3D 素描筆:創新虛實空間結合互動裝置開發與應用展示

zPen 3D Sketch: Development and Application Demonstrations of an Innovative Interactive Device bridging Real and Virtual Spaces

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"zPen 3D Sketch" is a new human-computer interface/device aimed at bridging the real space of a user and the virtual space inside a computer display screen by an easy to use and affordable approach. By holding this 3D Sketch pen, a user can "stick" a "virtual end" of the pen "into" the virtual 3D space "inside" the computer display screen and operate by absolute 3D positioning to draw 3D curves and shapes or interact with 3D images.

The motivation of the "zPen 3D Sketch" comes from difficulties in drawing and designing 3D free curves using existing input devices. Mouse, 2D or 3D, operates based on relative positioning on a plane or in a space separate from display screen and can become very non-intuitive in designing 3D free curves. Force-feedback input devices, such as Phantom Omni [1], also operates in a separate space and is expensive. Virtual-Reality system, e.g. [2], provides immersed 3D visual and positioning capability but becomes inconvenient for designers using papers, physical models and other computer works at the same time, not to mention the fact that 20-32% of the population does not have full stereoscopic depth perception [3].

The operation of the zPen is similar to using a pen on a touch display but has a 3rd dimension that connects the two sides of the computer display by coordinate mapping. Therefore a user operates the zPen in absolute positioning sense in 3D, which is direct and intuitive. Potential applications include digital design and art sketches in 3D, 3D game design, digital sculpting, interactive arts and augment reality.

This project modifies a zPen prototype, which was developed earlier, and develops a "3D Sketch" software prototype using Unity game engine. Mechanical improvements made the zPen move smoothly in response to 3D hand movements. The software prototype now allows 3D free curve sketch, color selection, save/recall function and simple geometry generation. Designers in the Dept. of Arts and Design of the NTHU will test a second prototype to explore new ways of creating designs and arts.

References

[1] Phantom or Touch products of 3D Systems, see https://www.3dsystems.com/haptics (accessed Oct., 2020).

[2] Gravity Sketch official website https://www.gravitysketch.com/.

[3] W. Richards W., "Anomalous stereoscopic depth perception", Journal of the Optical Society of America A 61(3): 410–414, 1971.
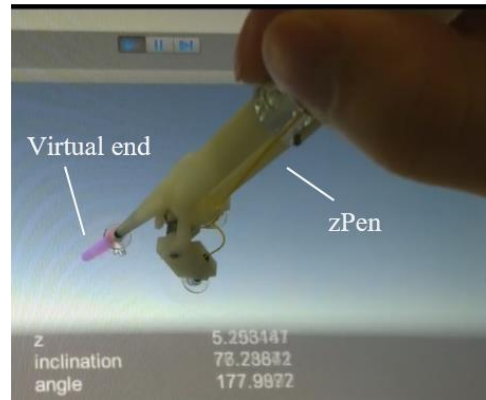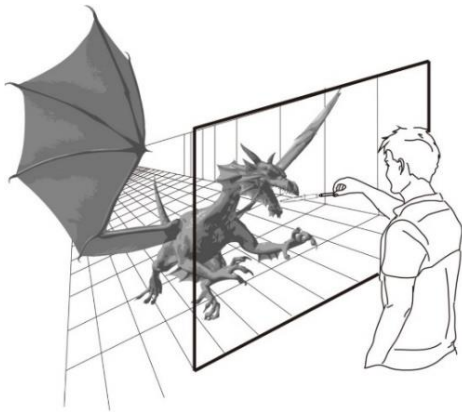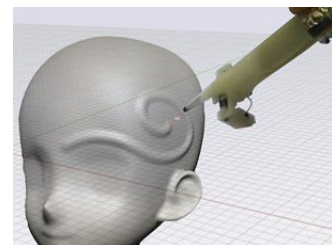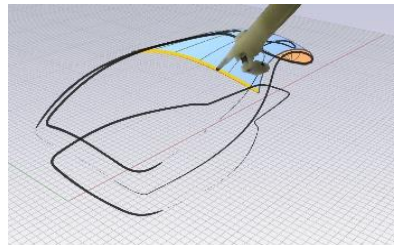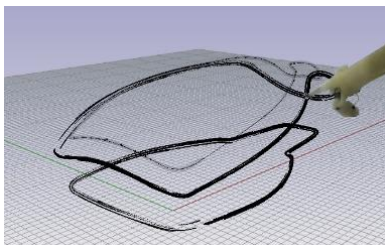
Idea and basic concept of the zPen as a new human-computer interface
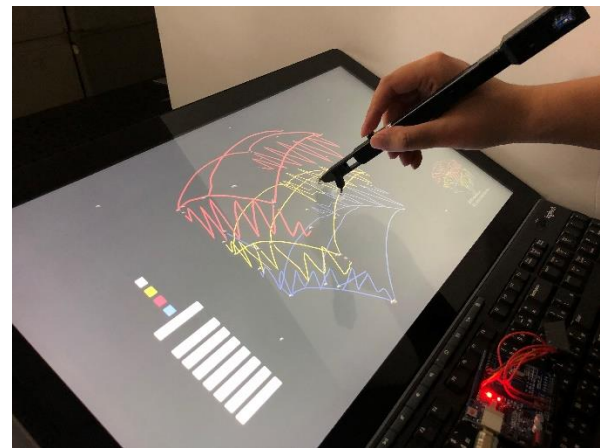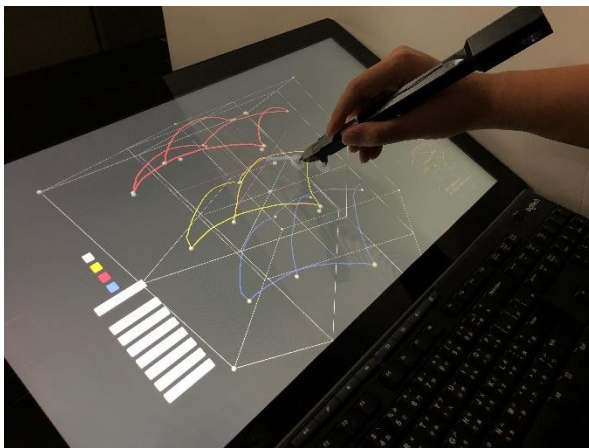
Current zPen 4.1 system and 3D Sketch 1.1 software prototype in operation
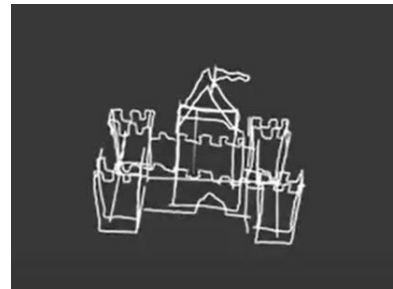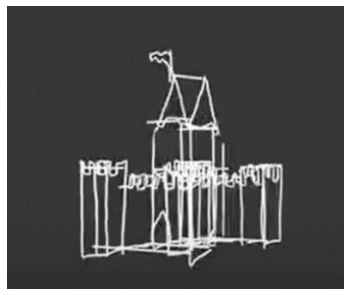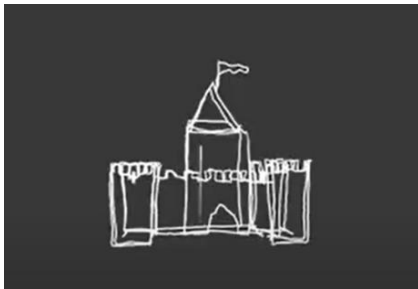
A 3D castle sketched using the system shown from 3 different view points

One goal of on-going development is to make a plug-in to a commercial 3D design software