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REVIEW PAPER ON REVERSE ENGINEERING FOR MEDICAL APPLICATION

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Abstract- Biomedical Engineering Application (BME) are developed to Understand, Control and Manipulate as well as shape, geometry and structure of Biomedical Objects. For reconstruction 3D models of anatomical structures and biomedical objects for design Medical Reverse Engineering is used which comes from Reverse Engineering Technology. Reverse Engineering also applicable for improving the efficiency and accuracy of orthopaedic surgery in medical field.
This paper represents the RE technology in ophthalmologic micro surgical tweezers which are developed to detect the defects and inaccuracy which makes the RE an efficient surgical tool. RE also establish a registration and hole feeling algorithm to solve most critical problem related to 3D human busts by using CNC milling machine and produce its human model.

Keywords- Reverse Engineering, Medical Reverse Engineering, Implant Design, Orthopaedic Surgery

1. INTRODUCTION

Reverse Engineering is a rapidly evolving discipline, which covers a multitude of activities. In this paper we only be concerned with reverse engineering of shape, but a broader interpretation of the term to involve understanding of design intents and mechanisms is also possible.

RE is a method of extracting design information or knowledge from a product and reproduce it based on the previous information. Now from medical application and components design point of view, the method and technology to reconstruct 2D/3D data are vital for many applications. There are two types of engineering:

(a) Forward Engineering
(b) Reverse Engineering

For new product where, previous data is not necessary for 2D/3D modelling, FE is commonly used. In case when we need to duplicate the object for further enhancement then RE technology is the best option for implementation. Here, RE technology can be divided into 2 parts:

1. Industrial RE
2. Medical RE

1.1 Industrial RE

Industrial RE is employed to reconstruct 3D models of the physical objects for Engineering style, Manufacturing process CAD/CAM/CNC, development, internal control and Dimensional examination. the standard object size is from 200x200x200 metric linear unit to 500x500x500 metric linear unit. The accuracy demand for 3D models is often high.

The typical demand is from ± twenty to ± fifty microns. Within the space of mildew & Tooling as well as micro-manufacturing, the accuracy demand is up to (1 to 5) microns. Forthe applications like the ship building and natural philosophy trade, the accuracy requirement is sort of versatile, reckoning on the dimensions of the objects and their functions.

1.2 Medical RE

When RE is employed for medical application development and analysis, it referred to as medical reverse engineering, it unremarkably concerned in victimisation patient knowledge for biomedical objects to reconstruct 3D models of anatomical structures and objects of interest for development of various medical product, applications, and medicine research. The accuracy demand for MRE relies on the particular applications. For the individualized cranio-maxillofacial implants, bio models and training models, the accuracy demand is essentially not high compared to Industrial RE, up to hundred(s) of microns. However, for the surgical tools and functional implants like spine, hip and knee implants, the accuracy demand is very high.

In medical production development, RE is played an important role in the design and manufacturing of medical training models, surgical tools, medical devices, patient data such as CT/MRI images. The complexity of the geometry of medical instrument has make use of RE technology for example – Tweezers use in micro surgery of eye has complex geometry, hence it requires RE technology for design.

The RP and RE application also found applicable in orthopaedic surgery which helps in improving the efficiency and accuracy of surgery.

Tweezers utilized in microsurgery of the attention square measure subject to frequent changes in style look. On the one hand, the simplicity of the tool. On the opposite hand, the quality of the pure mathematics of the handle has necessitated the employment of reverse engineering. Therefore, the aim of this work was to explore the chance of reverse engineering, during this example the speed of obtaining the merchandise paradigm.

The existence of geometric models provides monumental profits in up the quality and potency of style, manufacture, and analysis. In reverse engineering (RE), the form of a three-dimensional (30) physical object is scanned mistreatment thirty position scanners such as coordinate activity machines (CMMs), laser-based vary finders, optic-based scanners, and thus forth. Then the scanned knowledge area unit turned into a description for software package (CAD) or transferred into computer-aided manufacturing (CAM) like fast prototyping (RP) or American state edge to create the thirty replicas of the scanned objects. variety of RE applications have been wide investigated. RE encompasses several engineering approaches during which AN existing product is investigated either before or throughout the reconstruction method. In addition, it may be applied into some recent rising applications like customised manufacture, style simulation, medical application, animation, sculpture, etc.

RE procedure typically consists of 3 basic steps: knowledge capture, knowledge method, and model manufacture. Firstly, the knowledge capture is to scan the surfaces of a target physical half so as to require a degree cloud by applicable thirty scanners. Secondly, the scanned purpose cloud should then be refined and altered with the point- or polygon-based technologies within the processing step, like sampling, triangulating, aligning/merging, hole filling, smoothing, etc. Finally, the model manufacture is the method of making CAD models or physical replicas from the refined plane figure knowledge

2. LITERATURE REVIEW

S. No.	Author	Aim	Process	Result Observed
1.	L.C Hieu et al. (2010)[1]	Medical Reverse Engineering application and method	MRE Method	➢ RE for medical application ➢ Including surgical tools ➢ Bone Reconstruction ➢ Dental Implant
2.	Niranjan Singh[2]	Reverse Engineering-A general preview	RE Stages	Used in understanding the function and structure of object to make the new program or device which work with more efficiency than the previous one.
3.	AA Kaleev et al. [3]	Application of RE in medical industry	Reverse Engineering.	The use of RE is reduced the manufacturing time for new product upto16 Hours, instead of week
4.	Dong-Gyu Ann, Jun-Yong Lee, Dong Yee Yang (2006)[4]	RE and RPT Application for orthopaedic Surgery Planning	RE & RPT	➢ Improve the efficiency of surgery ➢ Reduction of surgical time due to good geometrical conformity & characteristics of bones
5.	Hyuing-Min Rho et al.[5]	Rapid RE system for reproducing 3dhuman busts	RE	Further Works to be needed to improve the inaccuracy for quality of the model in each RE step. In future, if quality satisfied, then system may be ready to use.

6.	SupakitRoopakum, Nattapon chanter apanich and kriskraiSitthiseritpratip[6]	Advanced Medical Imaging & RE Technologies in Craniometric Study		This Study is helping in to reconstruct the three-dimensional model of skulls. This is very useful to neglect measurement errors which are influenced by instruments and human.
7.	Mohd. Javid ,Abid Haleem (2017)[7][7]	Additive manufacturing in medical cases	Reverse Engineering Technology Process	The technology helps in solving medical problems which are beneficial for humanity.
8.	Sang C Park, Minho Chang (2009)[5]	Reverse Engineering with structured light system	Reverse Engineering	Identification of missing areas from multiple scanning data and minimise the number of scanning direction.
9.	L. Li, N. Schemenauer, X. Peng, Y. Zeng, P. Gu* (2002)[8]	reverse engineering system for rapid manufacturing of complex objects	Reverse Engineering	3D optical digitizing system, Surface reconstruction software for the manufacturing of complex objects in 3D

3. CONCLUSIONS

Here I have presented a Reverse Engineering application in the field of medical about manufacturing of biomedical tools and models as wells as medical devices designs. The optimate selection of software is very important for implementation especially in the medical application. Reverse Engineering have some distinctive advantages to prefer over other software's like rapid prototypic, CAD/CAM, FEM, etc.

Reverse Engineering provides powerful modelling tools such as manipulations and TMC. These tools are not available in RP & CAD packages. These packages provide the common tools for the surgery planning especially in the dental field. R.E technology is also applicable in the modelling of human models. With the use of R.E technology, tweezer is a tool used in the microsurgery of eye was developed. The complex geometry of tweezer has necessitated the use of manufacturing time and increase the speed of obtaining the product.

In the orthopaedic surgery planning for fractured bones, R.E have been applied. This technology improves the efficiency of surgery.

There is no single code which will fulfil and satisfy utterly the necessities in data processing and geometrical modelling works [1]. the choice of the code so depends on the end-use application, particularly the complexness of the geometrical modelling processes and knowledge exchange among the packages. the subsequent square measure the standard code and tools that square measure necessary for implementation of MRE applications, as well as

a) Medical Image process (MIP),
b) Speedy Prototyping (RP),
c) Finite part Analysis and simulation (FEA),
d) Reverse Engineering & Dimensional examination,
e) Freeform Modelling,
f) CAD/CAM, and
g) Dental CAD/CAM.

This paper presented the concept and benefits of applying the R.E technology for medical components and application. This clearly shown that R.E is crucial for successful development of medical cases and application including surgical tools orthopaedic, bone reconstruction, medical training, dental implants, tissue engineering, etc.

4. FUTURE SCOPE

With the advent of RE in Medical field, models can be viewed and physically handled before surgery, implant fit in different cases and benefiting in evaluation of the procedure. With the use of RE, less risk to patient and reduced cost through savings in Orthopaedic, Dental and reconstructive surgery.

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