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POTENTIAL OF DLP TECHNOLOGY FOR DESIGNING NEW PRODUCTS AND INTERPRETATION OF MUSEUM OBJECTS

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Abstract: *In 2001 EnvisionTEC introduced first additive manufacturing system, which uses DLP (Digital Light Processing) projector for building parts. Z Corporation adjusted mentioned process to design and engineering aplications. In the year of 2010 they launched ZBuilder Ultra machine. The results are stong and smooth parts. Process enables plastic models manufacturing faster and with much lower production costs, and therefore the process supplements conventional additive technologies. This paper is assessing the potential for new products design, and industrial design heritage communication during museum exhibitions.*
Key words: *DLP, new products development, industrial design, museum, prototypes*

1. INTRODUCTION

The main problem of additive manufacturing processes application to non-engeneering fields, where only small financial resources are available, are still high production costs. Clients often want inexpensive, smooth, strong (unbreakable) part that is as much simillar to injection moulded plastic parts as possible. DLP technology costs less then conventional laser and FDM (Fused Deposition Modeling) processes, and can be therefore applied even into earlyest - concept design - and intermediate phases of new product development. One new and interesting, with additive manufacturing processes still not enough supported, is the field of museums.

In this paper DLP process is described, as well as the basic characteristics of the parts, built with mentioned process. In continuation we are discusing about the possibilities of the process usage during concept design and during museum presentations. Problem of industrial design heritage interpretation is exposed. Museum objects, related to industrial designed products, are usually made of plastics and/or metal, which is why smoothness and accuracy of the models well interpret the form and surface of original objects even in smaller scale.

We are also introducing a case study of producing concept model of kiosk K21 made with 3D printing process, as well as the possibilities that DLP technology is offering today. In conclusion results and metodology of further reasearch with accent on production of test parts for testing public response on museum exhibition are exposed.

2. DLP TECHNOLOGY

2.1 DLP Projector

DLP technology was developed by Texas Instruments company. Already in 1987 an optical semiconductor DMD (Digital Micromirror Device) was developed. The technology was later named DLP (Digital Light Processing) and is today applied widely in digital projectors and televisions (Texas Instruments, 2010).

2.2 Additive Manufacturing

Use of DLP projector in the field of additive manufacturing was first introduced in 2001, when EnvisionTEC presented a system, which uses mentioned technology for solidifying liquid photopolymer. Machines produced by EnvisionTEC are specialized mostly for medicine, i.e. for hearing aids, dental and jewelry industry. In 2009 they developed a system named Ultra that was adapted and optimized for MCAD (Mechanical Computer-Aided Design) industry by Z Corporation, producer of 3D printers (ZPinters). In July 2010 ZBuilder Ultra was launched, and both of the companies signed OEM (Original Equipment Manufacturer) partner agreement. (Envisiontec, 2010).

2.3 DLP building process

Building process is similar to stereolitography, except that the photopolymer is solidified with DLP projector instead of with laser beam. Lightning runs upon the entire section of 3D model, which causes the solidification of the entire part layer at once, which fastens the building speed. Therefore the building of the part with ZBuilder Ultra can be even twice as fast as with other similar systems. Building time (up to 12.7 mm per hour) therefore depends only on model hight, and not on the number of models in building area, which is positive for producing more parts at the same time (Fig. 1.). Photopolymer in yellow color SI500 has similar mechanical properties as ABS (Acrylonitrile Butadiene Styrene) plastic. Material is strong and flexible.

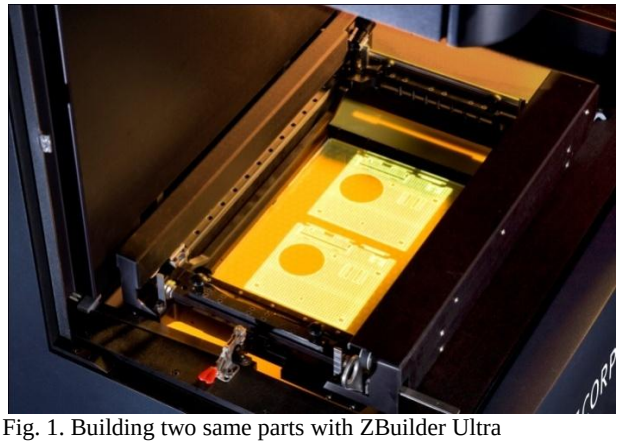

Fig. 1. Building two same parts with ZBuilder Ultra

Building area of the device is 260 x 160 x 190 mm. Resolution on X and Y is 0.138 mm, and on Z 0.05 or 0.1 mm. Because models have similar charasteristics as injection molded parts, they are most frequently used to verify form, fit and function, as well as the ergonomy of plastic elements during new product development. Because of the good flexibility characteristics the prototypes can also be used for verifing snap-fit features. (Z Corporation, 2010).

3. DLP TECHNOLOGY AS CONCEPT DESIGN AND MUSEUM OBJECT INTERPRETATION SUPPORT

3D model in the phase of concept design helps designer to improve his creative process. The same model at industrial design exhibition helps musem visitor to understand designer's process better. It must be inexpensive, fast produced and accurate enough to be built also in smaller size. At museum exhibition those models can be used for presentation of author's design process or for interpretation of an end product. In museum parts can be applied as presentation tools at exhibition (scale models), as didactic tools during pedagogical programm, intended also for vulnerable groups (tactile copies for blind and people with low vision), and as souvenirs (rapid manufacturing parts), that can be sold in museum shop or used as promotional gifts.

Additive manufacturing in the fields of museum work is being used for quite some time now, but because of the high price of the process their usage is still pretty rare. Some examples of exhibitions are known, like the permanent exhibition in the Krapina Neanderthal Museum, Croatia and design exhibition of Patrick Jouin in Pompidou Centre in Paris (Guillaume, 2010). In Krapina models of archaeological objects such as Neanderthal bones made by stereolitography and fullcolored 3D printed sculls are exhibited. Data for producing these models were acquired by CT (Computer Tomography), which was used also for bone artefacts recording and archiving (Kovačić & Radovčić, 2010). This case is a very good exemple of interdisciplinary cooperation of archaeologists, anthropologists, museologists, computer engineers, 3D digitization and additive manufacturing experts to represent development of our civilization more understandable.

Also the Multimedia Centre in Sečovlje Salina Nature Park in Slovenia is interpretatively enriched with 3D printed models. In the main room a fullcolor model in scale 1:1.000 is placed, that captures 3.5 x 4.5 km large area of salt-pan. For building this model, DTM (Digital Terrain Model) and DOP (Digital Orthophoto) data were used. Near the large model a tactile model of salt-pan in measures 105 x 125 cm is placed, and three other enlarged models, which represent building of salt chrystals (KPSS, 2009). All of the tactile models were made primariliy for blind and people with low vision, but they are also an interesting didactic tool for all other museum visitors.

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4. CASE STUDY: K21

For designer and architect Saša J. Mächtig we made 3 models of concept varieties for new kiosk K21. Models in scale 1:20 and of 160 mm hight were 3D printed on ZPrinter 510. Parts, made from plaster like material and infiltrated were made for improving author's creative process and communication with potencial clients and users. His request was to gain as smooth surfaces as possible, which we achieved with grinding and lacquering.

3D printing process was chosen because it is digital, has lowest costs of producing larger parts, and because of its accuracy and building speed (IB-PROCADD d.o.o., 2006). Thanks to the material that the system is using, DLP technology enables the model to come near to the physical preferences of the end product. The process is also suitable for more precise manufacturing of smaller parts.

5. CONCLUSION

Potencial of DLP technology for concept design and interpretation of industrial design museum objects is vast and it lyes in accuracy, repeatability, strength performances, low production costs and speed.

6. FURTHER WORK

We are preparing an exhibition related to Saša J. Mächtig's work, where we are planning to experiment with the support of 3D technologies as presentation tools, mostly with real models and computer visualizations. K67 (first variety of kiosk from the middle of the 20th century, which was in production for some decades) and K21 will also be presented on the museum exhibition as scale models, produced with DLP process.

Both industrial designed modular products, that verges on an architectural scale, are hard to present consistently only in original scale. Thus we will produce a larger number of test models in scale 1:100 and of 32 mm hight (Fig. 2.). These models will be used for introducing author's work to museum visitor by making compositions by putting together modular elements on their own. This interactive presentation will be one of the methods to test public response to additive manufacturing presentation expedients.

Results will offer good groundwork for further research of integration of 3D technologies into museum processes. Getting to know the usefulness of 3D processes and advantages of DLP technology will improve museum communication at industrial design museum exhibitions.

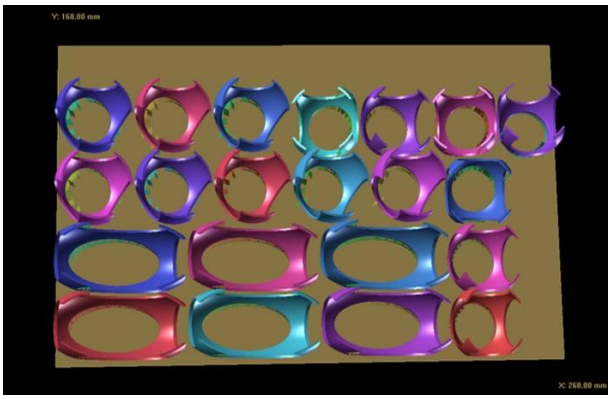

Fig. 2. Visualization of K21 models in scale 1:100 that are prepared for building

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