AN EXPERIMENT WITH THE VOICE TO DESIGN CERAMICS

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ABSTRACT

This article is about how experiential knowledge that the craftsmen gains in a direct physical interaction with a responding material can be transformed and utilized in the use of digital technologies. The article presents an experiment with a 3D interactive and dynamic system to create ceramics from the human voice and thus how digital technology makes new possibilities in ceramic craft. 3D digital shape is created using simple geometric rules and is output to a 3D printer to make ceramic objects. The system demonstrates the close connection between digital technology and craft practice.

INTRODUCTION

The overall field of this research is about integration of digital technology in the field of 3D design, especially in fields rooted in arts and craft. In this case it is about how experiential knowledge of crafts rooted in ceramics is transformed and utilized in the use of digital technologies. Thus experiential knowledge represents the idea of an intuitive and humanistic crafting and tacit knowledge according to Dormer (1994).

The approach in this study is driven by a desire to humanize the use of digital technology in the field of 3D design. By humanizing is meant that the involvement of the body is being exploited. It can be hand gestures, body movement, or as in this experiment, the voice, forming the basis for an interaction through digital technology. This is seen as in contrast to the predominantly use of mouse clicks and typing numbers, which does not utilize the body as a tool to accentuate the design with digital technology.

As the voice is among the main communicative and expressive parts of the human, a part of the overall project is made to investigate what the voice is capable of creating in 3D ceramics. Specifically, this paper focuses on one experiment in the exploration of a digital interactive design tool that uses voice as input and 3D physical form as output by rapid prototyping. However, the main idea is to explore the human voice as a tool for interaction rather than e.g. to express audio as an artistic expression.

LITERATURE AND THEORY

The project builds on McCullough's (1996) idea about a close connection between digital work and a crafts practice, and that the hand- and brain activities related to computer technology may be analogous to practical activities where tacit knowledge, according to Polanyi (1966) is involved. McCullough's research is based on studies of crafts; design processes and tools related to fundamental human activities. McCullough suggests that computer systems should be developed much more from the user's perspective.

In this study the overall aim is to support the designer to utilize tacit knowledge within the use of computer technology in the experimental and creative stage of sketching in the design process.

The approach for exploring this is based on an idea of material as an inspiring partner in the design process. By exploratory and playful interventions and by being attentive to the response of the material an understanding is obtained and thus the material works as a partner in the design process. Manuel de Landa (2002) describes such interplay as …a form that we tease out of those materials as we allow them to have their say in the structures we create. The ceramicist Bernard Leach (1940) describes it as …a living embodiment of the intention… and crafting and execution as a unity that is intuitive and humanistic - One Hand, One Brain (Bernard Leach 1940).

This approach is based on a craft based design approach that Hansen (2010) calls interactive material-driven

designing. The approach is characterized by two levels, forming a whole. A first level is to identify and develop a potential of a material, e.g. the potential of liquid clay to create patterns by gravity. A second level is to explore and realize the potential by producing a number of representative 3D examples of what can be done and how. This is about an intimate interplay or we can in this case call it *interaction* between the designer and the responding material at the very moment in the process of giving form by physical interventions. The two levels are coherent and interrelated and developed over time through experiments, and reflected as a unique artistic fingerprint in the final artefact.

Hansen's conclusion is that such an approach to designing is utilized with digital technology when the designer develops his/her own digital interactive and generative system, or we can in this case call it *responding digital material*. This study constitutes such an approach exploring a digital interactive design tool that uses voice as input.

The aspect of interaction within digital technologies with such a generative potential regarding audio is well known in the field of event-based productions such as computer games, interactive art installations, performances etc. Such use employs digital technology as part of its own medium and makes up a clear distinction when compared to a digital design tool for making independent works of art (Paul, 2003); the purpose of this project.

Nevertheless experiments with audio based digital systems have also headed in the direction of independent works of art. *Reflection* by A. Fischer and B. Maus (2008) is a data sculpture based on a FFT frequency spectrum analysis, which was performed on audio clips and arranged in a 3D coordinate system consisting of frequency and time. Their final sculpture was created with a CNC Milling Machine. Another example is Jan Henrik Hansen's (2012) sculptural work, which focuses on the interpretation of music into space and form with a digital technique, dealing with the wide spectrum of music, from single sounds to whole arrangements. A third example is *Sound Surface* - 3D printed pots by Jonathan Keep (2012) which represents a series of pots generated from sound data based on musical pieces, and computer code using the *processing* programming language to create 3D digital surface texture. The captured digital files are following 3D printed in clay.

On one hand these examples deal with an experimental development of the designers own generative digital material based on an audio input, and an output to a 3D Rapid Prototyping techniques to make 3D result. That is quite related to present project. On the other hand these related examples make up a clear distinction to present project by using already composed musical pieces compared to this study's idea of using the human voice as a tool in the very moment of form-giving. Present study distinguishes itself exactly by the real time interaction between the designer's voice and the digital

material and thus by an intimate interplay according to the idea of interactive material-driven designing. Furthermore present study distinguishes itself by solely being a tool for 3D designing rather to express audio as an artistic expression.

DATA AND METHODS

In this research the research through design methodology (Frayling, 1993) is employed which for this purpose is defined as an experimental design practice that is part of the design research and contributes empirical data. The method is explorative and experimental, which in this study means that the research questions and empirical series of experiments are produced and developed in the process of research. This approach is seen as a reflection on action similar to Schön's ideas (1983). The method begins with a definition of a frame for carrying out experiments, which reflect the overall research question. In this case it reflects how the ceramic craftsmen utilize experiential knowledge within the use of digital technologies specifically with voice interaction. This approach is inspired by Binder and Redström's (2006) notion of exemplary design research.

... by creating examples of what could be done and how, i.e. examples that both express the possibilities of the design program as well as more general suggestions about a (change to) design practice.

The intention with this paper is to give an insight into an experiment in this frame and the potential it exhibits

AN OVERVIEW OF THE DIGITAL INTERACTIVE SYSTEM

In this study the experiment is about a digital interactive design tool that uses voice as input and 3D physical form as output.

An overview of the system can be seen in figure 1. It consists of an audio feature estimation module, a shape creation module, and a 3D print module.

Figure 1: The overview of the digital interactive system

AUDIO FEATURES

It is necessary to know which audio features that are used for the system. This will provide understanding of the complexity and dynamic utilized in the generative system and in the 3D geometry that the system produces.

To extract the wanted audio features from the voice the software Max msp has been utilized. In this case three bands of frequencies; Low, Mid and High are extracted. Furthermore Loudness, which in this case is defined as the average of the amplitude on the number of samples,

entered every 33 milliseconds. Examples of the extracted values from Max msp can be seen in figure 2.
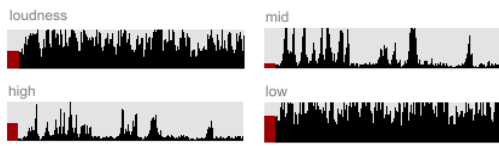

Figur 2: Extracted values from Max msp

SHAPE CREATION

By the use of the computer engine, *Unity 3D* (see figure 3) the different audio features was utilized for a parametric setup, and input to several coherent and interrelated geometries forming a whole using simple rules.

The overall shape consists of two spirals defined by two kinds of geometries. Furthermore the two spirals are connected by cylinders (see example at figure 3) to make a whole. Spiral 1 is defined by forms of spheres (see figure 4, left) and Spiral 2 is defined by crosses (see figure 4, right) The spirals have been chosen to investigate the complex relationship between two curved lines in a 3d space with the purpose of discovering new unforeseeable shapes. Furthermore this is clarified and emphasized by the contrast of spheres and crosses respectively.
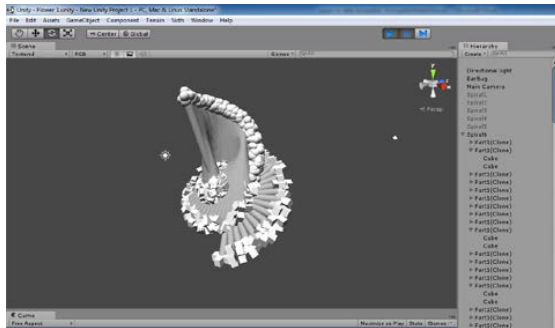

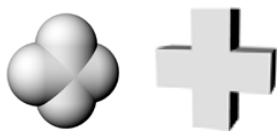Figure 3: The interface of the computer engine, Unity 3D with an example of the overall shape.

Figur 4: Geometries on the spirals. Forms of spheres and crosses respectively.

The height, radius and number of rotations are based on different audio features as a parametric input. Also the size of the geometries at figure 4 and the distance between the spirals (thus also the cylinders) are

dependent on different audio features' input. If there are no inputs the shape will appear as a dense mass.

The relation between audio features and geometries in present experiment is as follows:

Spiral 1, defined by forms of spheres: height=High, radius=High, number of rotations=Low and the size of the forms of spheres=Loudness.

Spiral 2, defined by crosses: height=High, radius=High, number of rotations=Low and the size of the crosses=constant.

Furthermore the distance between the spirals and thus the size of the cylinders are defined by Loudness.

This generative system is reflecting the first level of interactive material driven designing; the identified and developed potential of a digital material.

Intervention makes it possible to obtain an understanding of the responding material. This is going on in real time, which means the response is immediately, and if there is no intervention the shape will return to its initial shape as a dense mass. This exploratory and playful intervention is referring to the second level of interactive material driven designing; an intimate interplay between the designer and the material and being attentive to the response. Furthermore the overall shape can be frozen any moment and exported as a 3D printable file. Thus the potential of the system can be explored and realized. A number of representative 3D examples of what can be done can be viewed in figure 5.
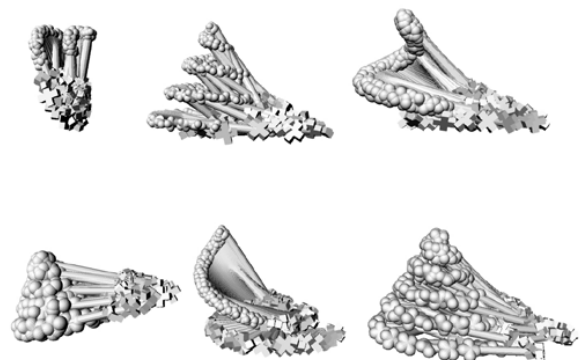

Figur 5: A number of representative 3D examples of what can be done with the responding system.

3D PRINT

In figure 6 a digital shape is shown as created in ceramics by the use of a 3D powder printer from ZCorp. The recipe for utilizing ceramics powder in this 3D printer is based on the research by University of Washington Department of Mechanical Engineering in Seattle, Washington (Ganter, Storti, & Utela, 2009).

Figure 6: The digital shape is shown as created in ceramics by the use of a 3D powder printer from ZCorp

EVALUATION OF DATA

A digital interactive design tool that uses voice as input and 3D physical form as output has in this experiment been explored. The main idea has been to explore the human voice as a tool for interaction rather than e.g. to express audio as an artistic expression.

Firstly a 3d interactive and dynamic real time system based on a number of audio features has been successfully developed. Secondly it has been explored by interventions and a diverse number of representative 3D examples of what can be done have been realized. Furthermore the digital shape has been realized in ceramics by the use of a 3D powder printer from ZCorp.

RESULTS AND DISCUSSION

The number of representative 3D examples has shown a high degree of diversity and thus how the high amount of audio features in interplay with the interrelated geometries contributes dynamic and complex results.

Thus the voice is an exceptional tool for interaction because it contributes with high amount of audio features at a time. In this case it places the performer between having control and not having control. That is about unpredictability, - and surprising and useful results. A certain control is needed and can only be obtained by interventions and experience. This is about an intimate interplay between the designer and the material and by being attentive to the response, according to the idea of interactive material-driven designing. This is also what links crafting and execution as a unity that is intuitive according to Dormer (1994) and Leach (1940) and thus how experiential knowledge will be obtained. In this process it will be possible to grasp and capture dynamic and unique moments for 3D printing, which will reflect an individual artistic fingerprint. Thus the craft-based designer can utilize his/her experience about experiential knowledge in the use of digital technologies.

CONCLUSION

The experiment has successfully shown how a craft-based design approach based on experiential knowledge can be transformed and utilized in the use of digital technologies.

Furthermore the experiment has shown how digital technology with voice interaction makes new possibilities in ceramic craft. A main finding is how the high amount of audio features provided by the human voice at a time in interplay with interrelated geometries contributes with a high degree of complexity.

ACKNOWLEDGMENTS

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