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RAPID PROTOTYPING AND JEWELRY DESIGN

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Abstract: *Jewelry making, despite its long tradition, hasn't changed much through time. 3D technologies allow a number of advantages in the field of design, development and realization of jewelry. With the help of interactive modifications we manage to shorten development time, constantly increase product's quality and implement easier and thorough control of development process itself. All this enables us to work quickly and efficiently. Visualization allows easier and better communication with our clients, potential customers and enriches advertising means or brand itself. The most important contribution is certainly the possibility of development and final production of highly complex forms on a basis of fractals, geometric patterns and mathematical algorithms, which were, until the arrival of 3D printers, impossible to present in physical form.*
Key words: *jewelry, 3D technology, complex forms, rapid prototyping*

1. JEWELRY

Men have always felt the need to boast ergo the jewelry is one of the oldest forms of body decoration. Knowledge about jewelry and its fabrication advanced rapidly, and soon in Ancient Egypt, there were real masters in the processing of gold and precious stones. Through time tools have remained much the same, changing only in details and approaches taken (McCreight, 2004). Goldsmiths are real masters of profession, and can produce wonderful products to take your breath away. However, despite enormous knowledge accumulated, because of technological limitations, they cannot create some sophisticated, complex geometric shapes that are based on fractals, repeating patterns, or mathematical algorithms. Even if they could realize such forms at the level of a prototype, they would be unable to perform the stage of multiplication using only traditional rubber mold, because the wax model couldn't be cut out of the rubber.

2. IDEA DEVELOPMENT

Field of designing is constantly evolving through the development of technologies, materials, changes in the cultural aspects and is also in conjoint advancement with them. Thus, the computer and information technology is changing the social paradigm, goldsmith profession has gotten the opportunity to make a decisive shift, in the very time when additive technologies (AT) are being developed and invested in.
As a connoisseur of 3D technologies, I've participated in introducing 3D technologies into jewelry, and so I realized that it's essential to integrate them in the whole process of development, from planning stage to final realization of the product.

During the development phase of a particular object, it often happens that communication becomes extremely complex and opportunities for error increase, namely because of a numerous involved in the process. It is therefore essential that the designer is familiar with software which enables prudent work. Using the software designer can bypass many challenges that would otherwise lead to troublesome outcomes. Challenges can occur quite early, as in conceptual phase. It is often of most difficulty to draw (define) form of a complex jewelry on two-dimensional surface such as paper. In addition, to plot some details, a lot of explanation is often required. Consequently, we notice that designer is the only one who knows exactly what he wants, and spends extra time clarifying details to the person who will construct virtual model. It's therefore highly welcome, that designer performs in 3D computer modeling or construction, and brings the design to the stage where all affected can discuss the outcome (designers, technologists, goldsmiths, management). At this stage we can talk about the benefits of communication within the team. Based on the virtual model, it's easier to estimate the final product. Technologists can try out necessary parameters of the operations; molding, assembly, and other details. Based on data of weight and consequently costs of manufacturing, decision about pricing can be done by the Management. Throughout this process, costs cutting, improvement of quality and significant reducing of development time are achieved, regardless of developing individual item or a whole collection.

3. PARAMETRICS

Accuracy of 3D technology is astounding. Forms and details can be controlled much more precisely than it can ever be done by the traditional techniques (using rasps, scalpels, and other hand tools). Hence we can achieve better and more precise details, more evenly tensed surfaces and uniform thickness, which subsequently allow easier and nicer casting lines, coherent modular parts, which ultimately can be assembled into a whole effortless. In addition, same parts are modeled only once and allow, if desired, multiplication.

Although the design of a product starts with an idea and its sketch, design requires a continuous research, modification, and maximizing control over the final shape, as early as in development phase or entire work process. Therefore it's always happening, during the design process, that the shape is evolving. Here, a break through can be made with parametric design. Parametric designing enables designer an option to change certain parameters during generation process. This makes creativity frameless. Designer can consult among colleagues or with customer during his work and can jointly make changes or minor interventions to the model. Stated means that out of a baseline created, model is tailored to achieve clients', engineers' or others desires, goal being to achieve the best possible result. The chosen model is then saved and stored, nevertheless it still enables alternations. This way we save time and avoid unnecessary re-designing of the virtual model. It all transfers into our customer' satisfaction, thankful to smooth communication, knowing the end result and eliminating unpleasant surprises. This interactive cooperation, in term of model adaptation, serves to speed up the process and reduces the costs incurred.

4. COMMUNICATING THROUGH VISUALIZATION

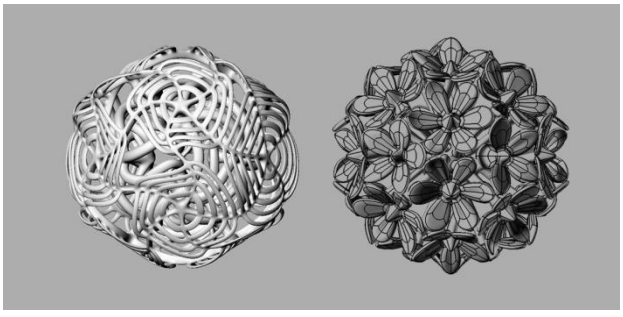
Although, in nowadays visual image plays a significant role, it isn't being used only for the final presentation. Option of visualizing offers many benefits, which were also identified by the industries that develop new products. They began to use visualization for better presentations and therefore better communication with their customers. In addition, we use it, where we have to define materials, colors, textures, reflections, and similar conditions. Such software has progressed to a degree, where simulation of the future environment, which the products are designed for, can be simulated and designs fully adjusted to fit these very specific conditions. In our case, we already test in advance, how a certain form of ring will react to its surroundings, its brightness, luminousness and what details should we emphasize (Kerlow, 2009).

Visualizing has achieved such levels recently, that we can even use this approach for rendering final products (virtual photography). Causes vary. Either because of a better final quality, where there is no unnecessary scratches or problems with reflections, mirroring of lights or even photographers, unless we want it to. Secondly, due to excessive costs, which are conceived as a result of large orders, or mostly because the product is still under development, so with the help of virtual photography, advertising campaigns, packaging designs or necessary feedback check-outs are commenced in advance.
Through visualization, clients are not surprised by the final product and know exactly what they'll get, and so do we.

5. NEW FORMS

As I already mentioned in the introduction, jewelry does not represent any functional role anymore, but serves mainly for decoration purposes.

If we look at the jewelry from decorative point of view in particular, we can certainly argue, that the aspect of shape plays a major role. Precious metals, which are in principle used for manufacturing, have a specifics of a shiny luster and features which enable reflections of surrounding on its surface. These reflections of rays and refractions of ambient images, give jewelry special charm and beauty. With ongoing search of appropriate forms and tensions we create an interesting display, which catches the eye. Through a variety of different materials used (high-gloss, matte, waning etc.), we obtain different variations of reflections, and in combination with the surface tensions, intensity of surroundings reflect on the surface area, is taken care of. We know that the spherical surfaces cast back wider part of the space around as do flat surfaces. For example, a perfect sphere reflects 360° of the environment, while flat objects casts back only the environment directly in front of them. If we are aware of these features, jewelry design has to utilize them in appropriate manner, to achieve the product's end quality and "right shine". Previews of these reflections are enabled in afore mentioned 3D software through visualizations, some programs are able to do it in real time.



Complex shape of Jewelry, modeling by Bostjan Bensa

In my opinion, the most important aspect of new technologies comes with the possibility of developing new, sophisticated geometrical shapes, fractal patterns, mathematical algorithms, or other organic forms. With these concepts products, environment and world are growing to be more and more interesting and subtle. Such interesting notions were being formed while ago, under the name of MGX by Materialise, where established designers created beautiful lights in geometric shapes, with the help of additive fabrication. Architecture use similar idea, where pillars of virtual basis facilitate unhurried materializing. Product design in general, my area of expertise, does not lag behind (Hopkinson, 2006).

6. 3D PRINTS

Problem facing user of 3D software is primarily the fact, that the product is in a virtual format and environment, where there is no real sense for measures. Man perceives space primarily based on experience, what are the dimensions of defined objects, and sets by comparing, a sense of size for others. Even though we have measuring units, net, etc. to our disposal (in 3D software), helping us to perceive, the true, real feeling of size is obtained only with the ultimate 3D print. Prints can be used to conduct various tests like measurements, perception of form and completion, technologists can review possible problematic details, clients get an even better feeling about the final product, etc. Currently there are quite a few different technologies on the market that we can choose from.

In the final stage 3D prints are also used for molding of finished products, commonly made of precious metals such as gold, silver and platinum (Solidscape produces usable wax models). Surfaces, made using additive technology, are generally not so smooth and need a final polishing process, the procedure is somewhat complex and considerably time-consuming. However, the great advantage is in easier and better interpretation of the final product and in creation of models with blind corners and very complex geometry, which allows us to materialize new forms (Drstvenšek, 2004; Chua et al., 2009).

7. KVADRATPLUS

The groundwork of 3D and additive technologies is in place and development in rapid. Our job is to search for new concepts and in combining different software equipment (Grasshopper, T-splines, Paracloud, TopMod …), creating new forms, which are then implemented into a variety of products and into our surroundings. In this way we enrich our environment and set new challenges. We explore the possibilities of morphing between already manufactured products or so-called auto-designing (growth, metamorphosis), possibilities of transformation (on the level of color and form) through sound waves, morphing between individual products, fractal growth and fading of specific details or similar. In terms of shape or form options can be left quite open, but in terms of functionality itself – comfortable wear of jewelry, results must be controlled or at least boundaries have to be set in some contexts, because otherwise, we could arrive to the level of sculpture. Vast possibilities of shapes alone allow for numerous form of interpretation, meaning our mission won't end soon.

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