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Research article

THE SYNCHRONISATION OF MOTION CAPTURE RESULTS IN THE ANIMATION CHARACTER REINFORCEMENT PROCESS

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Abstract: Animation is a collection of frames that express a motion activity. The animation consists of actors, characters and performance components that present a story — one of the technologies in making an animation with motion capture. The results of catching motion in the form of motion record data are then synchronised to animated characters. However, the problem is that there are difficulties in synchronising animated characters with the results of catching motion so that the motion can be more subtle. On capture, this motion uses Kinect as a motion capture sensor for actors. The results of this capture then become motion data. The synchronisation of motion data from the motion capture results with Kinect then adjusts the joint body character points, frames, time with three-dimensional (3D) animated characters according to the flow of character actors. This synchronisation is adjusted to the recording of character movements starting from the motion of humans, animals and objects that invite motion activity with motion capture methods both marked and without markers. In making 3D, there are models of giving a body or bone frame (rigging) after giving the body frames is done by giving visual effects, lighting, rendering, and compositing. Rigging is the installation of bones to characters used to place and manipulate animated controls on characters that will be animated to produce the desired gesture. Animation synchronisation is to create animated characters manually; the file is used for. The synchronisation is Biovision Hierarchy (BVH) with gesture giving movement without having to save the keyboard in every animation movement manually.

Keywords: Motion Capture, Animation, Rigging, Synchronization

摘要 动画是表示动作活动的帧的集合。动画由呈现故事的演员，角色和表演组件组成 - 这是制作动画捕捉动画的技术之一。然后以运动记录数据的形式捕捉运动的结果与动画角色同步。然而，问题在于使动画角 色与捕捉动作的结果同步存在困难，使得动作可以更加微妙。捕获时，此动作使用 Kinect 作为演员的动作捕捉传感器。然后，该捕获的结果变为运动数据。来自运动捕捉结果的运动数据与 Kinect 的同步然后根据角色演员的流动使用三维（3D）动画角色调整关节身体角色点，帧，时间。这种同步被调整为从人类，动物和物体的运动开始记录角色运动，这些运动通过标记和没有标记的运动捕捉方法来邀请运动活动。在制作 3D 时，通过提供视觉效果，照明，渲染和合成，在给出身体框架之后，存在给出身体或骨骼框架（装配）的模型。索具是将骨骼安装到角色，用于在角色上放置和操纵动画控件，这些角色将被动画化以产生所 需的手势。动画同步是手动创建动画角色;该文件用于。同步是 Biovision Hierarchy（BVH），手势提供移动，无需手动将键盘保存在每个动画移动中。

关键词: 动作捕捉，动画，索具，同步

INTRODUCTION

At this time computer technology is developing very rapidly making it more comfortable in the process of producing 2-dimensional and 3-dimensional animation, all people much favour the animation because it is not limited to age[1]. In making animation there are several stages, namely making 3-dimensional characters (modelling), giving a body or bone framework (rigging) to manipulate animated character movements in order to produce movements desired by animators, giving visual effects, lighting, rendering and compositing[2]. Many people think that making 3-dimensional animation is an animator, only tasked with moving animated 3-dimensional characters[1] there are many ways to drive animated characters, such as manually or by utilising existing technologies, namely motion capture[2-3].

In producing animation, many animators who make short animations move characters manually which takes a very long time because they have to move manually on animated characters and save the resulting movement into the frame if the animation made 1-5 minutes long will take 1-2 days because the method used is still manual[4-5]. By utilising motion capture technology which is currently widely used in filmmaking, robotics, games, and animation, with motion capture animators can produce more realistic movements and speed up the work of animators in making animation[3]. Motion capture using motion capture produces the Biovision Hierarchy (BVH) file format which is a file format that is widely used by animators in making animations that makes it easier to provide movement in animated character or models[3][6]. The BVH file consists of two parts, namely the first part is the hierarchy section that describes the initial pose of the framework, while the second part is motion data that contains motion data that has been recorded using motion capture[7]. Many animators make short duration animations difficult to synchronise BVH files with animated characters; here the author will explain how to make animated characters move according to the recording results from motion capture[2][4].

RELATED WORKS

The synchronisation of animation with motion capture using the proposed rigging consists of steps, which are simplified in this study which will be explained in the following section.

Functional Needs Analysis

Analysis of functional requirements needed for moving animation that matches the capture results with motion capture[3][6][12] as for the functional requirements, among others, the resulting animation must be without making a keyframe manually by the animator, the animation moves according to the original movement and the motion of the recording results with motion capture[2].

Analysis of Number of Joints

Analysis of the number of joints to avoid errors in reinforcement on animated characters because it will affect when synchronising BVH files to animated characters[2][8][15], to find out how many joints there are in the human body[5][14]. Each joint will be named according to the sequence of joints that are in the anatomical structure of the human body[1][4]. The results of this analysis will be used as a reference in the rigging process on animated characters as shown in figure 1 below.

Figure 1. Human body joints[10]

The results of the analysis on the joints of the human body are nineteen joints in the human body, not yet consisting of joints of the fingers and toes[6]. In this study not using all the joints of the hands and feet, only a few hand joints were used[9][11].

Motion Capture Analysis

Motion capture analysis has two types of tools, namely using markers and markerless[10]. The process of taking motion with markers must use tools on animators, unique clothing, and green background spaces so that movements performed by actors can be recorded and stored in BVH file format, while without markers do not use tools, unique clothes and special rooms to make motion arrests on actors[1][6][7]. The author uses Kinect X-Box 360 motion capture which is a type of markerless device because the price is relatively low and does not have to use a special room for recording motion[9][10][13] as shown in figure 2.

Figure 2. Kinect X-Box 360

In Figure 2, one of the motion capture devices from a well-known company, Microsoft, which issued a video game console named X-Box 360 or Kinect, is a Project Natal, using the Kinect sensor to read the bone structure in the human body.

This paper is a development of research[1] where in previous studies it has not discussed the technicality of how character synchronization from motion capture data with animated characters is made so that the results of synchronization in the form of motion that is not real or smooth in accordance with the original motion of the actor. So this study seeks to show the technical synchronization of animated characters and motion capture results in real accordance with the motion of the actor[2].

RESEARCH METHOD

Analysis of making 3-dimensional characters to determine what characters will be created, by making a character blueprint on paper or in applications such as adobe illustrator or Corel draw, to make it easier to create characters in the blender application, as shown in Figure 3. The blueprint consists of two parts namely the front and side.

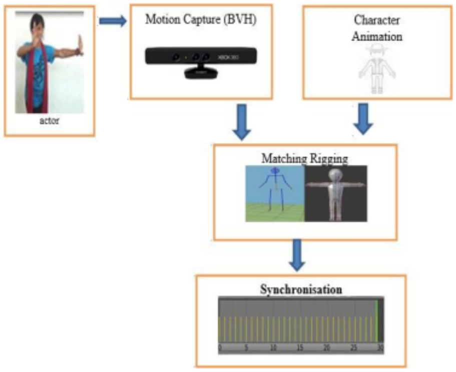


Figure 3. Flowchart system

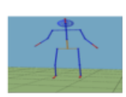
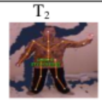
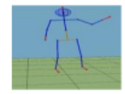
Where on the front makes the shape of the front of the character such as the length of the body, legs, hands, head, and make the eyes and mouth, while the side makes a character posture consisting of the shape of the hands, feet, chest shape and rear body shape[4] Blueprints are very important in making animated characters because without a blueprint for making 3-dimensional characters it will be difficult because there is no description of the characters to be made like what and how.

The results of the arrest of the actor (BVH) are then made an adjustment process to synchronize the motion to the animated character, starting from the body's reinforcement settings, the rhythm of motion, time and suitability of the motion.

RESULT AND DISCUSSIONS

The results obtained by the analysis carried out in the previous chapter, the author can make 3-dimensional animation by utilising Motion Capture and synchronisation in making animations so that the results desired by the author will describe the results obtained by the previous analysis as shown in table 1.

Table 1. The Results of Catching Movements Using Kinect

(A) Tracking	(B) Depth	(C) BVH
T_1 		
T_2 		
T_3 		

In table 1, Kinect has three cameras consisting of (A) RGB cameras with 640 x 480 resolution with 32bit colours with 30 frames per second, Kinect RGB cameras can do face recognition and detect three colour components namely Red, Green, and Blue. (B) Camera Depth A sensor or depth sensor is an infrared projector, in the form of a moving frame that has joint points of human motion. The Dept. Sensor consists of a combination of an infrared laser projector that can take video data in 3D. (C) Is the result of recording the motion when the actor moves (T_1-T_3), the camera recorded from monochrome the way the sensor works is almost the same as the Depth sensor, but on the monochrome sensor it works simultaneously to view areas or spaces in 3D without regard to light conditions[10].

Character Creation

Character creation has several types of software for image representation (blueprint) into 3D animated characters, namely, Blender, 3ds Max, AutoCAD, and others[2][6].

In this study the author uses Blender software to create animations because the open source and specifications for running blenders are relatively light compared to other software, blending effortlessly in creating 3-dimensional characters using the prepared blueprint[1][10], animated characters generated using a blueprint can be seen in figure 4. Characters created are not always the same as the blueprint that exists because what is described can be different when made in a blender.

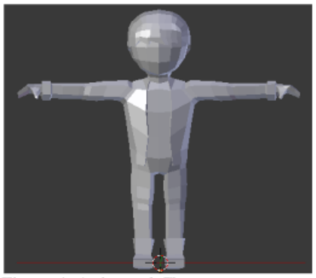


Figure 4. Animated Character

Character Reinforcement

Reinforcement or rigging gives bones to characters that have been made, just like humans who have bone animated characters also need bones to be able to move[9], bone installation must adjust to the number of joints that have been analyzed before so that the movement produced animation is more realistic[3][7], reinforcement very important in the synchronization process because when synchronizing the *bvh file will adjust to the bones that are in the character[2][5] the results of the repeater can be seen in Figure 5.

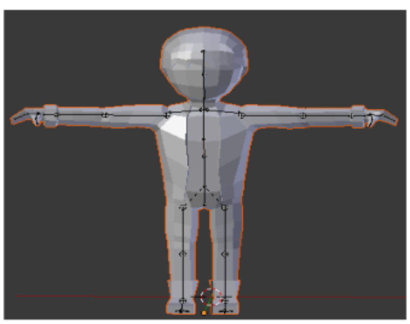


Figure 5. Rigging

File Biovision Hierarchy

Before doing the synchronisation process, it is done to find out the number of frames that have *bvh files from the motion capture using the Kinect sensor by using the Brekel Kinect Pro V1 application specifically for Kinect X-Box 360. There are many supporting applications to run *bvh files like Bvhacker, Blender, and 3ds Max as shown in figure 6.

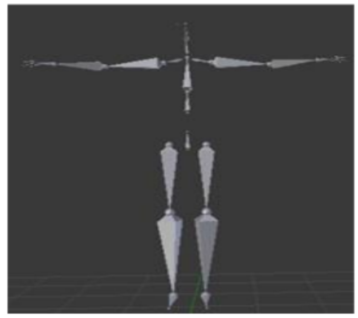


Figure 6. Skeleton BVH before synchronizing

In figure 6 is a skeleton *bvh that has not been synchronized with animation, imported using Blender software where *bvh data that has been recorded uses Kinect sensors and stores in digital data, BVH files have two parts namely hierarchy and motion data, part of the hierarchy consists of ROOT, OFFSET, and CHANNEL. Root is an integral part of the BVH file structure because it represents all the bones that are in the BVH file framework, Offset describes the origin of bones by defining the name of the bone and the direction of growth from X, Y, and Z, while the Channel defines the position and rotation of the resulting movement as shown in figure 7.

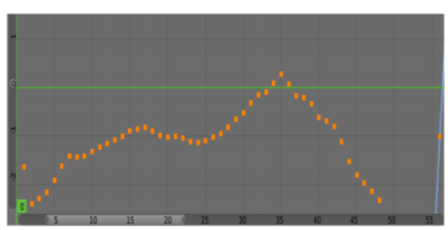


Figure 7. BVH frame graph before synchronizing

Each record has some frames and graphs, the frame graph represents the movement of each bone in the skeleton *bvh, in figure 7 the *bvh file has a framed graph with the Dope Sheet length equal to the number of frames that the *bvh file has. At the time before synchronization, the chart is more dominant upward and results from a slower movement when running in a blender. In the Dope Sheet animator can change the speed of movement of files *bvh from slow to fast, Dope Sheet representing each skeleton BVH as shown in figure 8.

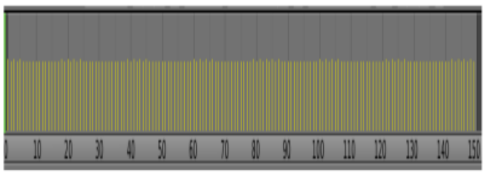
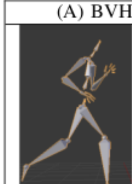
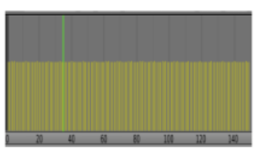
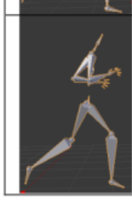
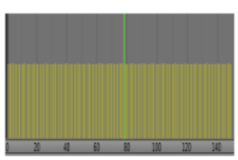
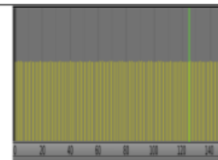
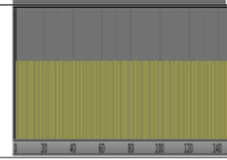


Figure 8. BVH frame before synchronizing

The channel consists of Motion and Frame, showing how many frames are in animation, while Frame Time shows the sampling value or we can determine the speed of a movement from digital data captured by Mocap, and the Channel contains a skeleton representing an animated frame.

Table 2. The movement of the results of recording digital data using motion capture

(A) BVH		(C) Frame
	B_1	
	B_2	
	B_3	
	B_{149}	

The results of digital recording data using mocap have a frame of 149 (B_1-B_{149}) when synchronized the number of frames that the original file has and synchronization will not be the same.

BVH Synchronization to Animation

The synchronization of character animation and *bvh is very difficult because there is little information available, in the synchronization process there are three ways namely, manual synchronization, script writing, and using plugins from MakeWalk, the author uses the third method, using the MakeWalk plugin because it is easy to use. MakeWalk plugin itself is made from one of the Make Human Community applications that provide free to users; the Make Human application also provides the creation of animated characters like humans that have been directly equipped with bones, where animators simply synchronize animated characters and *bvh files as shown in figure 9.

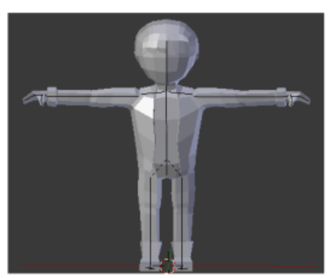


Figure 9. Animation and Bone Character

The characters produced by using the blueprint and blender application, by utilising the bone feature in the blender so that the characters that have been made with a blender can move according to the wishes of the animator. To speed up the work of an animator, there is one feature called synchronization.

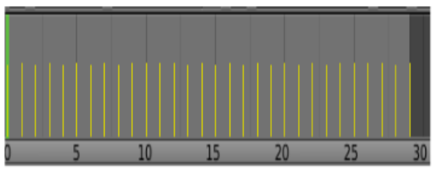


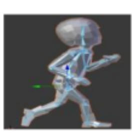
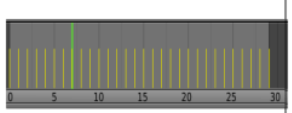
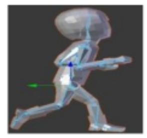
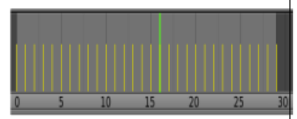
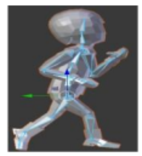
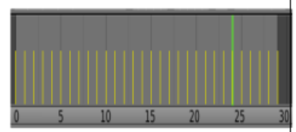
Figure 10. Frame After Synchronization

In figure 9 and 10 are the results of synchronisation of the *bvh file above, the results of the frame graph and the number of frames that are different from the original *bvh file.

Synchronization Results

Can be seen in Table 2 above the number of frames that are owned by Table 3 is different, although the number of different frames movement movements produced by the original file (C_1-C_{149}) and synchronisation are not different from the original file, to see the results can be seen the movements in table 2 and table 3. Not all BVH files will be reduced in frame when synchronizing using MakeWalk, it has the disadvantage of not being able to synchronize BVH files with a long duration, can not change the movements that have been synchronized, but behind its weaknesses there is an advantage of accelerating synchronization for animators who make animations that have a short duration.

Table 3. Results of BVH synchronisation and animation

(A) Character	(B)	(C) Frame
	C_1	
	C_2	
	C_3	

CONCLUSION

Synchronizing animated characters with *bvh files is proposed in this paper. In making animations there are still many who use old methods that will take a long time in the production of animation because they have to move the animated characters manually and save the movement into the frame, with synchronization animation and *bvh files can help in the very long animation process to be more short because without having to move the animated character manually and save it into the frame, using digital data recorded using Motion Capture Kinect X-Box360 and synchronizing with animated characters makes the animator's work faster.

The method used in this research is very good to use to make animations that are of short duration because they do not use very large capital and do not take a long time and the results obtained are not far away by using paid ones, weaknesses that are owned if the recorded movement is not feasible then recording must be done so that the results obtained are better than the previous results.

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