DIGITAL MAKING – A MODEL MAKING PROCESS TRIGGERED BY CLAY-LIKE MEDIA

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Abstract. The respect of haptic media like digital clay, Designers can feel the physical material through the digital clay. According to this feeling they can make the model in the virtual space. The traditional make-mode ways are almost in software. Compared with this ways of past, the intuitive interaction way is more intuitive than traditional way that use mouse/keyboard to adjust the node of model. In this research, we propose a capture mechanism using the characteristic of physical material to explore 3D form.

1. Introduction

One often used in inspiring or exploring design alternatives is by making. With digital media involved, a new way of design making process has emerged. Such process is called digital making. With the nature of digital technology, most of digital media presently used in design process has lost the sense of touch in return with the power of virtuality. However, by making the design objects with haptic senses, designers can grab and experience the design intuitively. The haptic sense has to be embedded in digital media directly in order to provide the proper experience of digital making.

In addition, by combining physical interactions (touch) with its corresponded model making functions, the media itself provides not only the new model-making process but also an influential representation. One of those approaches is *digital clay.*

By controlling the representation as well as material through the digital clay or clay-like media, models are created during the interacting process with media itself. Compared with digital clay, conventional model making are

mainly using mouse/keyboard as inputs. It will need more training and focusing anything but the modeling process for adjusting details of model. However, digital clay is an easy concept but difficult to implementation. Therefore, in this paper, we focus on our approach towards a clay-like media for triggering the model making process in making/exploring 3D irregular form particularly.

2. Relevant Researches

One of common practice in implementing a media for digital making is to use the haptic element of the virtual reality interface as the major subject of research. Within this trend, clay or so-called digital clay has been explored more in terms of form-sculpturing behaviors. Such as (Jarek, et al. 2003). The main reflection on design process is to use the sensible touch and forming characteristics of clay and to embed analyzed design requirements into the operation mechanism of digital clay itself. Related researches in representing the concept of "digital clay" can be divided into three groups as followed.

First group uses clay's exterior to be the style of modeling (Thomas 1998) as shown in Figure 1. Their implementation and impacts in design are aiming at supporting rapid ideation and dynamic sculpting, especially in the initial (upstream) phase of design.

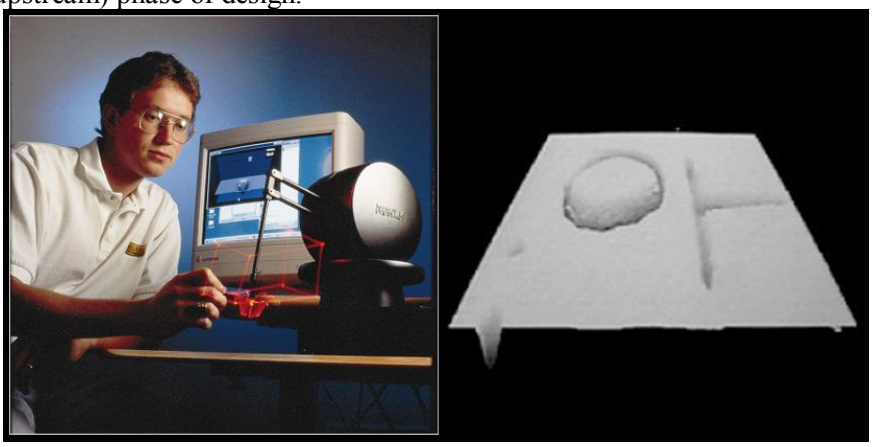

Figure 1. Use clay's exterior to be the style of modeling (Thomas 1998)

Second group uses clay as intuitive and tangible interfaces to work or to facilitate collaboration (Ishii, et al. 2004, Jarek, et al. 2003). One example is shown in Figure 2. Designers often feel comfortable manipulating clay and sand to test their own concept as it requires no special skill.

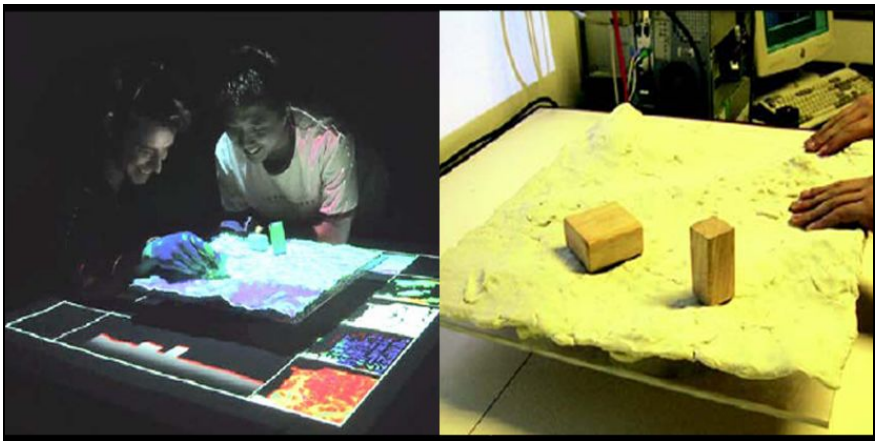

Figure 2. Using clay as intuitive and tangible interfaces to work or to facilitate collaboration (Ishii, et al. 2004).

The third group of digital clay is including real world presence and virtual object presence, giving the illusion of a real interaction by visual feedback and physical object manipulation in (Alexandre, et al. 2004, Chai, et al. 1998, Jarek, et al. 2003). As shown in Figure 3, the clay is used as a control interface for controlling the model, and further understanding the complicate model in virtual space.

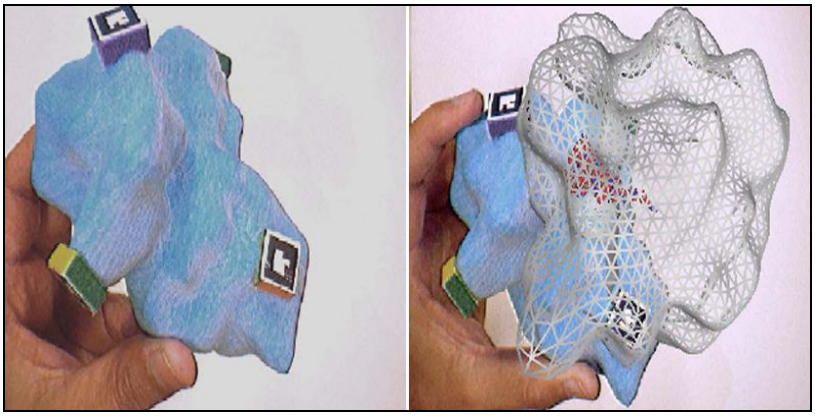

Figure 3. Digital clay is used as a control interface for controlling the model, and further understanding the complicate model in virtual space (Alexandre, et al. 2004)

3. Our approach: a haptic media platform

As described above, even though the representation has been explored and implemented, but the focus is more on treating clay as it will be in physical world, not at the interaction with clay. Therefore, we are testing a possible platform that can incorporate not only the purpose of digital clay, but with diverse materials within the scope of model-making. This is to say, the clay itself is not the object but the platform the clay is situated is the focus.

In addition, a haptic tool itself with raw materials that it is applied is the basic facilities for the interaction within our interest. For the haptic approach, the tactile and kinesthetic senses are two main perceptual cues to our ability to understand 3-D form and to perform physical manipulations such as elaborated in (Alexandre, et al. 2004). By taking advantage of human abilities, the personality of this tool is to grasp and manipulate physical objects and materials that we are also exploring.

This platform is based on the concept of direct manipulation over clay-like media that are either electronic or just clay. By combining physical materials with the advantage of digital media, X-Media can incorporate the network as well. Each combination of tool/material pair behaves as it would be in a physical environment, but reflects onto their outcomes (virtually, as in our current approach). For example, designer can grasp all kind of physical materials that will have their corresponded influence over virtual model. According to designer behavior, physical object will to produce many data. For instance, designer can dash the clay to the platform, and this action can be analyzed by pressure sensor of system.

4. The Platform: X-Media

For testifying our exploration, we have developed an interactive platform called "X-Media". The framework of X-Media is shown in Figure *4*. The first prototype of X-Media is composed by six components: (1) Pressure Sensors Layer; (2) Pressure Transformation Device; (3) Projection Screen; (4) CCD/COMS Sensors; (5) Computation Server; (6) Visual representation system. By mixing the pressure with CCD/CMOS sensors to tracking the interactive behaviors of designers, the system can judge several external factors of our material such as transparency, little pressure and characteristic by tracker devices. The sensors in our platform produce the potential difference. The pressure Sensor can receive the pressure and position information and then transform it into digital signals. The platform can then present the range and proportion through the array of LED. And the CCD/CMOS sensors can capture and record the changes in array of LED. The goal of a series of devices is for transforming the activities into light

intensity. The lighting can be further recorded by CCD/COMS sensors and then digital information. When system recognizes these digital signals, the pre-defined rules as well logic will be applied to represent the digital outcomes (Figure 5).

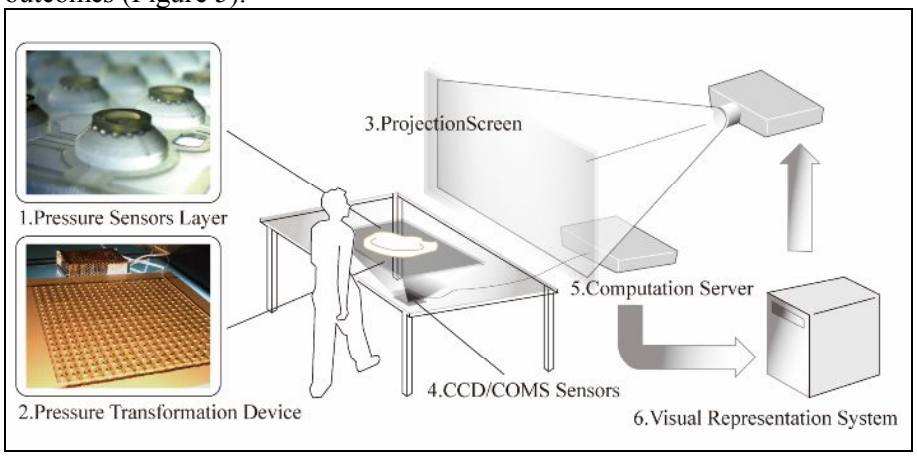

Figure 4. The system framework

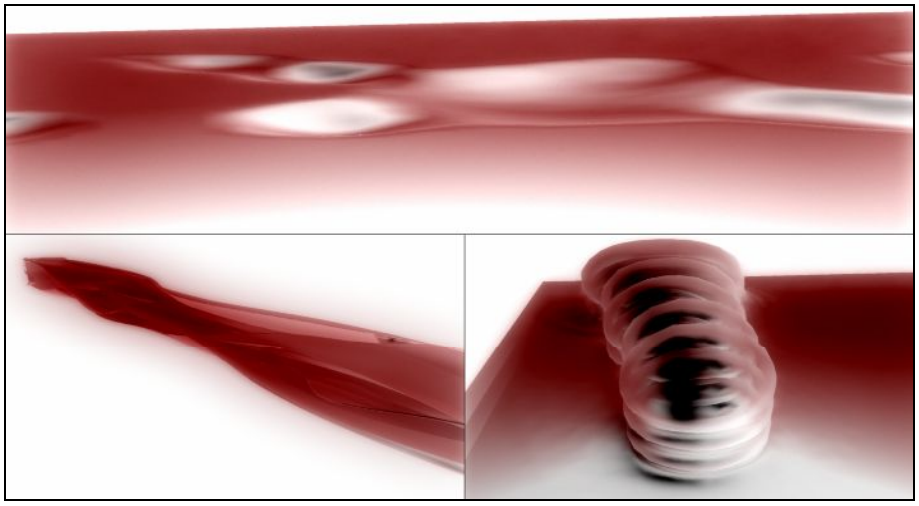

Figure 5. Exportation outcome of X-Media

4.1. THE PRESSURE SENSOR SURFACE

The silica gel (as shown in Figure 6, left) is used as our testing material and the surface layer (the clay representation). While operating the silica gel, it can sustain force and give the suitable feedback. We use silica gel to produce independent objects. These objects can pop up the supporting silica gel layer

(Figure 6). The silica gel can receive multi-direction collision (Figure 7). After changing shape, they can restore fast. And every silica gel in our current implementation can trigger a luminary independently. Therefore, the pressure from different materials can then be captured independently without interfering others.

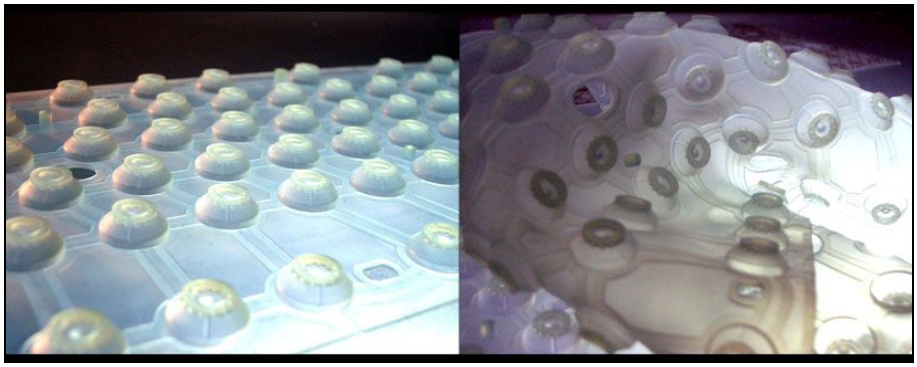

Figure 6. The supple silica gel layer

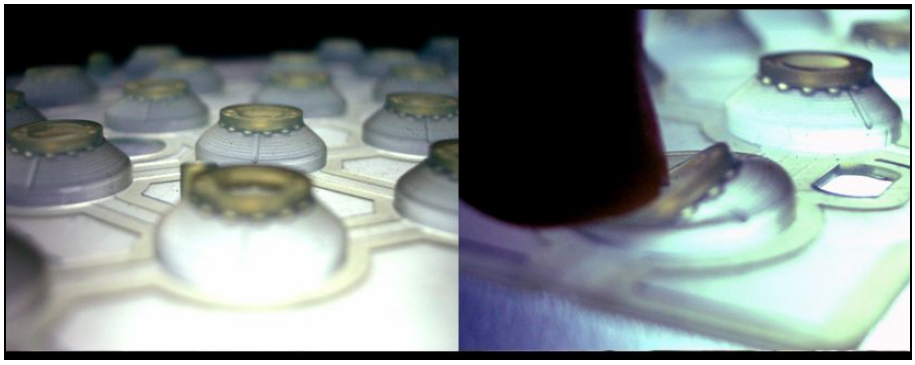

Figure 7. The silica gel layer can receive multi-direction collision

4.2. THE DEVICE OF TRANSFORM PRESSURE INTO LIGHT

The LED array of X-Media that is connecting to touch surface is constructed by condensed LED as shown in Figure 8. For receiving the information from pressure sensors, the LED array can transform the information back into the lighting and the changes of position.

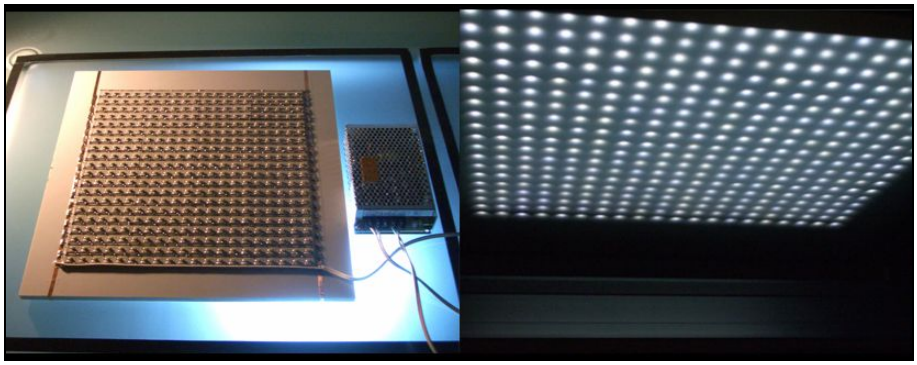

Figure 8. The LED array of transform pressure into light

4.3. JUDGEMENT AND COMPUTATION

The connection between device and computer is through processing programs to analyze and transform into digital representation. Finally, the digital representation is reflected in the action within virtual space. The 3D display is implemented using advanced OpenGL environment.

5. Conclusion

By implementing a platform rather than the media itself, X-Media provides a feasible computational device for recording as well as the possibility for recognizing the haptic behaviors in digital making. By shifting the media from clay itself to the platform, designers can experiment different physical materials easier without transforming every clay-like materials into digital form. The interactive making process based on X–Media will be conducted in the further studies.

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