Use of Motion Capture in 3D Animation: Motion Capture Systems, Challenges, and Recent Trends

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***Abstract*— In today's world capturing of motion from a video stream is a growing and challenging area. Motion capture system (Mocap) is widely used in today's realistic world including sports, entertainment, video gaming and many more. In this paper, firstly we provide an overview of different types of Mocap on the basis of Marker-based Mocap and Markerless Mocap along with their merits and demerits. Secondly, we discuss about the current trends for detection and tracking based on their motion in realistic scenarios and then, current challenging issues which are still an open challenge to researchers, academicians and experts in this area.**

***Keywords*— Animation, Mocap system, sprite, object detection and tracking, 3D animation, 2D animation, transmitters.**

I. INTRODUCTION

Animation emerged out in the early 20th century in the year 1911.The small changes created an illusion which made the character in motion. It also helps the creators to control the movements of the character. Animation is basically a process of converting several images into an animation so that it seems like something is in motion. In 2D animation, the objects which are in motion are also called as sprites [1,2]. A sprite is an image to which, a specific location is allocated. To animate the sprite the location of the sprite is slightly changed frame by frame so that the sprite appears to be in motion. So there had to be something to adjust that flaw and that was the time when Motion Capture (Mocap) came into existence. Increase the speed of animation and decrease the work load on the animators. A technique was introduced which was called Mocap. By using this technique the movement of the real world objects can be captured and transfer the data into a tri-dimensional model. Since then the Mocap has evolved and it is most commonly used in film-making and video gaming industry so as to provide better results in less time, less work load on the animator and animation of faces to animate character's faces [2-4].

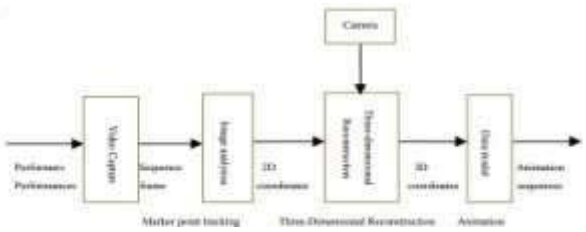

Fig.1. Block Diagram of Animation System

With the advancement of the technology, it is very difficult to bring the characters into motion so the mocap comes to play. By using it, movements can be created and hence the work load can be minimized. That is how the cut scenes and various character movements are made. Another place where mocap is applicable is the Film Industry. One of the leading studios using mocap is the MARVEL studio which is probably known to all. Mocap is used in various characters like the Hulk, the motion of the actor is recorded and the recorded data is then pasted on the character model and that is how the animated character hulk is given movement[5,7,8].

II. LITERATURE REVIEW

Capturing of motion from a video stream is growing and challenging areas have come to a very long means from their birth but till date, there are several open issues which have to be addressed. In this section some of the important systems are discussed with their drawbacks. This section provides a detailed description about current work done in this area.

III. MOTION CAPTURE SYSTEMS

Motion capture is a technique which can't be replaced by any other technique. However, Motion based system (Mocap) is not the only technique used for animation. It is necessary to understand several ways and techniques of animation to make out a difference and see that why capture motion is the best alternative used for animation. Basically, Mocap is broadly categorized into (a) Marker-based Motion Capture and (b) Markerless Motion Capture [12, 14, 16].

A. ***Marker-based Motion Capture***: In literature, there are several types of marker based motion capture systems. They are present to capture the motion of an object in video data. Some of them are listed below:

i. **Acoustical Systems:** In these systems, sound transmitters are positioned on the actor's main joints and three receptors are placed in the capture radius. Then, emitters are activated sequentially and generate a set of frequencies that are picked by the receptors and used to estimate the frequencies of emitters in 3D space. Due to sequential firing of transmitters, sometimes it becomes very difficult to gather the correct data [12,21].

Fig.2. Sound Transmitter Setup for Acoustical Systems [17]

ii. **Mechanical Systems:** This system comprises of sliders and potentiometers that are arranged in a desired joint and also enable the display of their locations as shown in Fig.3. Despite being a traditional approach main advantage of these system is that they are not affected by any field of magnet or redundant reflections which make them easy to use [6,10].

iii. **Magnetic Systems:** The workstation used for acquisition precision of data is moderately sky-scraping as shown in Fig.4. Sampling rate of these systems are approximately 100 frames per second (fps). These systems have one major disadvantage, i.e., a large numbers of cable wires are used to connect with the antenna which results in reduction of degree of freedom. To overcome this problem, Yabukami et.al. [8] developed a system where this issue is resolved. and processing of data is low-priced but the

Fig 3. (A) Input Using Transmitters (B) Wireframe Model (C) 3D Model (D) Final Animated Object

Fig.4. (A) Actor with Magnetic Mocap (B) Closer View: Magnetic Mocap Sensor.

TABLE I. A Review of Animation Using MOCAP

ame of the paper	uthors	bjective	rawbacks
he use of motion capture and D animation in the making of lf at first"	. Formella [1]	corporation of cutting edge chniques for motion capture as a upplement to traditional key aming.	trategies were not developed for the accomplishments of the pic.
ketch-based Skelet n- Driven 2D animation and otion capture	Pan et.al. [7]	resents an efficient 2D animation chnique, which allows the user to reate 2D animation.	rror accumulation in the tracking of object.
pplication erformance animation	. Manyu [2]	o study about motion capture and s use in the modern animation in levision.	he paper could not explain mocap in digital image processing nd computer vision for effectiveness of a particular ystem.
nimation from observation: lotion Capture and Motion diting	1. Guicher [3]	rovides a detailed overview of rocedure of creation of animated otion based in the realistic cenario in computer vision.	acing issues in recording the motion using magnetic sensors.
lotion Capture fundamentals	. Nogueira [4]	o provide a simple and efficient ethod to capture a motion from a ideo.	larker mapping techniques for non human beings and markless ocap in the creation of high definition.
he Research of Motion apture Technology Based on ertial Measurement	. et.al. [15]	o present motion capture system sing inertial sensors and real-time onitoring on any computer.	ocuses only on a single technique of motion apture hile there are other techniques to achieve it.
ptimal Camera Placement for lotion Capture System	ahimian et.al. [16]	o plot 3D positioned markers by method of triangulation using ore than one camera.	the image quality of the camera is abrupt or gloomy, there will e very low three- imensional estimation
xperimental Research on uman Body Motion imulation Based on the lotion Capture Techn.	ong et.al. [17]	o perform arm and walking in atic mode to test system stability multi degree of freedom in ynamic motion	his paper introduced the concept of motion capture, but in a ngle restricted direction.
systematic survey of martial rt using motion capture chnologies:the nportance of extrinsic edback	I. Rizhan et.al. [18]	o explore the upcoming future of esearch prevailing Martial Arts sing mocap technologies.	eeds further research on the topic as it does not focus on mocap ntirely highlighting Martial Arts.
larkerless Motion Capture ntegrated with Human lodeling for Virtual rgonomics	olombo et.al. [19]	latform development of a mputer to analyze the states and ovement of a user and validate e device design ergonomically.	the user does not move along with the traced path, the whole lgorithm gets disrupted and the process needs to be started over.
umanoid robots imitation of uman motion using offline and al-time daptation techniques	entaleb et.al. [20]	mphasis on real time motion onversion techniques acting upon e human base object motion sing a humanized robot.	wo types of humanoid robots are used. The process of motion apture cannot take place ithout these robots.

iv. **Optical Systems:** In this mocap system, the actor uses a specially designed suit with reflectors which are located in their key articulations. In this system, a camera with high resolution is located to keep track of movements of the actors as shown in Fig.5.. Major disadvantage of these systems are transmitter occlusion, in case of tiny or small objects such as hand or interaction with others [10, 11].

Fig.5. Optical Systems: Motion of Face Captured Using Reflectors [18,19]

B. ***Markerless Motion Capture*:** There is no special equipment needed to track the motion of an actor. The motion can be easily recorded from a video data sequence using motion based algorithm used to track and detect the objects. This process is done using software by eliminating all the limitations including computational constraints as shown in Fig.6. For e.g. Microsoft's Kinect, a system for low down-cost motion capture to the masses [9-13].

IV. CURRENT TRENDS IN MOCAP

According to the recent report on the motion based current trends, the 3D animation Mocap is widely used in communications, advertisements, movies, sports and health department .This market is likely to achieve $142.5 million worldwide by the end of 2020 [14]. Motion capture is very commonly used in the computer games industry [12-14, 22].

There are numerous invention features motivating the growth of international market via. new developments which mainly include the followings:

- Sky-scraping quality of animation in realistic scenarios with outstanding temporal accuracy and spatial.

- Ability to efficiently capture the dynamic and real-time bodily movement such as identifying the chances of any kind of injury at workplace, to enhance the performance in athletes.

- Reduction in the maintenance cost of 3D Mocap. This growing technology provides a new platform for digital animation and virtual reality.

- A step towards markerless motion captures (M- Mocap) technology among filmmakers, video gaming's animators and developers.

- In the year 2016, the top grossing games used optical Mocap for animating in the character of gaming.

Fig.6. Faceshift: Markerless Facial Motion Capture [13]

V. CURRENT CHALLENGING ISSUES

This technology has several open challenging issues till now which has to be overcome. Some of them are given below:

- Discrepancy of limited formats: Sometimes it becomes more difficult to set up differences between the actor and the animated object. For e.g., a digital character may be much larger in size as compared to the actor's body which results in overlapping of object. A lot of correction is required by the animator in this case which is a time consuming process and sometimes animation becomes impossible using this type of capture [11].
- Real time visualization: Till date, only some systems allow the visualization of realistic scenarios. Most of the time it starts to redo the particular video sequence or still rather than editing the data [13].Movement and space restrictions: These systems follow the movements that follow the laws of physics only. Secondly, these system have limited space need, which vary according to the systems that have specific needs of space, varying according to the position of moving or static camera and magnetic field interference [14].
- Equipments and their associated cost: To capture the motion in video streaming some equipments including software's are needed which also includes the operation cost and maintenance cost which is a challenging issue for small scale production houses or firms [11,12].
- Need of editing: Motion captured from video streaming requires editing because the original data tend to be restricted in amount and can cause peculiarity [14].

VI. CONCLUSION

This paper provides a detailed overview of motion capture system (Mocap) and their background. Firstly, this paper describes the various types of Mocap on the basis of Marker-based Motion Capture and Markerless Motion Capture with their advantages and their disadvantages. Secondly, current trends where these systems play an important role for detection and tracking based on their motion in realistic scenarios and then, current challenging issues which are still to be addressed. This paper also addresses the work done by researchers, academicians and experts in this area and demerits also. In future we will try to address the issues related to Real time visualization.

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