C30 The Virtual Crime Scene: The Role of 3D Motion Capture and 3D Model Buildings for the Reconstruction of Dynamics and Reproduction of Settings in a Case of Murder

Isabella Aquila, MD, Institute of Legal Medicine, University Magna Graecia of Catanzaro, S Venuta-Medicina Legale, viale Europa, Catanzaro 88100, ITALY; Alfredo Manca, Public Prosecutor, Corso Mazzini, Crotone 88900, ITALY; Giuseppe Ivan Aquila, Via Dante Alighieri, Crotonw, ITALY; Roberto Raffaele*, Via Thailandia N 1, Crotone, ITALY; Giuseppe Capoccia, Public Prosecutor, corso mazzini, Crotone 88900, ITALY; Manolo Vozza, Arms of the Carabinieri, Investigative Unit of Crotone, Crotone 88900, ITALY; Antonio Rocca, Arms of the Carabinieri, Investigative Unit of Crotone, Crotone, ITALY; Salvatore Gagliano, Arms of the Carabinieri, Investigative Unit of Crotone, Crotone, ITALY; Matteo Antonio Sacco, MD, Chair of Legal Medicine, University of Catanzaro, Viale Europa, Loc Germaneto, Catanzaro 88100, ITALY; Santo Gratteri, MD*, Viale Europa, Germaneto, Catanzaro 88100, ITALY; and Pietrantonio Ricci, Viale Europa-Località Germaneto, Catanzaro, ITALY*

After attending this presentation, attendees will better understand the role of virtual reality through the use of 3D Motion Capture (Mocap) and settings reconstruction technology.

This presentation will impact the forensic science community by demonstrating how these techniques are fundamental to accurately recreating scenes and environments in cases of murder, accidents, suicides, or altercations where it is important to determine the dynamics of the event.

The use of images is a fundamental aspect in a forensic pathologist's work. To date, photographic surveying is performed primarily by using 2D images; however, in recent years, the application of 3D technologies has gained importance. In the literature, various methods have been studied, including virtopsy, 3D printing, scanners, cameras, 3D modeling software, photogrammetry, superimposition, and satellite navigation programs. The applications were personal identification, estimation of age, sex, height, body mass, injury analysis, weapon identification, crime scene scanning, and Bloodstain Pattern Analysis (BPA). Very few studies have proposed a method for reproducing the dynamics of a crime. This study presents a virtual model created using 3D Mocap and modeling, namely the reproduction of settings. Mocap is a photogrammetric system designed to capture the movements of a person who wears tracks equipped with markers and is recorded by cameras through an algorithm to realistically reproduce movements. It also offers the ability to perform object tracking in space and head tracking to capture the person's facial movements. The recorded movements are interoperable with Motion Builder®, Max®, Maya®, Xsi®, Blender®, C4d®, Poser®, Daz® Studio, Face Robot®, and the Autodesk® Gameware product series, including HumanIK® used to create video game characters.

This presentation describes the method for producing a 3D video that reproduces the dynamics and the scene of a murder, later used in court. The device used was a stereophotogrammetric system, consisting of infrared OptiTrack® cameras capable of capturing movements up to 100 frames per second (fps). Some objects have been modeled in 3D manually, taking into account the original measurements.

A woman was found dead in her apartment with multiple injuries on her head, chest, and hands. A judicial inspection was conducted in which the planimetry of the apartment was requested. Each object was cataloged, photographed, and annotated. The analysis focused on the entrance (where the victim had been found) and the kitchen (an area to the left of the entrance where items on the ground were found). The choice of these areas resulted from the analysis of the other rooms that showed no trace of blood or signs of a scuffle. An autopsy was performed to topographically identify the injuries present on the anterior and posterior surface of the corpse, inflicted with a knife (12 lesions) and a blunt object (22 lesions). Each injury was numbered, photographed, and measured. The height and weight of the victim were recorded. During the investigation, the suspect focus was on a man. An external inspection was conducted on the man, whose height and weight were noted, and some abrasions on his face were also measured. Finally, a BPA of the house was performed. All data were compared and the dynamics were reconstructed. By comparing the data discovered at the scene, on the victim, and on the aggressor, the 3D computer technician was able to virtually recreate the environments in which two people, of the same heights and constitutions as the victim and the aggressor, mimicked the movements before the murder and the blows made during the murder. At this stage, the rendering of frames was conducted: this is one of the fundamental aspects of 3D computer graphics. It is the last stage that generates the representation of the final image, with the help of algorithms that define the color of each point. The rendering was entrusted to Supermicro® systems with multiprocessor Xeon® Quad and NVIDIA® Quadro® Plex systems for Graphics Processing Unit (GPU) rendering projects. This reconstruction allowed the forensic pathologist to give credibility to the hypothesized reenactment by making clear to the public prosecutor and to the investigators the dynamics and the cruelty of the blows. Therefore, the use of these forensic techniques is emphasized for their contribution in exploring the dynamics that otherwise would be difficult to demonstrate.

Forensic Science, Virtual Crime Scene, 3D Motion Capture

*Presenting Author