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Motion Capture Suit / Vest

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Abstract
Motion capture(Mocap) is sampling and recording motion of humans,animals and inanimate objects as 3D data.In simple terms it is one way of acting out an animation or recording of motion and playback.Mocap is used since 1872 when Edward Muybridge performs flying horse experiment to know that if a horse ever had all four feet off the ground while trotting ? so he placed cameras to capture movements of running horse and takes multiple pictures of horse and proved that statement true.After that Etienne-Jules Marey become first person to analyze human and animal motion with video.After all these main frame motion capture started when in 1915 Rotoscoping which is described in this paper later comes in animation techniques.
Then process of basic motion capture and some techniques used ie.,how motion or movements of an actor are captured using various markers,sensors,cameras and mechanical or magnetic suits and then how these recorded data is converted and applied on a virtual actor toperformsamemovements.Then some applications like films,animation,medical etc.So overall in this paper we tried to give basic knowledge on Mocap so that a normal person can also understand thathowMocapisstartedand how it is useful nowadays.
Keywords—Motion capture suit , Xsens MVN Link .

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I. INTRODUCTION

Breathing life into characters is definitely the best thing about motion capture. Because of this cutting-edge technology, we were able to see different characters we thought can only exist in a fantasy world. Here are some of the movies and TV Shows where fictional characters came to life with the help of a mocap suit.Motion capture suits are probably one of the best inventions created for movies and video games. It brings to life the characters we can only imagine in a fantasyworld as it moves and strides like the real thing. Such technology helps in makinga connection to the audience and conveys the story in a more effective way.

II. WHAT IS MOTION CAPTURE SUIT

Motion capture suits are probably one of the best inventions created for movies and video games. It brings to life the characters we can only imagine in a fantasyworld as it moves and strides like the real thing. Such technology helps in makinga connection to the audience and conveys the story in a more effective way.Motion capture suit or mocap suit records the real-life movements of an actor or an object and sends it to a computer program where it will be applied to a 3D character. The 3D character will then move exactly how the movements were captured from the suit.Mocap/motion capture suits are made to be skin-tight yet breathable and comfortable and are usually plain colored. There are suits that have traditional markers or sensors to capture the full body movements while others rely on an inertial measurement unit (IMU). IMU has sensors with accelerometers, gyroscopes, and magnetometers for tracking. Most of the mocap suits available in the market are IMU-based. Here are some of the well-known IMU-based mocap suits.

a) Perception Neuron 2.0

One of the affordable mocap suits in the market, Perception Neuron 2.0 is a full bodysuit with full hand and finger tracking. It has 32 IMUs they call "neurons" and is compatible with software such as Autodesk Maya, MotionBuilder, and Moveshelf..

b) Rokoko Smartsuit Pro

Probably the most popular mocap suit is the Rokoko because it is considered to be one of the best mocap suits out there. It has 19 IMUs, or 9DOF as they refer to, and comes with Rokoko Studio Pro software. It is also compatible with popular plugins such as Unity, Maya, Houdini, Blender, and MotionBuilder.

c) *Xsens MVN Link And MVN Awinda*

MVN Link and MVN Awinda both operate with 17 sensors. The only difference is that MVN Link is a Lycra suit with wired trackers while MVN Awinda is a strap-based suit with wireless trackers. Both suits have magnetic immunity and are best used in fight scenes and those that involve fast movements

d) Head-Mounted Cameras

Head-mounted cameras have become an important part of facial capture. There are also cameras that capture the same without using any markers. Known products are Faceware and Dynamixyz. Faceware has ProHD cam, fiberglass helmet with an onboard mini lightbox while the latter offers markerless capture, has video recording, and custom software

III. HISTORY OF MOTION CAPTURE SUIT

***a*) First mocap in animation**

In 1915, animator Max Fleischer (known for shows like Betty Boop and Popeye), invented rotoscoping (a technique that could produce realistic movement of an animated character by using live-action film footage to paint over each frame). He used footage of his brother, dressed in a clown costume, dancing on the roof, and then traced that footage, frame by frame, onto the animation of Koko the Clown.

This would be the start of a new era of motion capture and animation, especiallyonce it caught the eye of Walt Disney.

Enter Snow White – the first full-length cel-animated feature film – which used rotoscoping to bring the characters to life. Many of the recorded movements that were traced onto the animated characters in Snow White were reused on other Disney classics, which is why, if you look really carefully, you may see the same dance routine in a number of Disney animations.

b)First mocap suit

A lot was going down in the world in the 1950s. While America and the Soviet Union were embroiled in the Cold War, both on a mission to get to the moon first, animator Lee Harrison III was in the process of developing the world's first mocap suit, which could record and animate an actor's movements in real-time. Potentiometers attached to the bodysuit picked up any movements and translated them into rough animation on a monitor. Within two decades, animators had improved the bodysuits, lining them with active markers and using large camerasto track the movements ,which produce digital animations that were farm ore detailed and accurate

IV. WHAT IS ROTOSCOPING

Rotoscoping is an animation technique which is done by tracing or drawing over live action footage, using it as reference in order to mimic lifelike movement in animation.Aside from its uses in 2D or traditional animation, its definition has since expanded into visual effects. Rotoscoping could also mean tracing over certain elements of a shot in order to isolate them for use alongside another shot or scene. These are called 'mattes', which are then transferred to another piece of footage or animated background, or manipulated in whatever way the project requires .

a) History and first use of Rotoscoping

Animation, that is, the process of manipulating images in an order that simulates motion, has been arguably a long-standing art that existed even before the invention of cinema, so when film and cinematography were introduced, artists tried their hand at producing animated films.Before rotoscoping, animators just drew how they perceived objects to move. Theresults were mostly rough and jerky movements, which moved, yes, but their movements were unnatural and rigid. Early animation did not have the fluid, lifelike movements that we enjoy today.

b) Rotoscoping today

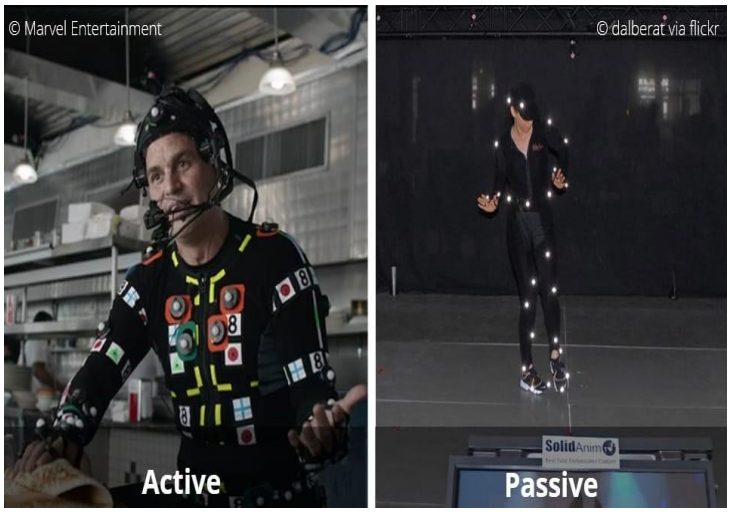
Rotoscoping is still used in visual effects today, having gone through many improvements and innovations, and like in animation, is now done through computers.

The basic principle is still the same, computer programs are used to create mattes frame by frame. Visual effects rotoscoping artists digitally isolate pertinent elements of a scene, which can be used with other backgrounds or elements in a final, composited shot

V. TYPE OF MOTION CAPTURE

a)OPTICAL MOTION CAPTURE SYSTEM

This type of motion capture uses two or more special cameras within the scene to capture the actor or the object's movement from different angles. Markers are placed on to a particular location in the actor's body. Once the movements are captured, it will then be reconstructed and applied to a 3D computer-generated model. There are two types of optical motion capture technologies – **passive** and **active.**



1) **PASSIVE**

Optical passive uses inert objects such as small white balls covered with retroreflective markers. These markers are tracked by infrared cameras to record all activity done when worn. This type of technique is widely used as it gives a more accurate result

2) **ACTIVE**

Optical active uses LED as its marker and each one of these markers is assigned to specific identifiers. Special cameras track the lights it emits to capture movements. Since it uses LED, this type of optical motion capture system can be used in a location outdoors even in bright light

b) VIDEO / MARKER LESS

For this technique, markers are pretty much non-existent. It uses algorithms from the software to track the actor's movements. The downside though is that room for errors is quite frequent compared to techniques using markers.

c) INERTIAL

Inertial motion capture uses a mocap suit with tiny sensors referred to as inertial measurement units or IMU. This type of sensor has accelerometers, gyroscopes, and magnetometers. An accelerometer measures the force and speed, gyroscopes for angular force, and magnetometers for magnetic fields whether from the natural or artificially.

VI. MAGIC OF MOCAP SUITS IN MOVIES

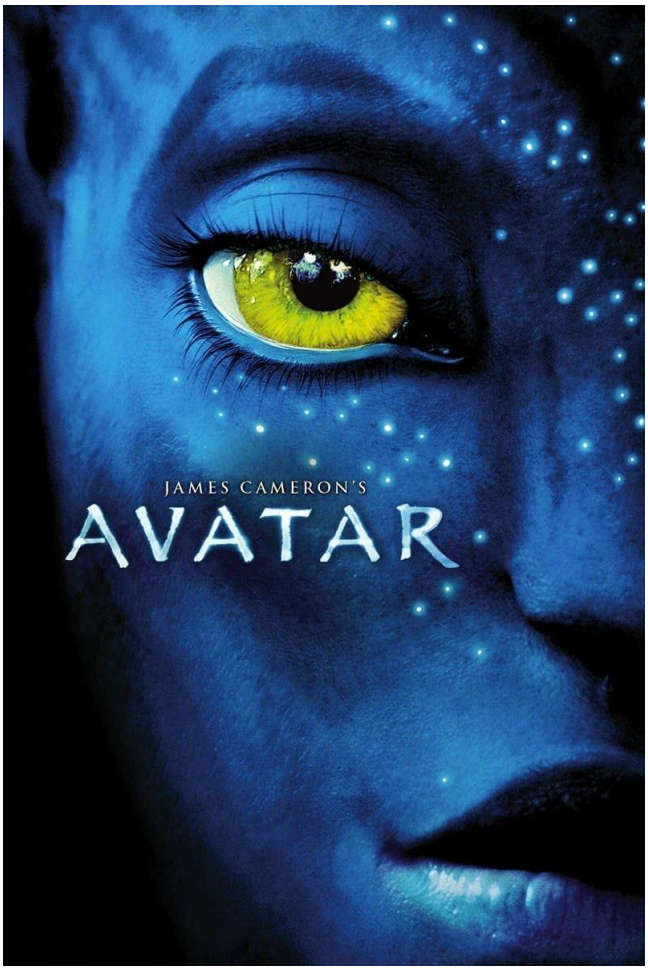
There are lot of movies created with the help motion capture or mocap suit. We can see a combination of visual and mind-blowing treatment of art and effort.

Some of the famous movies are mentioned below

a) LORD OF THE RINGS AND THE HOBBIT TRILOGY

There's only one character that immediately pops into our minds when we talk about these movies – Gollum, the one that started it all. And one does not simply forget the actor that brought this character to life – Andy Serkis. In his character performance, Andy Serkis wore a mocap suit with markers that are adjacent to his body key points.The first movie is more of just capturing the movements of the characters ratherthan the emotion. With lots of rotoscoping used. From the second movie onwards, facial capture was used where Andy Serkis wore a head-mounted camera with markers on his face. His mocap suit has infrared LEDs that are bright enough to be spotted even in daylight.

b) AVATAR



Avatar, which held on the biggest box office for almost a decade,isa movie that heavily relied on CG and motion capture. A massivesound stage was created which was surrounded by a grid of almosta hundred cameras—the specific number depending on the needs of the scene— and whose walls, ceiling, and floor were replaced with digitally-rendered structures and environments. Reflective dots were marked on actors' suits (that they kept on throughout filming) and props as they were tracked by the array of cameras.A computer then recorded the movement of these dots, triangulated their locations, then assembled them into "wireframe skeletons" which became thefoundation of the Na'vi bodies. Even facial expressions were perfectly captured using a unique camera that hung 6 inches away from the actors' facesThe actors were filmed in 3D so they closely resembled their digital alien counterparts. For this purpose, the Fusion 3D Camera System was utilized to capture scenes as if they were being viewed by human eyes. This camera was equipped with a pair of lenses that sit close together and had an adjustable lineof sight for better focus.

C) MARVEL CINEMATIC UNIVERSE

Mocap suit and its technology has given life to the superheroes and villains of Marvel that we've only read in comics. The Hulk, Thanos, Groot, Rocket, Spiderman, and Ironman are just some of the characters that donned mocap suits. But the most notable character would be Mark Ruffalo's Smart Hulk.Wearing a mocap suit complete with facial markers, the VFX artists were ableto give this green giant a more human form.To be able to get into the character while wearing a mocap suit, Mark Ruffalo was mentored by none other than Andy Serkis. Aside from mentoring, he alsohad a part in two MCU movies: The Age of Ultron and Black Panther. He played the same character for both movies as Klaw.

VII. FUTURE OF MOTION CAPTURE FOR ANIMATION

Following the success of Avatar, mocap has continued to evolve. Now there aremany different kinds of motion capture for filmmakers to use, from marker- based systems that track physical markers on the actors, to markerless systems that use software that tracks an actor's movement through identifying specific features on an actor (could be anything from their mouth to a piece of clothing). Studios such as Centroid Motion Capture and Goodbye Kansas have an impressive portfolio of productions that have successfully used motion captureBut the future of motion capture is markerless, and with the presence of AI and quantum computing, that vision is becoming increasingly possible. This will mean fewer cameras required, greater flexibility in terms of the space that is used, and a much faster process And, with the motion capture industry expected to be a $266 million industry by 2025, according to the Global Forecast on Research and Markets, the development of markerless mocap is very much on the near horizon. But perhaps the future of mocap is arriving in other ways.

VIII. CONCLUSION

There is so much more to look forward to in motion capture. And the suits are getting better as the years go by. I am fairly certain that animation will get betterin the coming years and I am excited to see and experience what other upgrades a mocap suit will have in the future. And with all the improvements and continuous advancements in motion capture, we can very much expect more jaw-dropping films, with a seamless blend of CG characters acting with live actors, and fascinating creatures to love (and hate) in the near future

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