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Capstone Project Report on Additive manufacturing (3d printing) in biomedical field: a review of materials and applications and challenges

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Abstract

The Paper represents the ways of utilising the additive manufacturing process.

Additive manufacturing (AM) is a deceptive technology as it pushes the fattier of manufacturing towards a new design perspective, such as the ability to shape geometries that cannot be formed with any other traditional technique.

3D printing is an additive manufacturing process whereby layers of materials are built up to create a 3D part. The genome was substituted with G- code, the programming language which courts how the 3D printer

assembles material. Within this study CAS data based accepted packaging made of renewable raw material is addressed.

INTRODUCTION

Additive manufacturing (AM) also known as 3D printing is a transformative approach to industrial production. That enables the creation of lighter, stronger & system additive manufacturing (AM) build up material from a part, stepwise & layer by layer. It allows or new design to be realised using only subtractive process.

3D printing:-

It is also known as additive manufacturing is a method of creating a three dimensional object layer-by-layer using a computer created design.

3D printing is an additive process whereby layers of material are built up to create 3D part.

Lately AM technologies is progressively employed in medical field of slowly taking over the conditional method of presenting producing patient specific medical device.

With further evolution of Bio-cell printing AM this technology has a potential to print the whole body organ within further years (……..)

The 3D printing process was modified for using Additive manufacturing (AM) ---------- stage while process.

a) **Virtual Stage: -** That includes modelling and simulating of required parts, and for this process requires computer of 3D modelling software.

b) Physical Stage:-

Which is manufacturing --------- and does required job as layering material and machine equipment.

And the in b/w for printing of required job was, the data from CAD filed 3D modelling software was perfectly read by additive manufacturing equipment and design the data by do making through layering of material in layers, to build 3D object.

Classification of 3D printing Technology :-

There are many types of 3D printing technologies, but no matter the technology involved, all are additive and built the object layer by layer.

Conditioned bio based fibre and a special binder.

Accelerating the development of 3D printing technology helps realize then circular bio economy where garments, packaging furniture & entire house are manufactured by 3D printing wood.

The 3D printing technologies can be divided in several classes and within this clause, there are different variations.

(i) Extrusion (extrusion of marten material)

(ii) Direct energy deposition (meeting with high energy power source)

(iii) solidification of power (Fusion or joining of particles)

(iv) Photo polymerisation (Solidification of a liquid polymer)

Sheet Lamination (Bonding of sheets)

Material Used for 3d printing in bio-medical appliances

In 3d printing material are transformed according to requirement & demand of the specific modal by changing its consistency. In this parson, filler and support material in lattice form are required which help in avoiding distortion of modal and material in safe. By using cutting tool with hand we can early rumour support material. But, we require an additional polishing in order to obtain good quality printing.

Correct material selection is very important for 3d printing process and printer as well on the requirement of model. While for medical application different complex anatomical structure requires different mechanical properties of the materials to fulfil the required performance of the printed object.

For ex-Bones are the simplest and cosiest biological tissues to be produced by 3d printing on the majority of the material are rigid. The material used

fir 3d printings of bone structure are acrylonitrile butadiene styrene (ABS), powder of plasters and hydroquinone.

But, related to soft tissue, dup research & strong proof is still needed to decrease the gap b/w a 3-d printed model & human structure. Most of the 3-d printing material lack of realism to mimic adequately a soft human biological tissue. Some examples are- reproduction of cartilaginous tissue, arteries for practicing value replacement, hepatic segment and hearts.

There are many more materials like the flexible TangoPlus™ photopolymer for 3-d printed brain aneurysm, Urethane and rubber like material for artery structure, etc.

Role of 3-d printing in Medical field

Every year 3-d printing offer more and more application in the healthcare field helping to saw and improve lives 3-d printing has broad range of uses in healthcare setting like-

(i) Cardiology

(ii) Neurosurgery

(iii)Gastroenterology

(iv)Radiation oncology

(v)Urology

(vi)Vascular Surgery

(vii)Pulmonology

(viii)Ophthalmology, etc.

Now, the main direct applications of 3-d printing in medical & Clinical field are:-

(i) Customize surgical tools and prosthesis : the 3-d printing can be used to manufacture custom implants or surgical guides and instruments. The customization of surgical tools and prosthesis mean a reduction of given by the additive manufacturing technique.

(ii) In study of osteoporotic condition, following a pharmacological treatment, 3-d printing is useful in validating the result achieved by the patient. This enables more accurate estimation of patients bone condition and better decision on the surgical treatment.

(iii) 3-d printing enables us to quickly produce prototypes of new design concepts or improving to existing darien.

(iv) 3-D printers have the capabilities to print with different dentition and colours can be used to accentuate details.

(v) Personalized drug 3-D printing : the 3D printing of drugs consist of the printing out the powdered drug layer to make it dissolve faster than average pills. It allows also personalized of the patients needed quality.

(vi) Bio printing: The 3D printing allows also the modelling of implantable tissue. For ex- 3D printing of synthetic skin for transplanting to patients,

who suffer burn injuries. It may also be used for testing of cosmetic, chemical and pharmaceutical products another ex- are replicating of human cars using mods filled with a gel containing bovine cartilage cells suspended in collagen and many more.

These Examples shows that 3D printing is one of the most disruption technologies that have the potential to change significantly the clinical field, which is helping in improving medicine and healthcare, making care affordable, accessible and personalized. As printers are evolving, printing biomaterial is getting earlier with safety regulated and general public is also acquiring a common sense about how 3D printing works.

In 3-D printing there are flaws in the system as lack of regulation:

Nowadays, Despite the additive manufacturing offers a great potential for the manufacturing, the 3-D printing products still do not have a proper legal status as implantable and non implantable twice. We know that all the 3-D printed products are categorised on custom made twice under the regulation (EU) 2017/745 of the European Parliament and of the council of the 5 April 2017. The EU has been working for many years on an update to the medical devices directive. However, the current version of the draft regulation lacks some depth that is mandatory to safeguard safe usage of 3-D printing technology and thus, enable its increasing prevalence in medicine.

Application of 3-D Printing in paediatric cases :-

In individual medicine & Surgery, we know that 3D modelling and printing gristly supports looking to the field of paediatrics, It is possible to identify four applications categories surgical planning, prostheses, tissue construct and drug printing.

We have seen many successful cases that demonstrate the potential of the additive manufacturing in surgical planning in paediatric cases. In specific, most of the applications of 3D printing reported in the congenital heart diseases. The (AM) helps surgeons to have more delayed information then the imaging technology can provide. The 3D printed model based on the data derived from computed tomography (CT) are magnetic presence (MRI) contributed to a more complete appreciation of the intracardiac anatomy, leading to a successful surgical repair for three of the five patients. Costly, CT and MRI data were used to construct 3D digital and anatomical models to plan a heart transplantation surgical procedure of two patients of 2 and 14 years old affected regularly by hyponastic left heart syndrome and pulmonary at resia with a hypo plastic right urenticle, These physical models allowed surgeon to cosily develop the optimal surgical treatment during the heart transplantation anticipation problems that may arise during the procedure. The specific dimension and distance can be measured, heart transplantation can be planned.

Conclusions:-

The 3D printing in medical field and design needs to think outside the norm for changing the healthcare. The three main parts of this technology are the ability to heart more people where it previously was not feasible to obtain outcomes for patients and less time required under the direct case of medical specialists. In few words, 3D printing consists in enabling doctors to treat more patients, without sacrificing results.

Therefore, like any new technology, 3D printing has many advantage and possibilities in the medical field. Each specific case in which 3D printing has found application shown in this analysis is a demonstration of this. However one must be accompanied by an updated and current legislation in order to guarantee its correct use.

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