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RESEARCH ARTICLE

VIRTIBOT – A VIRTUAL AID IN FORENSICS

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ABSTRACT

Opening new vistas in the identification of the cause of the death, identity of the deceased and in the identification of the criminals or suspects involved in the death is a virtual aid in forensic science serving humanity in medico legal postmortems in the form of Virtibot, a robotic technology. It is a Robot assisted technology tackling the autopsy with a high tech imaging approach. A non invasive forensic imaging technology comprising of MicroCT, Multi slice Computed tomography, Microscopic MRI, Magnetic resonance imaging, magnetic resonance spectroscopy, 3-D CAD/ photogrammetry, biopsy module, three dimensional optical scanner of the body , angiography unit, navigation system unit that can be used for direct imaging and a computer system for documenting, equipped with 3D simulation software serve not only the judiciary system but also relatives of the deceased due to the fact that it provides details without mutilating the body.

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INTRODUCTION

Forensics, imaging, robotic technology, virtibot Advances in scientific technology have been on the rise not just serving the humans during life but also after death. Owing to the overburden of population on one side and overall death scenario on the other side there has been a desperate dearth of forensic experts in assessing and fulfilling the demands of medico legal postmortems (Tirpude, 2012). Beyond legal issues as part of bestowing humanity are the Robot assisted technology tackling the autopsy with a high tech imaging approach using the virtual aid of Virtibot. The field of forensics as part of judiciary system supports humanity by the coalition of data and information for identification of the cause of the death , identity of the deceased and in the identification of the criminals or suspects involved in the death. Supporting the forensic sciences the field of radiology offers imaging as a valuable aid and along with it, the robotic technology contributes a great lot in this humane scenario (Soltanzadeh, 2014).

History of Robotics

Dating back to 1920, it was Karel Capek who was a pioneer to use the Czech word robotnik in a play which was later adapted in 1940's in Issac Asimov's science fiction. A robot is a computer controlled reprogrammable multifunctional device which is a synchrony of digital computer technology and servo control of articulated chains. The Robot Institute of America defines a Robot as a reprogrammable, multifunctional manipulator designed to move material, parts, tools or specialized devices through variable programmed motions for the performance of avariety of tasks (Moran, 2007).

Imaging and Forensics – Past to present

Pioneering modern postmortem science are 700 autopsies performed by Giovanni Batista Morgagni in 1761 (Bay, 2010). Contributing a great lot from 19th century onwards till the beginning of 21st century the role of traditional autopsy has slowly shifted to decline due to development in Imaging techniques in forensic investigations which dates back to 1977, when Wullenweber established the earliest applications of computed tomography relating to forensics to identify and elucidate the radiographic appearance of gunshot injuries (Wullenweber, 1977). Following it were other prominent pioneers such as Flodmark (Flodmark, 1980), Kalender (Kalender, 1990) and most significantly Prof Michael Thali and Prof Richard Dirnhofer associated with the virtopsy project (Dirnhofer, 2006 and Thali, 2007). However highlighting and honouring digital autopsy from fiction to reality happened with the evaluation and digital analysis of

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virtual Mummy in 2004 at the Museum of Britain (Navpreet, 2014).

Virtibot

OPENING new vistas overseas are the oasis of robot assisted technology in the form of virtibot system which ventures virtopsy (virtual autopsy) vividly in a versatile manner. Virtibots are medical robots first invented in the Institute of legal medicine at the university of Bern, (Oyake, 2006 and Persson, 2008), which perform robotic autopsy bridging forensic science, diagnostic imaging, computer science, automatic technology, telematics and biomechanics. They surround the body and create a three dimensional image of the body (Ebert, 2010).

Virtibot System

The virtibot is a six axis robotic system with several extensions which include a linear axis that increases working space and two systems namely tool changing and safety system. Significantly it consists of a dual source CT scanner with armamentarium for CT angiography, 3D optical surface scanner, 3D tracking system, a digital photogrammetry and a biopsy end effector for automatic needle placement (Simmons, 2014).

Supplementing the external post mortem examination aspect in conventional autopsy is the robot assisted surface scanning for three dimensional analysis and documentation of the deceased to scale and in colour.[15]Parallely aiding the internal post mortem examination aspect in conventional autopsy is the multi slice spiral CT and MRI.[16] Apart from these visualizing the cardiovascular system of the corpse is the post mortem angiography with the support of contrast medium (Grabherr, 2006). The robot surrounds the deceased body creating a three dimensional high definition image by manipulating and creating appropriate dots in the corpse with several markings with an objective of measuring and taking multiple stereo images using a digital stereo camera with a resolution of 0. 02 mm (Ebert, 2014). The entire human body is constructed in a three dimensional computerized model by combining robot assisted three dimensional image of the body's exterior using stereo camera and a CT scanner for recording the body's internal structure (Simmons, 2014).

Forensic Radiology Bridge

The forensic radiology bridge is achieved by the virtibot by combining magnetic resonance technology and computer topography software to acquire an overall analysis of the human body without cutting it resulting in virtual images of the deceased. Thus the virtibot stands up as a corner stone robotic forensic imaging technology replacing coroners in the field of identification of the deceased (Ruegger, 2014). Traditionally the one hour invasive conventional autopsy procedure involves a forensic expert (pathologist) who opens up the body by making a y shaped incision running down the chest and beneath each side of the rib cage. Next the brain is exposed by opening the skull and foreign objects if any are removed and stored as evidence (Jayashree, 2012). In contrary to the one hour cutting open body procedure, a cutting edge minimally invasive technology using a dual energy CT scanner and MRI machine is the face of the virtibot takes as little as 10 seconds to half an hour wherein maximum amount of radiation to the deceased is provided to produce very high resolution details of skin, flesh, bone, foreign objects thus ultimately constructing a virtual body obtained from six gigabits worth of information (Roberts, 2012). Finally the information from MRI and CT is downloaded to the high resolution flat screen LCD and the sophisticated video graphics card converts all the information database into a virtual human body wherein upto 6 members can examine in multiple angles by swiping a finger, removing layers of muscle, zooming organs, slicing tissues with a virtual knife (Soltanzadeh, 2014), Ultimately the robot assisted imaging forensic analysis contributes significantly in toxicology, histology, virology, bacteriology and diatomology (Ebert). With respect to the imaging armamentarium the essential devices utilized include the following – Micro CT, Multi slice Computed tomography, Microscopic MRI, Magnetic resonance imaging, magnetic resonance spectroscopy, 3-D CAD/ photogrammetry, biopsy module, three dimensional optical scanner of the body, angiography unit, navigation system unit that can be used for direct imaging and a computer system for documenting, equipped with 3D simulation software (Said, 2013 and Burton, 2007). Apart from imaging armamentarium equally important are the Picture archiving and communication service. These services help in archiving, tranfering, restoring, displaying and processing images in the digital networks. Interestingly this system comprises of collection of web based software which receives pictures from imaging systems with digital output such as MRI, CT scan and digital radiography (Levy, 2007 and Van de Wetering, 2009). Additionally it is imperative that all the imaging systems are compatible with Digital imaging and communication in medicine (Amis, 2007).

Limitations of Virtibot

Beyond all benefits, the process of virtual autopsy using a virtibot has negligible negative shades which includes being expensive, access for imaging devices, softwares, limitations of technology in certain clinical scenario, standardization of the procedure (O'Donnell, 2008).

Conclusion

Thus doing away with the conventional and traditional invasive body opening procedure (autopsy) are the virtibots which perform robot assisted virtual autopsy (virtopsy) with a nobel objective of scalpel free non invasive forensic imaging technology thus ethically contributing moral support to the relatives of the deceased and at occasions satisfying religious customs as well since there is no mutilation of the body (Rutty, 2007 and Lishimpi, 2001; Stawicki, 2008). Apart from this there are less chances of transmission of infection. Beyond ethics and scientific grounds it is a fascinating technical torch in telemedicine wherein digital database storage and transfer of information across the world serves the pathologist and forensic experts in identification of the deceased (Patowary, 2008).

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