



Movement Analysis 3D Character Animation Assisted on Kinect XBOX One Devices

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ABSTRACT

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The technology of Motion Capture is used to produce motion animation by capturing the movement of the artist, then recorded and applied on virtual 3D. This is especially helpful in animation movements that are difficult to work with conventionally, as imitating human body movements realistically is quite difficult for some animators. The use of Kinect Xbox One to overcome various human limitations in creating animated movements on virtual 3D objects in the form of humans or animals. The purpose of this study is to describe how to use the Kinect Xbox One and explore its ability to detect basic human movements that can be used by animators to be applied to virtual 3D objects. The results of this study indicate that the use of Kinect Xbox One as a Motion Capture is good enough to be used to produce animated movements, especially basic human movements in the type of basic locomotor movements, namely walking, running, jumping and jumping, basic movements of balance skills, namely bending, stretching, twisting and swing and basic manipulative movements, namely throwing, punting and kicking.

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1. Introduction

Entertainment films or videos that show scenes in a film that make us wonder how this could happen, animal characters who can behave like an ordinary humans. Animal characters in films that combine real-life and cartoons look so integrated into scenes in a story in the film. [1] Examples of films related to this include the film "Dawn of the Planet of The Apes" which shows a scene of an ape being seen. walk, communicate and ride horses like humans. [2] In the animated film "Happy Feet" the penguin animal character who is the main character, as we know the penguin animal shows funny behavior and has limited movement in walking. Motion Capture technology is one of the assistive devices used by the filmmakers, with the ability to track human body movements, then capture and apply them to animal characters. according to [3] shows that animated films from 2017 to 2019 experienced good growth, for the animated film business in billions or billions of rupiah in 2019 has reached 265 billion US dollars or in rupiah around 3,900 trillion rupiahs per year, and it is estimated that in 2020 it will grow to 270 billion US dollars or around 4,000 trillion rupiahs. This allows the production of animated films to be higher, the demand for creative personnel in the animation field is increasing. But of course, it must be balanced with the quality of human resources who are competent and qualified in their fields.

According to Wawan Setiawan, [4] Director of Research, Education, and Development of the Creative Economy Agency (Bekraf) Every year, the need for human resources in the creative field cannot be met and the animation sector in the creative industry has the highest opportunity. This is an opportunity as well as a challenge for prospective workers in the creative field, a great opportunity to increase their competence to enter the world of creative work and the challenges, especially for educational institutions that will produce human resources every year. What kind of human resources should be? Of course, human resources are following the needs of the creative economy industry.



According to Daniel Harjanto, a pioneer of the Indonesian animation industry, the successful development of the animation industry in Indonesia must be carried out proactively by government agencies, educational institutions, industry, and communities. According to Wawan Russiawan from the Creative Economy Agency [5], Human Resources issues are also a major problem between educational institutions and the animation industry, namely that there are still differences in learning on the education side and the need for human resources in the animation industry, resulting in reduced employment.

The use of Motion Capture technology in animated films has long been applied, [6] there are at least 123 animated films that use Motion Capture technology in scenes or actions on animated characters in the film. [7] Motion Capture can provide considerable time savings for working on animation projects, which can work on 197 animated motions for 15 hours using a motion capture system or Motion Capture. whereas if you don't use Motion Capture it takes about 4 months. The research objectives to be achieved are to describe how to use the Kinect Xbox One device to produce the desired animated motion, to explore the animated motion scene generated from Motion Tracking through the Kinect Xbox One device to be applied to a 3D human or animal character model.

According to Simon Kay [8], Motion Capture In its simplest form is the recording of the movement of an object by a computer using a series of sensors. Motion Capture is a process of planning, recording, and integrating data from people wearing clothes that have sensors. [9] Mikhailchuk from Teslasuit.io, Motion Capture or mo-cap, is the process of digitally recording the movement of people or objects. Motion Capture technology is currently widely used in the entertainment world, especially in the gaming and filmmaking industries.

[10] Several advantages of using Motion Capture technology, the short production time limit, namely the amount of material to be refined, the movement does not change even if it is complex or large because it is limited to the movement of the person being captured. This allows the animation work to be completed completely and is much cheaper when compared to other means.

[11] That Motion Capture Systems have evolved from simple to highly flexible and specialized systems. Types of Motion Capture systems such as Mechanical, Magnetic, and Optical, optical mocap have developed far beyond the rest. Motion Capture became so popular in the world that the film and videogame industries invested heavily in the development of Motion Capture projects.

[12] Bilesan et al, in their research on Markerless Human Motion Tracking Using Microsoft Kinect SDK and Inverse Kinematics. conducted a study of anatomical joint angles captured using Kinect compared to 3D rotation angles which are standard motion capture systems. According to Suryajaya [13] in Research on Motion Capture Techniques in the Process of Making 3D Animations Using Microsoft Kinect. The conclusion that can be drawn from this research is that Kinect can be used as a Motion Capture tool on condition that it uses the OpenNI driver and Brekel Kinect software as software to convert motion capture results into files that can be used in 3D animation. In its performance, Kinect requires a certain area to perform calibration and tracking. Motion capture power by Motion Capture also depends on the software used whether it has facilities that support the speed of capturing movement so that the results issued are also movements that are as expected, for this study it is necessary to test again using Kinect Version 2 so that you can see the difference in the results achieved.

while in the research on Optimization of Markerless Motion Capture Techniques Using Multi sensors in Making 3D Animations [14], that the use of Kinect version 1 as a markerless Motion Capture tool or mocap can help animators in moving the original, but the use of one Kinect has the disadvantage of not being able to record movements such as jumping, turning and standing from a squatting position. While the use of two Kinects can cover the weaknesses that exist in the use of one Kinect with the right combination of placement of the two Kinects.

The use of Kinect Version 1 still has many shortcomings but there have been developments from better improvements, especially in the accuracy of motion tracking. In this study, we will use Kinect Xbox One or Kinect Version 2 and the results of the Movement are applied directly to 3D characters by analyzing the Animation Movement of 3D Characters Assisted by Kinect Xbox One Devices.

2. Method

2.1 Study of literature

Study of several research results and sources of reliable articles that discuss the topic being focused.

2.2 Observations and Assistive Devices.

Observing the place used as a motion capture room with adjusted room size. Prosen motion capture using Xbox One device and iClone7 software.

2.3 Basic movement analysis table

The process of recording animated movement data based on basic human movements, according to Gallahue [15] about the basic movements, including locomotor skills, balance skills, and manipulative skills. The body movement section that will be tested is the movement of the head, hands, body, and legs. Testing the recording of Movements should be mapped on the Movement first or which part of the body will be tested for recording. This is done so that the test is measurable and limited to the part to be tested.

TABLE 1
BASIC MOVEMENT SKILLS
Basic Movement Skills

Locomotor	Balance	Manipulative
1. Walking	1. Straight Sideward Rolling	1. Under Arm Throwing
2. Galloping.	2. Sideward Rolling	3. Over- Arm Throwing
3. Skipping.	4. Forward Rolling	5. Slide Armthrowing
4. Step Hopping.	6. Backward Rolling	7. Cathing
5. Sliding	8. Stretching	9. Under-Armrolling
6. Running	10. Culling	11. Bounce
7. Meaty	12. Jumping And Landing	13. Cathing And Rolling Ball
8. Hopping.	14. Twisting	15. Passing And Cathing
9. Leap.	16. Balancing	17. Striking
10. Standing	18. Direction Charging	19. Shooting
11. High Jump		20. Punting
12. Standing Long Jump.		21. Kicking
		22. Dribbling
		23. Trapping

In testing the basic movements, all types of basic movements were not carried out, due to budget limitations and supporting infrastructure, so the movements to be tested were adopted from table 1 and adjusted to conditions in the field.

TABLE 2
BASIC MOVEMENT REMAPPING.
Basic Movement Remapping

Locomotor	Balance	Manipulative
1. Walking	1. Bend Down	1. Arm Throwing
2. Running	2. Stretching	2. Kicking
3. Hopping.	3. Twisting	3. Punting
4. Leaping	4. Balancing	
	5. Direction Charging	

Schematic Creation of Movement Recording Test Process and the steps for testing Motion recording using an *Xbox One* can be seen in Figure 1.



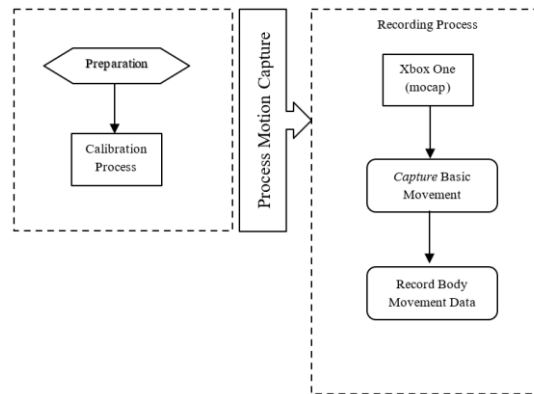


Figure 1. Schematic of the Motion Recording Test process.

3. Result and Discussion

Kinect is one of the additional pieces of equipment provided for the Xbox game console made by Microsoft. Kinect can detect the movement of Xbox users to provide a more real experience in playing without the help of a joystick. Xbox users can play games with just the same motion as they are in the game. Because Xbox One can detect the user's movement this tool can be used as a Motion Capture, which is used to capture human movement and applied to human 3D objects. Kinect Xbox One works markerless without using markers on the face to feet but can detect the user's body movement.

The calibration process starts from the calibration process on the Kinect Xbox One device against the object that is the target for recording its movement, selecting 3D Movement objects, and the Calibration Process. In this study, devices that support the research process were used, namely laptops, Kinect Xbox One devices, iclone 7 software, and Kinect Mocap Plugin v.2.

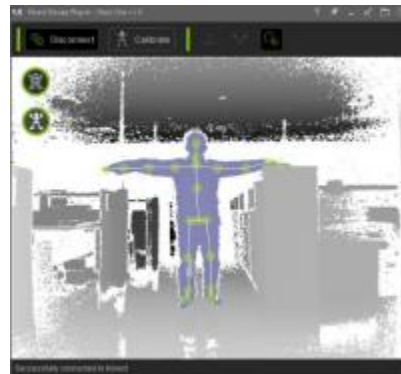


Figure 2. Calibration Process

Figure 2 shows the calibration process carried out to ensure that the object to be recorded is following the calibration standards of the iClone 7 application. does not match or needs to be re-calibrated until both are green.

The standard size in question is the measure of the distance between the Kinect Xbox One device as a Motion Capture tool and the object as a talent whose movement will be recorded. The size of the distance, height can be seen in Figure 3.



Figure 3. The Distance Limit of Mocap with Objects

According to the Software Development Reallussion documentation is the height of the Kinect Xbox device is between 0.5 to 1.1 meters, the closest distance or range for Kinect to record objects is 1, 5 meters from the Kinect device to the recorded object. The maximum distance is 4 meters. For object heights that can be recorded from 1.75 meters to 2 meters. When testing direct calibration on the talent object as we show in figure 4 Nearest distance is 1.2 meters Farthest distance is 3.8 meters



Figure 4. Nearest And Far Distance Calibration.

The closest most effective distance is 1.2 meters from the Mocap device and the most effective for the furthest distance is 3.8 meters. If it is 4 meters away, some of the centers of the reinforcement joints are red, which indicates the object is not perfectly detected. The character or object used to apply the motion from the Mocap results using the human character created in the iClone 7 software.



Figure 5. Human Character Object

Data from this human object is every movement recorded with a frame size of 60 fps, the number of polygons that make up a 3D object human is 50410 and uses 600MB of computer memory from 2 GB of memory. In the Locomotor Movement Test, there should be 8 movements, but in the test, only 4 basic movements are used. Movement of Balance Skills from 10 movements to only 5 movements will be tested and Manipulative Movements from a total of 11 movements to 3 basic movements only. All of the basic movement reductions tested were carried out due to the limitations of supporting equipment, space used, and research costs. The weight of the test scores given for each movement is Very Good with a value of 4 (four),

Good value of 3 (three), Poor value of 2 (two), and Bad value of 1 (one).

3.1 Basic Locomotor Movement Tested

TABLE 3.
DATA OF LOCOMOTOR BASIC MOVEMENT RECORDING TEST RESULTS.

Basic Movement		Walking	Running	Hopping	Leaping
Head	SB	4			
	B		3	3	3
	KB				
Right Hand	TB				
	SB				
	B	3	3		
Left Hand	KB			2	2
	TB				
	SB				
Body	B	3	3		
	KB			2	2
	TB				
Right Foot	SB				
	B	3	3		
	KB				
Left Foot	TB			2	2
	SB				
	B	3	3		
Total Weight	KB			2	2
	TB				
		20	19	15	15

Description : **SB**=Very good, **B**=Good, **KB**=Poor, **TB**=Bad

For walking movements, the head is detected very well, the right and left hands are good because the palms do not move much, as well as the soles of the feet sometimes move too much. However, this can be overcome by editing the excessive moving parts. For a leisurely running movement, the movement can be detected or captured well even with a little discomfort. The hand movement that follows it, but can still be considered to produce a good movement. If we look at the results in the test result percentage of Jumping Motion is the same as Movement Jumping, the result is detectable well. On the head, body left leg, and right foot was detected well, while the right and left hands were not so well detected. From the results of testing the basic locomotor movements, it can be said that the Kinect Xbox One detection has a fairly good ability to produce basic animated movements.

The results of this movement test can be seen in the form of a percentage bar graph as follows

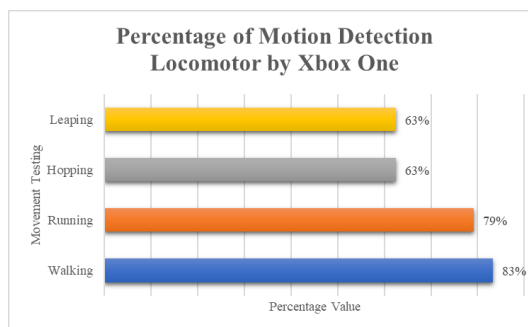


Figure 6. Data of the Basic Locomotor Movement Test Chart.



3.3 Test of Movement of Balance Skills

TABLE 4.
DATA OF TEST RESULTS RECORDING OF BASIC MOVEMENT OF BALANCE SKILLS.

Basic Movement	Bend Down	Stretching	Twisting	Balancing	Direction Charging
Head	SB	4			
	B		3	3	
	KB				
	TB	1			1
Right Hand	SB	4			
	B		3	3	
	KB				
	TB	1			1
Left Hand	SB	4			
	B		3	3	
	KB				
	TB	1			1
Body	SB	4			
	B		3	3	
	KB	2			
	TB				1
Right Foot	SB			4	
	B		3	3	
	KB	2			
	TB				1
Left Foot	SB	4		4	
	B		3	3	
	KB				
	TB				1
Total Weight	13	22	18	20	6

In the basic bending forward movement test from a standing position, the head, right and left hands were not detected properly. the cause was the intersection of the joints in the hands and the body so that the tracking system on the Kinect was unable to detect the difference in the joint points. also in other parts of the body, right and left legs are not detected properly. The basic movements of stretching and swinging are detected well, stretching is stretching the arms sideways along with the legs, swinging is swinging the arms forward and back the results are good or can be detected.

Meanwhile, the circular motion, which is the rotating movement of the hands and body to the left and right in a standing position, is not detected properly, because of the intersection of the arms. The basic movement of Rotating the Body, which means turning all parts of the body without being detected at all or the 3D object's bones will fall apart completely.

Testing on the basic movements of balance skills, namely bending, stretching, twisting, swinging, and twisting the body. It can be seen in Figure 7 the Balance Skills test chart percentage.

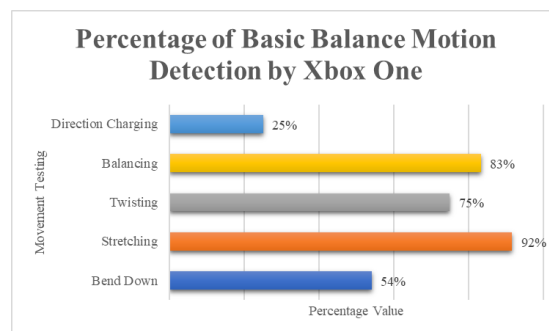


Figure 7. Graph Data of Basic Movement Test of Balance Skills



3.4 Manipulative Movement Test

TABLE 5.
DATA ON THE RESULTS OF THE MANIPULATIVE BASIC MOVEMENT RECORDING TEST.

Basic Movement		Arm Throwing	Kicking	Punting
Head	SB	4	4	4
	B			
	KB			
	TB			
Right Hand	SB	3	3	3
	B			
	KB			
	TB			
Left Hand	SB	3	3	3
	B			
	KB			
	TB			
Body	SB	3	4	4
	B			
	KB			
	TB			
Right Foot	SB	3	3	3
	B			
	KB			
	TB			
Left Foot	SB	3	3	3
	B			
	KB			
	TB			
Total Weight		19	20	20

Manipulative motion is a movement that involves the act of controlling an object especially with the hands and feet, there are many types of this movement as listed in table 1, but not all movements tested in this study, there are only 3 movements that will be tested due to various limitations in this study The movement includes throwing, in this movement the ability of Kinect Version 2 is very good at detecting the movement of objects by the camera. For kicking and kicking movements, as seen in figure 8, these basic movements, especially the head, body, right, and left legs can be detected well, only the right and left hands for kicking and kicking movements are less well detected.

Overall these three basic movements can be detected by Kinect version 2 or Kinect Xbox One for motion capture purposes. In the field, on testing basic locomotor, balance, and manipulative movements using the Kinect Xbox One device as a Motion Capture to capture the movement of the talent which is then implemented on human 3D objects, it can be said to be successful overall. However, the limitations in this study are quite influential in producing the desired movement, so that the results of the research can still be improved with various supporting applications and adequate equipment, and of course a representative testing room as a basic human movement testing studio. Testing on the basic manipulative movements, namely the basic movements of throwing, kicking, and kicking. In figure 8 the Manipulative Graph shows the basic movement data detected quite well in the manipulative movement percentage.

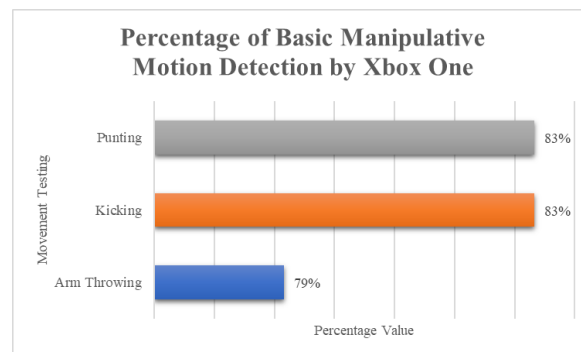


Figure 8. Graphical Data for Testing Basic Manipulative Movements

4. Conclusion

Based on the results of the discussion and several tests in research on the implementation of Kinect Xbox One which is used as a Motion Capture, it can be used to produce animated movements, especially basic human movements, so that it can save production time, or at the time of manufacture movement animation. The selection of supporting software for the Motion Capture Technique will determine the quality of the motion that can be recorded or produced because each software has its strengths and weaknesses. This study shows that some of the basic locomotor skills testings that are used as a reference for animated movements to be tested using the Xbox One Kinect motion sensor are quite successful in detecting movement well. Testing of Basic Movements for Balance Skills shows that there are movements that are not detected properly by the Kinect Xbox One motion sensor, namely bending and twisting. Basic Movement Manipulative skills that are well detected by the motion sensor of Kinect Xbox One are throwing movements using the left and right hands.

The use of the Kinect Xbox One motion sensor needs to be tested using 3 or 4 sensors with the same version at once to see how accurate the basic motion can be detected to improve the quality of better Movement. More basic movements that are tested would be better, but it is necessary to provide complete facilities to fulfill basic movements that require auxiliary equipment, a large enough space.

The research that has been carried out has limited infrastructure and research costs, so this research needs to be supported to produce a better knowledge contribution. The space for researching Motion Capture Techniques is less spacious, at least it requires space with a minimum size of 5x10 meters to be able to move more freely. Motion sensor devices are limited so it is necessary to add new devices and for further research, it is better to use at least 3 motion sensors with objects tracking humans and animals.

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