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My Choreographer: An Augmented Reality Dance Training System

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Abstract : This innovative and one-of-a-kind user interface (UX) concept for a virtual fitness dance framework seeks to assist users in living a safe lifestyle. A variety of academics and businesses have created workout programmes that use a simulated coach to teach the individual what steps they can take. However, such applications can be challenging to correctly follow the interactive guide's movements, and the guidance given to remind users of their proper body posture has limitations. This is due to the fact that most applications are designed for users to merely observe and follow a character's movements (poses) from a third person viewpoint. Users in this dance training method will observe the exercise-postures of a virtual skilled trainer seen in first person and receive coaching in a step-by-step gesture. The preliminary study for dance and performance is based on the architecture of my choreographer (MC). More dance styles are being added to the library of the improved MDS prototype. The MC device architecture has been demonstrated through a series of trials to train dance trainees. The MC prototype has a lot of promise for promoting dancing, exercise, music, and social engagement. The MC method is intended for commercialization to dance training/culture centres and dance enthusiastic.

Keywords: Augmented Reality, Dance, Interface Design, Cues

1. Introduction

Technological advances in physical fitness have brought physical training to a higher level where humans could historically only see it in their imagination. Because of advancements in advanced hardware and applications, this idea is becoming a possibility. Traditional teaching and instruction are being replaced by virtual teachers in the physical training sector in particular, where human experience can be minimal, especially in the dance field. Figure 1 depicts the many dancing forms that are now popular. Emerging technology such as augmented reality (AR) with advanced instruments and algorithms can be seen as a possible futuristic robotic teacher that not only lectures but also has the power to correct learners' errors. This phenomenon has, in general, given rise to a modern mode of instructional design in both cutting-edge academia and design practices. AR, on the other hand, is the

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combination of the digital and physical worlds, thus augmenting the real-world experience. It connects the physical and virtual realms by incorporating graphics and sound into the user's experience [1]. The progress that AR has made right from its inception over a decade had just been remarkable as described by [2]. The history of augmented reality began in the 1950s, when Heilig proposed that cinema should be able to draw all of the viewers' senses into the onscreen action in an appropriate fashion [3]. This technology is already being used widely in the commercial world from the automotive industry, gaming, retail and with wearable technology as demonstrated by the google glass project. Bloxham [1], pointed out although it is still in its early stages, AR is being used increasingly to bring learning to life.

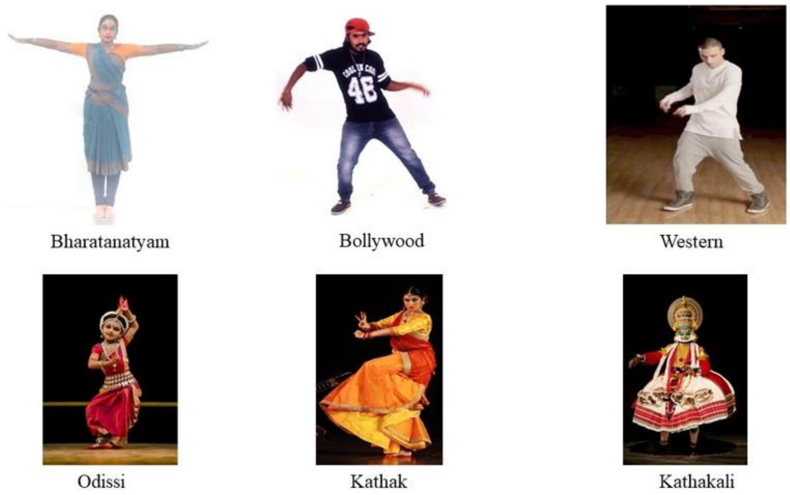

Figure 1: Popular dancing forms

The possibility to extract accurate spatial-depth data of real physical environments-objects and further embed their augmented forms virtually suggest great potential of such technological tools to be included in the educator’s standard digital toolbox of educational technologies. However to create high quality teaching and learning environments through AR, we need to understand and explore the potential of AR as an enabling technology for education which include, the fundamental of AR theories, the ability to design and implement certain AR techniques and the capability of applying AR technologies to applications of interest.

In this article, we discussed the development of our most recent project i.e. my choreographer an AR dance training system. A pilot test on the AR dance training system demonstrated that the system has the ability to improve learning experiences, and could be replicated by using AR as virtual mentors in many fields where human experience is minimal.

2. Materials and Methods

MC is divided into four main levels: interface, knowledge source, framework, and competency-based instruction using Kinect. There are two kinds of interfaces: audio response and gesture-based. The system's deployment environment can be a desktop, notebook, or games console. The high-resolution RGB camera is mainly used for tracking and gesture recognition. Until the final MC was used with participants from India and Malaysia, the version was checked with experienced choreographers for heuristic input. The MC architecture has shown high potential as a futuristic physical activity training platform through a series of device tests. The proposed system's architecture is made up of three main components: instruction with Kinect, motion capture, and performance assessment. Figure. 2 depicts the relationship between each variable and the system interface is shown in Figure. 3. As for matching the dance postures and steps, the Pose Matching Dance Training Movement

Recognition Algorithm (PMDTMR) proposed by [4] for tracking and mapping of dance movements with a virtual educator of a pre-recorded video was used. This method was also adopted and used by [5].

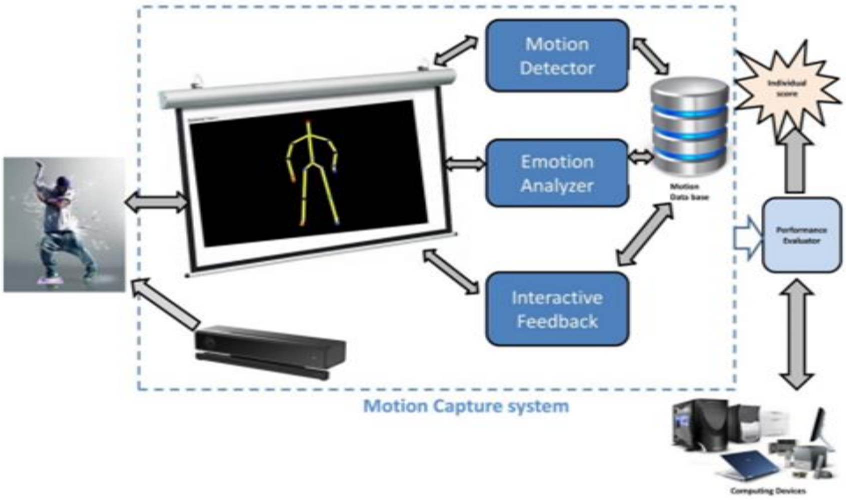

Figure 2: MC dance training system architecture

Figure 3: The interface of the MC dance training system

The participants' dance motions were captured by a high-definition motion capture camera and graded using a motion detector for eventual motion correctness. The motion detector combines the motion recognition method with motion detection technologies. The integrated feedback section gives feedback and comments to the learner. Based on repetition, the success assessment compares the student's motions and assigns individual points to each dance step conducted. The computer devices are used to visualize the average motions made by the student by a physical teacher, either in the same position or from a distance. Based on Hallgren's guidelines for determining inter-rater reliability [6], a completely crossed design was used in which an assessor with movement analysis expertise separately viewed skeletal motion details of each person (dance trainee) engaging in the fundamental movement skills and registered the incidence of body motions and arms/legs motion. The assessor then checked their registered body movements and arms/legs motion to calculate a 100 percent match, and the total amount of body movements and arms/legs motion for each person (as calculated by the rater's 100 percent match) was used to compare assessor scores.

As for the acquisition of motion data and configuration of motion data collection equipment, the previous research method by [7] used the current Microsoft Kinect for Windows Software Development Kit (SDK) offers an Application Programming Interface (API) and access to the data streams of the camera, which produces 30 data frames per second. By default, the skeleton stream tracks 20 joints

(Figure 4). Three floating point numbers representing the XYZ coordinates in meters from each camera, with noise levels compensated for by a tracking state, represent the joint locations. In the Kinect Skeleton Tracking Algorithm measurements, a variety of variables influence the noise level: intense lighting, player size, user clothing and occlusion, for instance. For each joint, a tracking state represented by a validity character is given to indicate a degree of trust in the data returned. The returned state is either: Tracked, Assumed or Not Monitored. The highest confidence data is returned by a monitored state as the joint can be calculated directly. The Inferred state implies that the Joint data cannot be determined explicitly and is estimated from other Tracked Joints instead, while the Not Tracked state indicates that the Joint data is not returned.

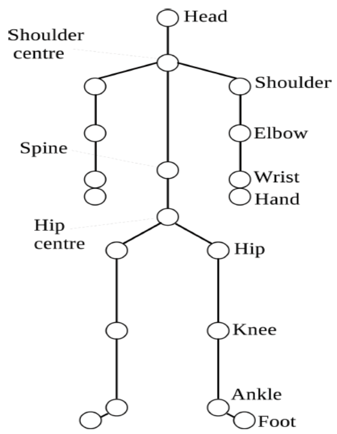

Figure 4: Tracked joint positions in the default position

2.1 User Interface

The user interface (UI) of the system comprises of four major elements namely usability, visualization, functionality and accessibility. The usability is where a software/ease product's of use and learnability. It is a quality measure attribute that assesses an application's usability. Visualization can provide visual signals that conventional text cannot. Visualization easily disseminates information. The system objects can be visualized effortlessly by viewing on the home screen (Figure. 3). Once the subject/user selects a particular dance style from the menu by pointing it with the hand, those virtual button(s) will execute the next subsequent menu or part of the system. The functionality is the primary component that allows the system to perform as intended. As for accessibility, when building a system, all types of users must be taken into account. Each individual's accessibility and user-friendliness should be taken into account. Therefore a new UI (gesture) is utilised in the proposed system to facilitate access to items and menus.

2.2 System Feature

The training level can be chosen based on the individual's degree of competence. There are three distinct sorts of training modes available for three different dancing styles namely novice, intermediate and expert mode. The novice mode was created to assist and encourage new dance learners, making it easier for them to grasp the dance routines. The intermediate mode promotes and assists a novice dancer in becoming an experienced dancer. Whereas the expert mode is for a professional dancer to master his/her dance move. The dance types available are Bharatanatyam, Western and Bollywood. The dance training competency is depicted in Figure 5 with the associated dance style and type of feedback provided.

2.3 Guidance and Feedback

Guidance is a crucial aspect to consider while supporting and assisting new dance learners and improving their dancing talents. A system that lacks direction and feedback is termed non-interactive.

Therefore guidance and feedback are offered in the system developed to make the system more interactive. The guidedance methos includes visual cues (green for right posture / red for wrong posture), textual information, speech and arrow marks guiding the next move to be done.

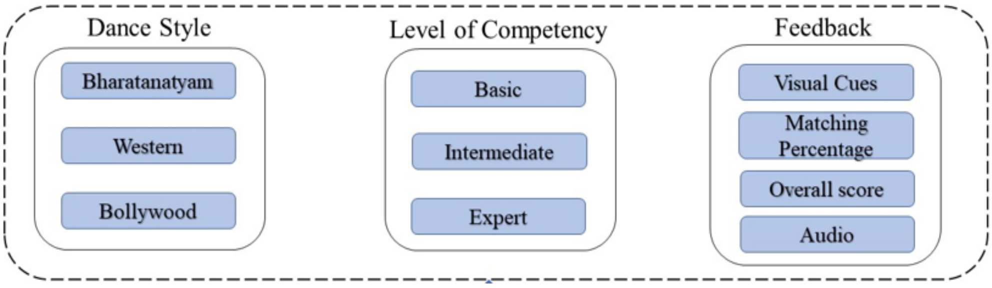

Figure 5: Dance training by competency

3. Result and Discussion

The MC system has been tested with over 150 dance trainees from India (*n=50*) and Malaysia (*n=100*) (Figure. 6) both selected higher learning institutions. The subjects were selected from these countries because the basic dance styles in the system's database were mostly Indian dance and one Western dance which were familiar to them. The criteria for evaluation testing were, (1) An individual who has a passion to learn different dance styles, (2) An individual aged 15 years to 50 years. The subjects were guided by the system throughout the session and the final performance score was displayed along with visual cues during the system testing. Results strongly indicated that the MC system has the potential to train dance trainees as an effective virtual choreographer. Furthermore, it assists participants in engaging with the new gesture-based contact put into motion by the dance training approach in order to gain consciousness. The achievement of these learning results was supported by the evaluation findings, which revealed that participants scored and exhibited substantially increased comprehension of dance with more accurate body postures and steps at the completion of the use of the dance training process.

Figure 6: System testing by subjects (left image India, right image Malaysia).

4. Conclusion

In this project, an AR based choreographer system was developed to overcome the limitations of the currently available dance training systems. The test results of the dance training method showed that the system was useful and could assist trainees in properly understanding the dance steps of the specific dance. The implementation of the motion user interface using AR technologies was extremely beneficial to dance trainees while engaging with the dance training framework because it did not distract them from touching any gadget such as the keyboard, mouse, or screen. MC system is conducive for dance training. It provides an alternative and robust method in learning how to dance. It has huge potential in assisting the enthusiastic dance learners to learn how to dance, pre-training activity for movie directors, enhance tourists experience and promotes better lifestyle, for obesity, pre-diabetic and hypertension patients. Also as an alternative dance training system during this pandemic time.

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