International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 03 | Mar 2021 www.irjet.net p-ISSN: 2395-0072

New Technique To conserve Designer Intellectual properties through Reverse Engineering

Gajanan Pradhan[1] , Prashant Paraye[2]

[1]*Associate Chief manager, Godrej & Boyce mfg.co.ltd, Mumbai, India*

[2]*Lecturer, CIPET (Central Institute Of Plastics Engineering & Technology), Bhopal, India*

Abstract - *Can your conventional method of design patenting will able to save your creative or innovative design secure? I doubt. In fact "NO". If you are planning to save your unique and innovative design and earn some royalty out of it by just filling the design patent. So, this will not work. This is not a feasible solution in current indian market scenario. In this competitive world, everybody wants to copied the unique / market idea and make some profit out of it. Copy or bench mark is new term introduced in this market and for help them various engineering tools software/ machines are available for copying exact design. Due to this, you will not able justify your ownership with that design.*

We do not want our designer creativity, hard work and many years of experimentation are copied just like that. In this paper, we are come up with the new techniques of Design patenting,conserving it in .stl format will able to save the intellectual properties of designers.In current Design patent filling procedure, Only Product view has been captured in patentform like front view, side view & isometric view. In other words, only geometrical features which can be drawn by cad software and dimensioned. Apart from that there are many aspects in surface design like free form, freestyle which could not be drawn or dimensioned. Thisfree form shape will play a major role and provides the WOW factor into that particular design and enhance the product reach into the market.

In this paper we are using new tools like 3d scanning, 3d meshing, 3d surfacing and digital inspection and captured those free forms which strengthen designers to secure their legal rights over the design

Keywords*: 3d scanning, 3d meshing, 3d surfacing and digital inspection*

1.INTRODUCTION –

Reverse engineering is a kind of engineering which takes advantage of an already created object. The final purpose is to create another object similar to the existing object. Reverse Engineering Service let you digitize the chosen product into 3D CAD data. The boot up of product and parts can update and modernize as client's desire. By eliminating the physical inventory ReverseEngineering helpsthe product development and manufacturing. [1].

The scanner converts the physical object into point cloud. This kind of reverse engineering can be used to make digital 3D record of the objects, for security copies identify potential patent infringement [3].

In our case, we will take advantage of a 3D printed object. More specifically an object is selected to cover dimensional complexity of object and specifically freeform in shape.

Many object created by an Artist and designers not have geometric or freeform copyright on their original work. That means the there is no rules or methods to conserve it .Designer are unicorns, gifted and they have innate ability to create the unbeatable design which helps us ease our life by using their design product in utility prospect and some of design which provide us the pleasure in our life in design prospect. Ultimate our aim is to use reverse engineering to ConserveDesigner Intellectual properties

1.1 3D SCANNING

3D scanning (often called laser scanning) is a surface-based 3D measurement technique. Scannig results in a large quantity of points in a systematic pattern – also called point cloud data (Boehler and Marbs, 2002). Final results after processing of the raw data can be line drawings, CAD models, 3D surface models .

There are numerous systems available for various object sizes, ranges, and accuracies. 3D scanners are already being used in industry (for example, automotive and clothing) for design, creation, quality control, and rapid prototyping, as well as in engineering and construction for documentation of plants, structures, and landscapes. However, 3D scanning opens up new avenues for documenting artefacts in archaeology, architecture, and cultural heritage.

Typically, scanner manufacturers have their own software, which may or may not be sufficient. However, this is not always the case, necessitating the purchasing of a separate software kit. There are a variety of stand-alone products available. Some specialise in fitting features and designing CAD models, while others concentrate solely on mesh development. [5]

1.2 3D SCANNING

RE is a method of collecting three-dimensional data in digital form from physical models or samples and easily transforming it to a computerised form using 3D scanning [6]. It has obvious benefits in terms of speeding up the design-to-market process and integrating it with other time compression and rapid replication technologies like CAD/CAM/CAE and RP/RT. The RE process is divided into two stages: (1) Digitizing or measuring a mechanical component, and (2) modelling the element in three dimensions using the digitised data. The surfaces are transformed into a solid model after they have been extracted from the digitised data. For RP systems, the solid model can be exported to CAD/CAM or as an STL file. The replica of the scanned model can be created after the file has been transferred to CAD/CAM or RP systems. (5)

Typically four steps in the reverse engineering process:

1. Data digitization
2. Coordinates reconstruction
3. Data point manipulation and
4. Surface approximation.

1.2.1 Data Digitization

In the reverse engineering method, the three-dimensional measuring machine (3D CMM) is the most widely used digitising device. By measuring methods, 3D CMM can be divided into two types: contact and non-contact. For various applications, each has its own method and drawbacks.

A contact form 3D CMM is the most common. During the scanning process of a 3D CMM, the probe gently touches the surface of the measured portion. As long as the touch pressure is high enough to cause the sensor to capture signals, the 3D profile data in the X, Y, and Z directions of the parts is collected.

The 3D digitised data of the parts is then captured for later use through the computing process. This type of 3D CMM system is also known as a "point-to-point" system. The 3D CMM device can provide precise measurements, but it is time and labour intensive. A non-contact 3D CMM, on the other hand, uses band scanning of laser or LED picture sources and a CCD camera to capture 3D data of parts. The triangle measurement approach is the most widely used computing concept. It has a fast scanning speed and is ideal for fragile pieces. (5)

1.2.2 Coordinates Reconstruction

After the data parts have been digitised, they go through a model reconstruction process. The reconstruction of the coordinates is the first step. In most cases, the part must scan several regions during the scanning process. Each data file has its own coordinate system for each scan. Two files of data must be computed and transferred during the stitching process in order to synthesise into a single coordinate scheme. When performing data transformations by computer, the process of coordinate reconstruction is often time consuming. (5)

1.2.3 Data Point Manipulation

Data point manipulation and characteristic line specification should be used in the pre-processing of calculated data. Sorting, rearrangement, segmentation, reduction, smoothing, and exaction are all examples of data point manipulation. This procedure will reduce data measurement noise. (5)

1.2.4 Surface Approximation

After the digitised data noise has been eliminated, the surface approximation must be calculated. The digitised data are used as inputs in the surface approximation, which uses reverse engineering tools to produce the surface model. After the surfaces have been shaped, they are transformed into solid models, which are necessary to export the NC (Numerical Control) or STL (Rapid Prototyping) file. (5)

2. Methodology

In our case study, we have taken rhino miniature to present the free form and complexity of product to clarify our points.

Step 1

Actual photos of Rhino miniature with all fine details

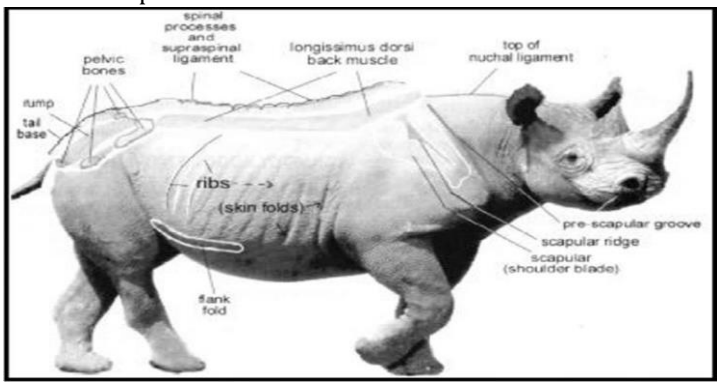

Figure 1 Original Image

Below image specified, conventional way of drawing and in which, free form of the shape like prominent folds on stomach and neck, flank fold, ribs, texture on the body and profile cannot be captured and dimensioned like any other geometrical features

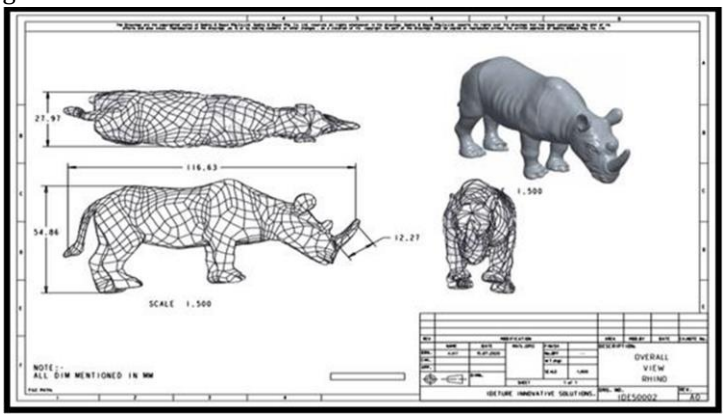

Figure 2: Draft Product

Step 2

We have scanned rhino miniature on EIN-SCANNER SP. The product has a complicated geometry and contour surfaces to ensure the minute details & strategically for ensuring a correct mesh. We used both rotating and fixed feature option of a scanner. Apart from that, Scanner has limitation for capture the black object, so we have to paint miniature with developer spray with white color to get a better result.

After some scans and picking the best one, we have to orientate the mesh in the software. Fig. 2 shows stl file output after scanning. We consider this stl file as a master file and this will be used for Design patent /copyright and further to compare with copied product in the market.

Figure 3: (A) Scanning of physical object and

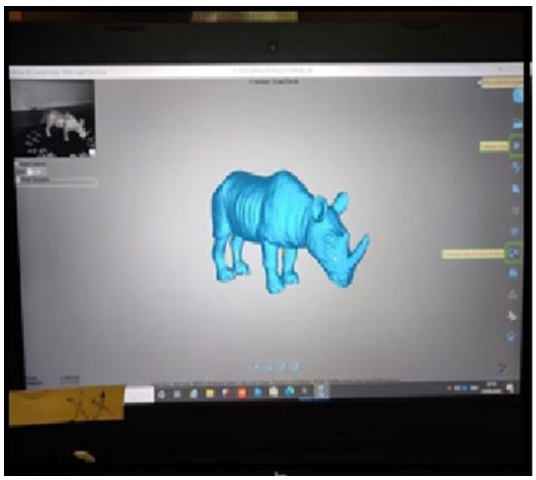

Figure 3 (B) Scan object in software

Step 3

Our intent is to show the copied market product and copyright violation. We have intentionally modified some feature in rhino miniature which acts as a copied market product for study. We used the mesh mixer software to modify the part features.

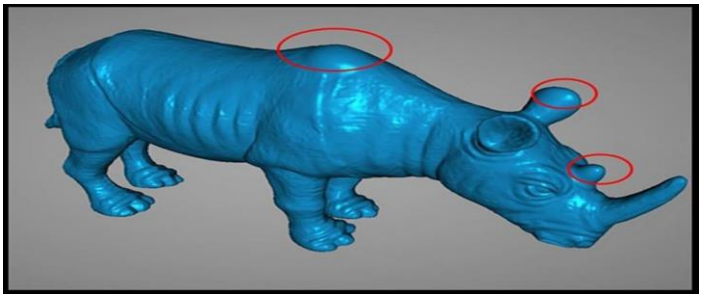

Figure 4: Scanning object with features

Step4

After that, modified part has been 3D Printed on Prusa I3MK3.

Figure 5: 3D Print Product

Step 5

We have again scanned the copied market product on 3D Scanner. (3d printed rhino). This output scanner helps to compare with a master file.

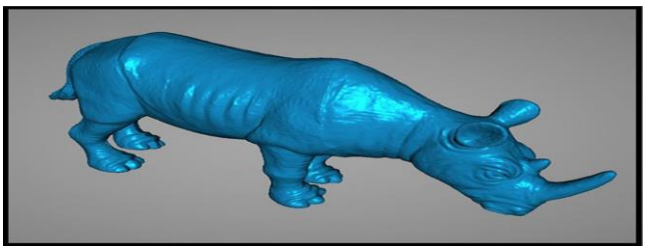

Figure 6: 3D Scanning Product Of 3D Printed Part

Step 6

Finally, we used 3D inspection feature of GOM inspection software to compare the mater file with copied product scanned file. GOM inspection is mesh processing and dimensional analysis software for comparethe cloud and iges /stl data.

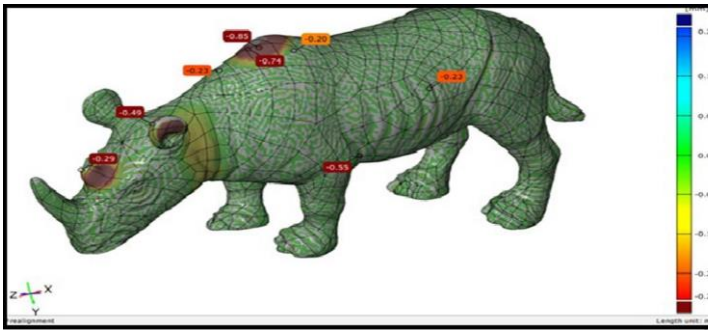

Figure 7: Scanning 3d inspection devition on both

3. Result

Table 1: Surface Deviation

Element	Property	Deviation	Average	Range	Min	Max	Count
Surface comparison 1	dXYZ	-0.86	-0.86	+0.00	-0.86	-0.86	1
Surface comparison 2	dXYZ	-0.86	-0.86	+0.00	-0.86	-0.86	1
Surface comparison 3	dXYZ	-0.20	-0.20	+0.00	-0.20	-0.20	1
Surface comparison 4	dXYZ	-0.21	-0.21	+0.00	-0.21	-0.21	1
Surface comparison 5	dXYZ	-0.39	-0.39	+0.00	-0.39	-0.39	1
Surface comparison 6	dXYZ	-0.45	-0.45	+0.00	-0.45	-0.45	1
Surface comparison 7	dXYZ	-0.29	-0.29	+0.00	-0.29	-0.29	1
Surface comparison 8	dXYZ	-0.74	-0.74	+0.00	-0.74	-0.74	1
Surface comparison 9	dXYZ	-0.85	-0.85	+0.00	-0.85	-0.85	1
Surface comparison 10	dXYZ	-0.49	-0.49	+0.00	-0.49	-0.49	1
Surface comparison 11	dXYZ	-0.29	-0.29	+0.00	-0.29	-0.29	1
Surface comparison 12	dXYZ	-0.23	-0.23	+0.00	-0.23	-0.23	1
Surface comparison 13	dXYZ	-0.20	-0.20	+0.00	-0.20	-0.20	1
Surface comparison 14	dXYZ	-0.23	-0.23	+0.00	-0.23	-0.23	1
Surface comparison 15	dXYZ	-0.55	-0.55	+0.00	-0.55	-0.55	1

The inspection software result clearly specified the deviation at various places. Software clearly showed only deviation at the point which has modified in the copied market file. Deviation report specified the deviation ranging from **+0.86 to -0.55** mm.

4. Conclusion

This new methodology consisted of 3D Scanning of Original part, 3D scanning of copied part anddigital inspection of both part. The result of inspection helped to justify the design patent violation criteria. This method is very fast and most economical .This methodology will be era of utility anddesign patent process.

This case study permitted us to discover how the reverse engineering can be useful for conserving & securing of already existing product or newly launch masterpiece. This l will help designer secure their design and prove their authenticity with product design.

By using this methodology, we will able to keep check on our competitor and player who copies the others product and take away margin of OEM supplier.

This new methodology consisted of 3D Scanning of Original part, 3D scanning of copied part and digital inspection of both part. The result of inspection helped to justify the design patent violation criteria. This method is very fast and most economical .This methodology will be era of utility anddesign patent process.

By using this methodology, we will able to keep check on our competitor and player who copies the others product and take away margin of OEM supplier

5. Acknowledgment.

First author wants to thanks, Ideture innovative solutions, Nagpur, For providing infrastructure & financial support for facilitating the 3D Scanner and 3D Printing machine.

6. References

[1] Yan X, Gu P. "A review of rapid prototyping technologies and systems. Comput Aided Des"1996;28(4):307–18

[2] Aronson RB. "Forward thinkers take to reverse engineering. Manufacturing Engineering Dearborn" 1996;117:34 –5.

[3] Curless B, Levoy M. A "Volumetric method for building complex models from range images. Proceedings of SIGGRAPH 1996, New Orleans, LA, 5–9 August. New York: ACMPress" 1996.p. 303–312.

[4] Li, N. Schemenauer, X. Peng, Y. Zeng, P. Gu* "Areverse engineering system for rapidmanufacturing of complex objects"Department of Mechanical and Manufacturing Engineering, The University of Calgary, 2500 University Drive, Calgary, Alberta, Canada T2N 1N4 Received 1 July 2000; received in revised form 1 April 2001; accepted 1 August 2001 Robotics and Computer Integrated Manufacturing 18 (2002) 53–67

[5] A.W.L. Yao "Applications of 3D scanning and reverse engineering techniques for quality control of quick response products" ORIGINAL ARTICLE Int J Adv Manuf Technol (2005) 26: 1284–1288 DOI 10.1007/s00170-004-2116-5

[6] Yau HT (1996) "Geometric modeling of engine intake ports by digitization and reverse engineering. Proc of the Japan/USA Symposium on Flexible Automation" 1:737–744

[7] Matej Paulic*, Tomaz Irgolic, Joze Balic, Franc Cus, Andrej Cupar, Tomaz Brajlih, Igor Drstvensek "Reverse Engineering of Parts with Optical Scanning and Additive Manufacturing" Faculty of mechanical engineering, University of Maribor, Smetanova ulica 17, 2000 Maribor, Slovenia 24th DAAAM International Symposium on Intelligent Manufacturing and Automation, 2013 Procedia Engineering 69 (2014) 795 – 803

[8] Chang CC (1999) "Reverse engineering and applications" Kao-Li, Taiwan, in Chinese

[9] Chua CK, Leong KF (1997) "Rapid prototyping". Willey, New YorkFeng KC et al (1990) "Reverse engineering and applications" Kao-Li, Taiwan, in Chinese

10] Lai JI, Wong WT (1998) "Applications of reverse engineering in CAD model rebuild. Mag Mech Ind," pp 211–220, in Chinese

7. BIBLIOGRAPHY

Gajanan Pradhan, M. Tech, Machine Design & Robotics

Prashant Paraye, M. Tech, Mechancial Engineering