in the virtual situation. The learner observes the motion of the virtual master and follows it till the virtual avatar performs the same motion as the virtual master. Users need to wear external devices in training, which only fits for professional users. For general users and fans, online education is more available. Nadia M.etc. (2008) introduces a virtual dance learning platform which is quite similar to ours. They provided a Web3D learning framework for folk dances. Students can interact with the platform and observe how the virtual dancer performs, but the interaction is not natural so far.

Interaction techniques can make users feel comfortable when learning and training. User Interface (UI) is important on that human directly interact with the computer through the UI. Many design guidelines and principles suggest how to design a nice UI. For example, Fitts’ Law provides the layout design and UI controls design theoretically. Moreover, input devices are not limited to keyboards and mouse. Many natural and intuitive input devices can improve the user experience, such as touch-screen and data glove. Smartphone as an input device has been studied by Dongwoo etc. (2011), because of its low cost, mobility and popularity. They introduced three object manipulation techniques with the help of the sensors of the smartphone, including object translation, object scaling and object rotation.

In this paper, we introduce a military boxing learning system. In our system, the 3D military boxing motion data are captured by an optical motion capture system. O3D, an open-source web API for creating rich and interactive 3D applications in the browser, implements our system. Moreover, some natural human computer interaction technologies are used in our system, so that users can observe and learn the details of each military boxing action under different views and scales by translating, rotating and zooming the 3D human body model. Besides keyboards and mouse, smartphones are also fit for the system, which provide natural interactive operations by voice and touch technologies.

The remainder of this paper is organized as follows: First, we outline the structure and data of our 3D learning system and how we build our
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