SIMULATION OF TEMPORAL AND KINEMATIC MOVEMENT OF AR PASUA PA PERFORMANCE

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Abstrak

AR PASUA PA (*Augmented Reality Papua-Sunda-Aceh Performance Arts*) merupakan sebuah pertunjukan dengan menggunakan aplikasi *augmented reality real time synchronization* dalam penciptaan seni pertunjukan 4.0. AR PASUA PA menggambarkan tentang siklus kehidupan manusia sejak terbit dan terbenamnya matahari. AR PASUA PA sebagai salah satu strategi pelestarian warisan seni budaya khususnya seni pertunjukan dari Papua, Sunda, dan Aceh. Pengembangan AR PASUA PA merupakan upaya konservasi, rekonstruksi dan revitalisasi seni pertunjukan dengan memanfaatkan teknologi *Augmented Reality.* AR PASUA PA memberikan peluang untuk pengembangan seni pertunjukan 4.0 di masa pandemi Covid-19. Simulasi gerak temporal dan kinematik pertunjukan menjadi salah satu cara memahami gerak tari Karwar (Papua), tari Cikeruhan (Sunda) dan tari Guel (Aceh). Penelitian ini menggunakan metode kualitatif dengan teknik simulasi dan analisis gerak virtual. Hasil penelitian ini menggambarkan gerak temporal dan kinematik pertunjukan AR PASUA PA. Pemahaman gerak tari secara virtual dengan mempelajari posisi dan turunan waktu pertunjukan. Simulasi gerak yang dilakukan oleh tangan, kaki dan tubuh penari baik tunggal dan kelompok.

Kata kunci : Simulasi, Kinematik, Augmented Reality

Abstract

AR PASUA PA (Augmented Reality Papua-Sunda-Aceh Performance Arts) presents a show using an application of augmented reality real time synchronization in the creation of performing arts 4.0. AR PASUA PA describes the cycle of human life starting from the Sunrise until the Sunset. AR PASUA PA as one of the strategies in order to preserve cultural arts heritage, especially performing arts from Papua, Sunda, and Aceh. AR PASUA PA development is an effort in order to conserve, reconstruct, and revitalize performing arts by utilizing augmented reality technology. AR PASUA PA provides opportunities for the development of performing arts 4.0 during the Covid-19 pandemic. The simulation of temporal and kinematic movement of a performance is one way to understand the movements of the Karwar dance (Papua), the Cikeruhan dance (Sundanese) and the Guel dance (Aceh). This research applied qualitative methods with simulation techniques and virtual motion analysis. The results of this study describe the temporal and kinematic movement of the AR PASUA PA performance. The understanding of dance movements was done virtually by studying the position and time derivative of the performance, as well as the movement simulations performed by the hands, feet and body of the dancers, both solo and in groups.
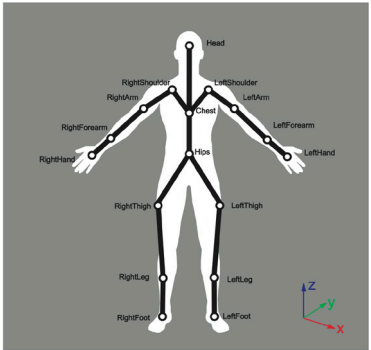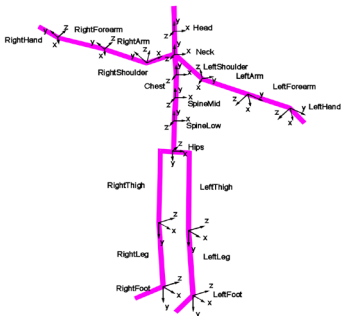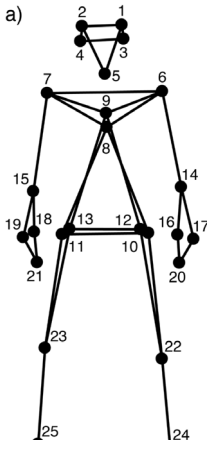
Keywords : Simulation, Kinematic, Augmented Reality

INTRODUCTION

The development of Augmented Reality Papua-Sunda-Aceh Performance Arts (AR PASUA PA) is an effort in order to conserve, reconstruct, and revitalize performing arts by utilizing augmented reality technology. AR PASUA PA creates opportunities for the development of performing arts 4.0 during the Covid-19 pandemic. The movement in the performing arts provides a narrative and forms the basis of performance in terms of multidisciplinary research and the scope of interest in dance, health and simulation technology. The simulation of the temporal and kinematic movements of the performance is one way to understand the movements of the Karwar dance (Papua), the Cikeruhan dance (Sundanese) and the Guel dance (Aceh). Every dancer's movement pose has a kinematic pattern structure. The understanding of temporal and kinematic movement is important for improving dancer performance and developing motor control [6] (Neto, 2008: 1052).

The optimization of body, hands, and feet movement techniques in dance performances produces a knowledge base in the form of a collection of the Karwar dance, Cikeruhan dance and Guel dance motion poses. A collection of motion poses that is arranged into a virtual movement knowledge base or a database of AR PASUA PA dance movements can be used as a source of practical or studio learning. The dance movement repetition by dancers at various levels of the movement steps, movement variants, and duration was done in order to consider the same movements and correctly performed by the students. Kinematic and temporal movement database and visualization help the training process of synchronizing dance movements in the performing arts 4.0 AR PASUA PA. The movement model of each pose can be categorized as one-dimensional movement. Following are the hierarchical kinematic model points.

Fig. 1a. Hierarchical Kinematic Model 1	Fig. 1b. Hierarchical Kinematic Model 2	Fig. 1c. Hierarchical Kinematic Model 3
		markers (f: front; b: back; l: left; r: right): 1 head fl, 2 head fr, 3 head bl, 4 head br, 5 chin, 6 shoulder l, 7 shoulder r, 8 chest 9 back, 10 hip fl, 11 hip fr, 12 hip bl, 13 hip br, 14 elbow l, 15 elbow r, 16 radius l, 17 ulna l, 18 radius r, 19 ulna r, 20 finger l, 21 finger r, 22 knee l, 23 knee r, 24 ankle l, 25 ankle r
Source : Hachaj, 2017: 4	Source : Hachaj, 2018: 27	Source : Burger, 2018 : 6

This research on simulation of temporal and kinematic movement of AR PASUA PA performance applied qualitative methods with simulation techniques and virtual movement analysis. The depiction of the AR PASUA PA's temporal and kinematic movement patterns was carried out with hierarchical kinematic model points. The understanding of the dance movement patterns was carried out virtually by considering different positions of head, body, feet, and hands according to the tempo and performance time. The movement simulation was performed by AR PASUA PA dancers, both solo and in group. The kinematic variables, namely the start and end time of the movement, duration, angle, velocity, and acceleration of motion, were measured from the static position until the end of the performance [7] (Vences Brito, 2011: 1025).

This kinematic movement comparison can identify the same dance movements in the three types of AR PASUA PA dances. The kinematic movement in the performing arts learning process is carried out by dancers with normal and fast tempo. The information about the kinematic patterns between male and female dancers in performing dance movements is important for teachers to concern.

The changes in kinematic patterns between solo and group dancers are based on the development of basic movements from normal to faster tempo. The increase in movement performance is caused by temporal modulation of the head, body, hands and feet movement activities.

RESULT AND DISCUSSION

The dancers were positioned according to movement poses so as to form a kinematic movement simulation based on the tempo, as well as the positions that determine the plane of the head, body, hands, feet and the axis of rotation. The position of the rotation axis in a static pose allows comparisons between dancers both solo and in group. The position of a solo dancer and a dancer in a group is depicted in the form of hierarchical kinematic model points. The center of rotation rests on the body using kinematic estimation based on the calculation of the axis of rotation [7] (Vences Brito, 2011: 1025). The following are the movement poses and kinematic models of the Karwar dance (Papua) performed by female dancers in groups:
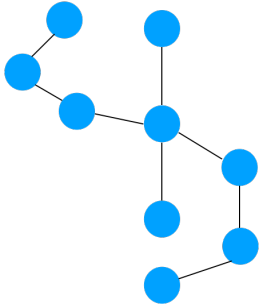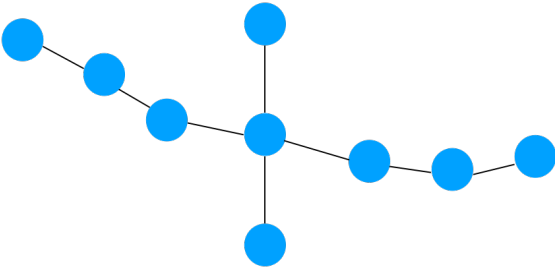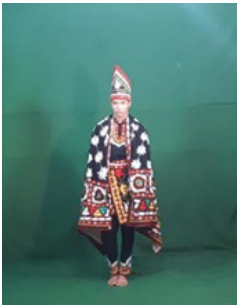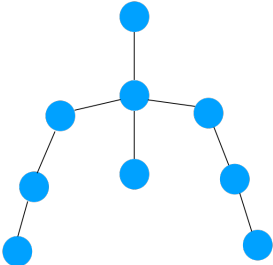
The position of a moving body for the hierarchical kinematic model is determined by the acceleration [4] (Hachaj, 2018: 26). The kinematic movement simulation is dynamically depicted in the form of animated movement poses. The female dancer on the right side compared to the female dancer next to her in performing knee bending movement is interpreted as descending toward the floor plane and so on. Another example of the movement poses and kinematic models of the Cikeruhan dance (Sundanese) with a solo male dancer is shown as follows.

In the Cikeruhan dance movement pose, a male dancer stretches both arms and slightly bends right leg. The kinematic movements of male dancers in the Cikeruhan dance are different from the kinematic movements of male dancers in the Karwar dance pose (Papua). The kinematic movements produced by dancers are differentiated based on the body proportion and movement velocity that are performed differently [3] (Hachaj, 2019: 36).

The movement is perceived expressively (Burger, 2018: 2) such as depicting emotions in spontaneous dance movements, synchronizing dance movements with dance movements of other dancers and so on. The kinematic movement [2] (Goebl, 2013: 1) is extracted from every move-

ment of the head, body, hands, and feet in the space and time dimensions. The duration of time delay among head, hands, and feet movements is relatively constant in terms of changes in the movement complexity and tempo. An estimated time (per minute) is able to change the kinematic movement patvterns. The dancer kinematic move-

ment describes a significant activity and synchronization velocity of the head, body, hands and feet. An important aspect of kinematic movements is a consequence of the hands and arms muscles, as well as shoulder joints.

Fig. 2a. The Movement Poses of The Karwar Dance (Papua)	Fig. 2b. Kinematic Model of the Karwar Dance (Papua) Performed by Female Dancer (right)
Fig. 3a. The Movement Poses of The Cikeruhan Dance (Sunda)	Fig. 3b. Kinematic Model of the Cikeruhan Dance (Sunda) Performed by Male Dancer
Fig. 4a. The Movement Poses of The Guel Dance (Aceh)	Fig. 4b. Kinematic Model of the Guel Dance (Aceh) Performed by Male Dancer

CONCLUSION

The kinematic movement of AR PASUA PA dance has different kinematic characteristics one another. The movement is also determined by the tempo or dancer movement velocity. The movement velocity of the head, body, hands and feet accelerates with the energy exerted from the three dancers. The dancer's kinematic movement poses and different speed tempos produce kinetic energy that is transferred by the dancer in the form of motion expressions while performing the show.

This simulation of the temporal and kinematic movements of AR PASUA PA dance illustrates the positive power when the dancer's body generates energy from the concentrated prevalence of head, body, hands, and feet activities. The temporal and kinematic movements performed by solo dancers and dancers in a group in the AR PASUA PA performance present a sequence of movement activities that reinforce expression, narrative, and performance dynamics. Different kinematic patterns during the dance movements indicate a variation in movements and a decrease in tempo, as well as a range of movements during the performance takes place.

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