Chapter 2 **Review**

In this chapter, the importance of two of the traditional media, sketches and models, will be described first. Then, some of the new media that is created by combining various design media will be described. Last, some research about AR is also mentioned.

2.1 Traditional media: sketching and modeling

2.1.1 Sketches

Throughout the history of architectural design, sketching always takes an important part in the design process. Many researches have shown the essential of sketching and its features those help to improve design thinking in various ways (Lansdown, 1987; Goel, 1995; Herbert, 1993; Goldschmidt, 1999; Rodgers, 2000). Much of the cognitive lies beyond articulate, discursive thought, beyond the reach of current computational notions. Goel (1995) argues that the cognitive computational conception of the world requires our thought processes to be precise, rigid, discrete, and unambiguous; yet there are dense, ambiguous, and amorphous symbol systems, like sketching, painting, and poetry, found in the arts and much of everyday discourse that have an important, nontrivial place in cognition. He also maintains that while on occasion our thoughts do conform to the current computational theory of mind, they often are -- indeed must be - vague, fluid, ambiguous, and amorphous. He argues that if cognitive science takes the classical computational story seriously, it must deny or ignore these processes, or at least relegate them to the realm of the nonmental. Due to the essential of sketching, many researches have been done to improve CAD system for drawing and sketching.

The Electronic Cocktail Napkin developed by Gross (1996) is an experimental computer-based environment for sketching and diagramming in conceptual stage of design (Figure 2.1.1). The project's goal is to develop a computational drawing environment to support conceptual designing in a way that leads smoothly from diagrams to more formal and structured representations of schematic design. With computational representations for conceptual designs, computer supported editing, critiquing, analysis, and simulation can be employed earlier in the design process, where it can have a greater impact on outcomes.

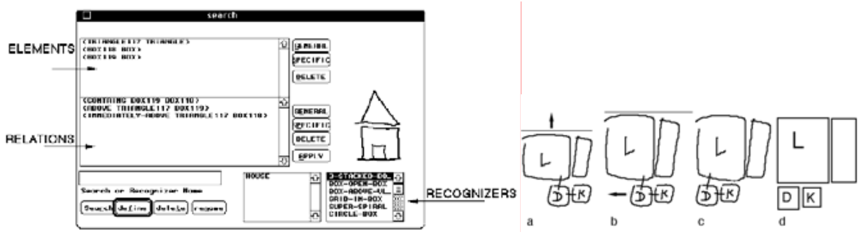

Figure 2.1.1: The Electronic Cocktail Napkin (Gross, 1996)

In 1993, Wellner provide a system called DigitalDesk to enhance sketching and drawing behavior (Figure 2.1.2). The DigitalDesk is a real physical desk on which user can stack his/her papers, lay out his/her favorite pencils and markers, and leave his/her coffee cup, but it is enhanced to provide some characteristics of an electronic workstation. A computer display is projected onto the desk, and video cameras pointed down at the desk feed an image processing system that can sense what the user is doing. No desktop metaphor is needed because it is literally a desktop. The DigitalDesk has the following three important characteristics: it projects electronic images down onto the desk and onto paper documents, it responds to interaction with pens or bare fingers, and it can read paper documents placed on the desk.

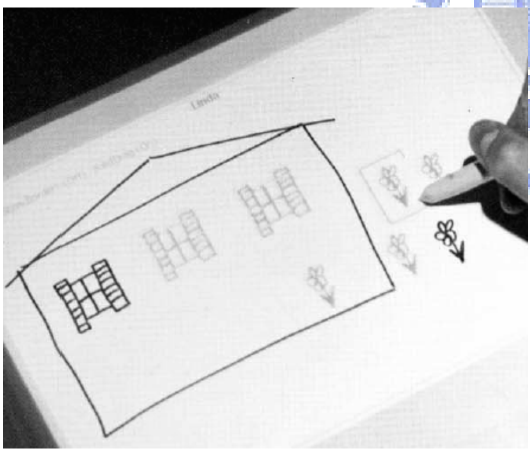

Figure 2.1.2: DigitalDesk (Wellner, 1993)

2.1.2 Models

On the other hand, Knoll (1992) pointed out that concept model is an important element to help designer constructing their thoughts. He also mentioned that sketch and model, which take different roles in design, have an important connection between each other.

Hiroaki (1998) proposed a new method for modeling 3D objects using hand gestures (Figure 2.1.3). First of all, a conceptual model, the so-called “image externalization loop” model, is introduced as a framework to realize an efficient 3D object creation environment. Then, a 3D shape forming method for implementing the model is described in detail. Two-handed spatial and pictographic gestures are used to describe the features of the object in shape, size and deformation pattern. The implicit superquadric functions apply to build a deformable 3D model with blending and axial deformations as their extensions. A generic hand gesture learning and recognition facility is developed and used to translate the gestures into specific superquadrics parameters to deform the object. Finally, some experimental results are shown to express the capability and usefulness of the proposed method with its potential application areas.

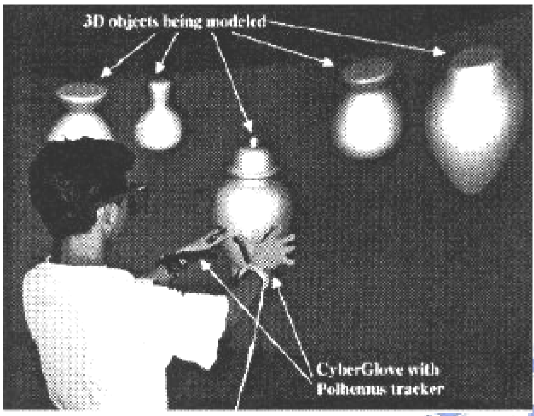

Figure 2.1.3: a new method for modeling 3D objects using hand gestures (Hiroaki, 1998)

In 2000, another interesting idea was presented: modeling should not have to specify the geometric and material properties of the models precisely. By contrast, children playing with construction toys like Lego and K'nex make simple models easily, and use their imaginations to fill in the details (Anderson and et al, 2000). With this concept, Anderson constructed a system which user can use simple blocks to proceed with 3D modeling (Figure 2.1.4).

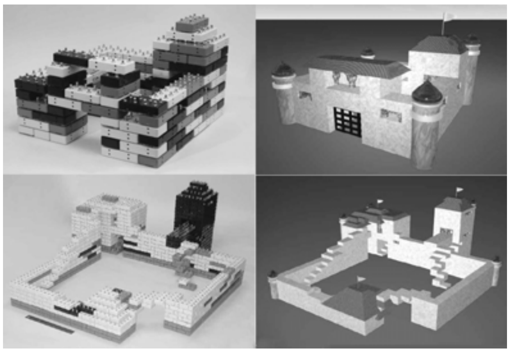

Figure 2.1.4: a system which user can use simple blocks to proceed with 3D modeling (Anderson, 2000)

Illuminating Clay, one of the projects in the Tangible Media Group, MIT, is a system which allows its user to alter the topography of a clay landscape model while the changing geometry is captured in real-time by a ceiling-mounted laser scanner (Figure 2.1.5). A depth image of the model serves as an input to a library of landscape analysis functions. The results of this analysis are projected back into the workspace and registered with the surfaces of the model (Piper, B., 2002).

Figure 2.1.5: The illuminating Clay (Piper, B., 2002)

2.2 Combination of sketching and modeling

Igarashi (1999) presented a sketching interface for quickly and easily designing freeform models such as stuffed animals and other rotund objects. The user draws several 2D freeform strokes interactively on the screen and the system automatically constructs plausible 3D polygonal surfaces. Their system supports several modeling operations, including the operation to construct a 3D polygonal surface from a 2D silhouette drawn by the user: it inflates the region surrounded by the silhouette making wide areas fat, and narrow areas thin. Teddy (Figure 2.2.1), their prototype system, is implemented as a Java™ program, and the mesh construction is done in real-time on a standard PC. Their informal user study showed that a first-time user typically masters the operations within 10 minutes, and can construct interesting 3D models within minutes.

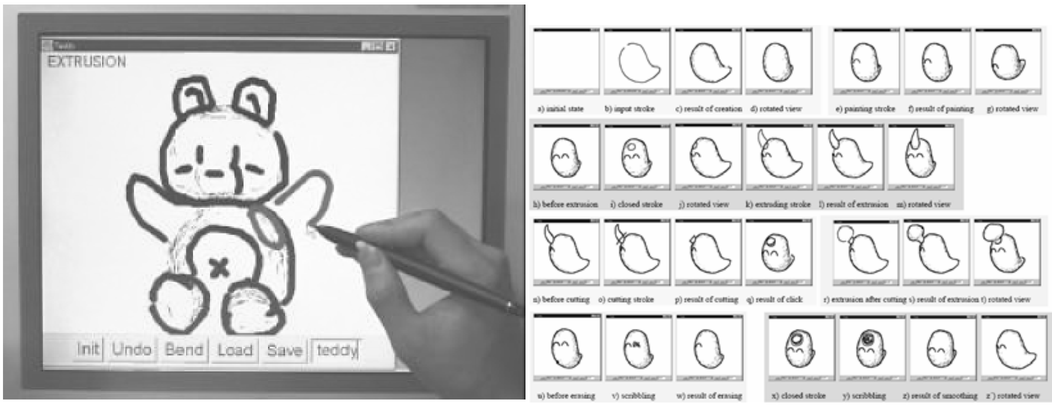

Figure 2.2.1: Project Teddy (Igarashi, 1999)

Space Pen (Jung and Gross, 2002) is a web-based system that allows any participant in a design project to 'walk-through' the work in 3D and annotates it with location-specific text comments (like post-it notes) or by drawing directly on the 3D model (Figure 2.2.2). Space Pen's 2D (in 3D environment) sketch recognition supports gestural commands to modify the model. Space Pen also allows quick generation of form in space by creating, and then drawing on temporary translucent surfaces. Comments and drawings are stored on a server for later review by others. Space Pen combines several ideas that individually have been previously demonstrated—annotation of 3D models, drawing on 3D surfaces, gesture recognition and 3D form generation, and immersive spatial walkthroughs. Space Pen's contribution is integrating these four components in a system to support asynchronous design collaboration.

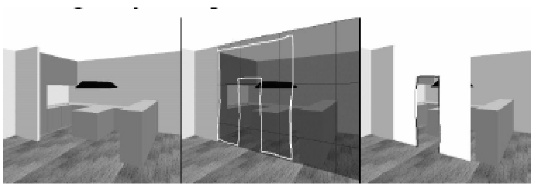

Figure 2.2.2: SpacePen (Jung and Gross, 2002)

2.3 Evaluation of design

Trancik (1986) brought out the thought that much architecture nowadays still doesn't have a good relationship with its environment.

To avoid the situation that the design doesn't fit the site, designers have to do some effort during the design process: evaluation. With traditional media, designers may draw on the tracing paper that has the photo of the site under it. By doing that designer can sketch directly on the scene and evaluate the design while in the conceptual stage. Some designers also used to use image processing software such as Photoshop to evaluate the result (Figure 2.3.1).

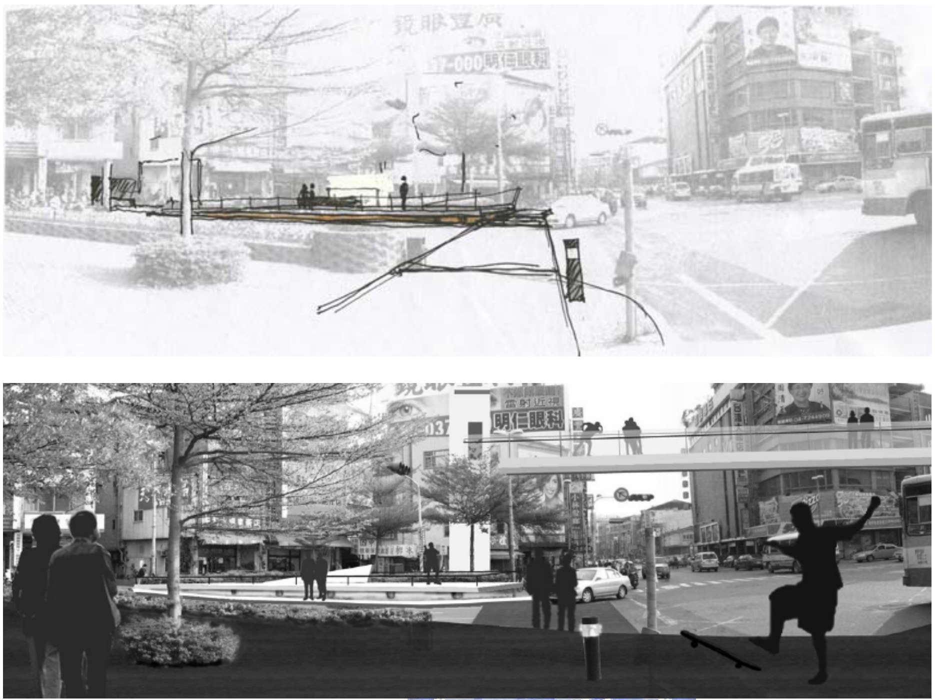

Figure 2.3.1: Designers sketch on the photo of the site.

In Industrial design, Balcisoy (2000) presented a new framework in Augmented Reality context for rapid evaluation of prototypes before manufacture. The design of such prototypes is a time consuming process, leading to the need of previous evaluation in realistic interactive environments. They have extended the definition of modeling object geometry with modeling object behavior being able to evaluate them in a mixed environment. Such enhancements allow the development of tools and methods to test object behavior, and perform interactions between real virtual humans and complex real and virtual objects. They proposed a framework for testing the design of objects in augmented reality context, where a virtual human is able to perform evaluation tests with an object composed of real and virtual components.

Figure 2.3.2: a new framework in AR context for rapid evaluation of prototypes before manufacture (Balcisoy, 2000)

For constructing spaces in virtual 3D space, researchers in University of Illinois at Urbana-Champaign developed a system called ShadowLight (Leetaru, 2003). ShadowLight is a virtual reality application that provides a spatially immersive environment for rapid prototyping and design. Rather than restricting users to the fixed toolkit of artistic or construction-centric manipulators of traditional systems, it provides a novel degree of flexibility by supporting a plugin architecture that allows the designer to utilize high-level components as the design media. Through this architecture, developers can create new functionality that integrates seamlessly with other elements in the ShadowLight framework. Each plugin provides its own interaction and simulation logic, allowing plugins that support static brush strokes to coexist with animated objects and complex physical simulations. Once a plugin is created, it may be used as an element on the designer's palette to be freely utilized as the media for creation. A given design created in ShadowLight may consist of interactively drawn static brush strokes and polygonal elements side-by-side with interactively placed intelligent agents and physical simulations. ShadowLight provides a consistent and intuitive interface to this functionality, seamlessly integrating the differing media into a single design environment.

Figure 2.3.3: ShadowLight (Leetaru, 2003)

To help modeling integrate with the environment, Piekarski (2003) presents new interactive AR techniques for modeling on the site. They presented a series of new augmented reality user interaction techniques to support the capture and creation of 3D geometry of large outdoor structures, part of an overall concept have been named construction at a distance. They use information about the user's physical presence, along with hand and head gestures, to allow the user to capture and create the geometry of objects that are orders of magnitude larger than themselves, with no prior information or assistance. Using augmented reality and these new techniques, users can enter geometry and verify its accuracy in real time.

Figure 2.3.4: New interactive AR techniques for modeling on the site (Piekarski, 2003)

2.4 Augmented reality

Augmented Reality, which blends the virtual and real within a real environment (Azuma, 1997), is a trend to integrate virtual and real world. Looser (2004) presented new interaction techniques for virtual environments. Based on an extension of 2D MagicLenses, they have developed techniques involving 3D lenses, information filtering and semantic zooming. These techniques provide users with a natural, tangible interface for selectively zooming in and out of specific areas of interest in an Augmented Reality scene. They use rapid and fluid animation to help users assimilate the relationship between views of detailed focus and global context. As well as supporting zooming, the technique is readily applied to semantic information filtering, in which only the pertinent information subtypes within a filtered region are shown.

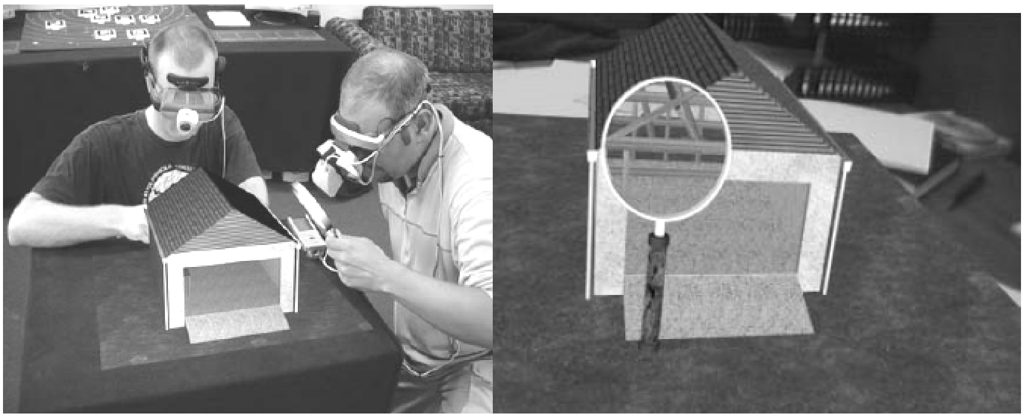

Figure 2.4.1: MagicLenses (Looser, 2004)