The CUBE: examples and research challenges in mega-screen interaction

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Abstract
The CUBE at QUT is an ultra-high resolution display and interaction system covering over 160m2. In this position paper we describe the impressive scale of the physical space and the IT installation, briefly introduce the range of interactive content available, and discuss the unique opportunities that the CUBE offers to explore large scale, collaborative interaction and visualization. www.thecube.qut.edu.au/

Author Keywords
Large screen displays; collaborative interaction; visualization; virtual worlds.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
The CUBE at Queensland University of Technology is a two-storey visualization space, offering 50m2 of accessible interactive touch walls, and 110m2 of projection space.

Figure 1. The CUBE, Zone 1 & 2, showing the Virtual Reef.

Zone 1 and 2 (illustrated above and below) is comprised of 20 Multitouch MT553 touch panels (1080x1920), 4 Panasonic projectors (2x (3840 x 1751)), 20 wide range loudspeakers, under each panel, and 2 dipole speakers for ambient audio.

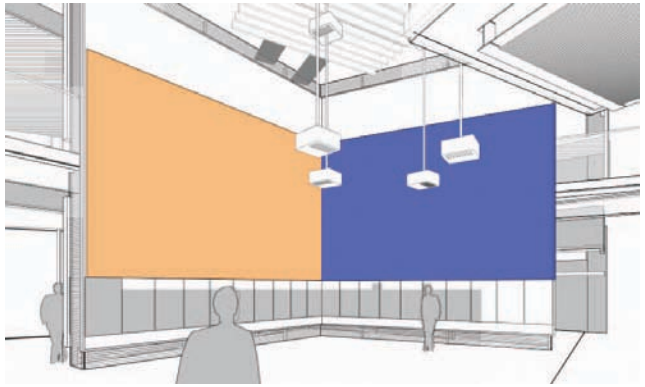

Figure 2. The CUBE, Zone 1 & 2, screen and projector layout.

On the facing single height walls, called Zone 3 and 4, are 12 (x2) Multitouch MT553 touch panels (1296x1920), 3 Panasonic projectors (5470 x 1170), 12 wide range loudspeakers, under each panel, and 2 speakers for ambient audio.

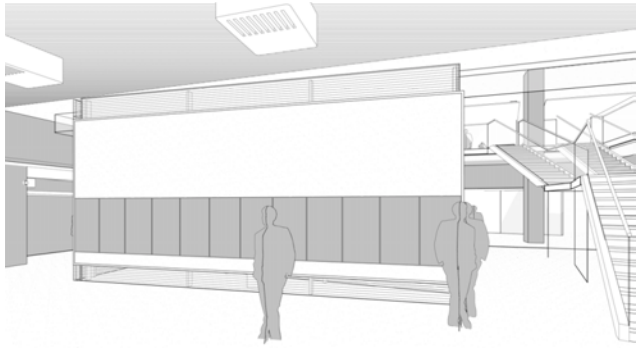

Figure 3. The CUBE, Zone 3 layout.

On the upper floors, also single height spaces, are further combinations of panels and projectors. Zone 5 has 4 Multitouch MT553 touch panels in landscape mode, (7680 x1080), 2 Panasonic projectors (3030 x 1200), 4 wide range loudspeakers, under each panel, and again, 2 speakers for ambient audio. Zone 6 offers projection only, with a blended image across the full single height wall.

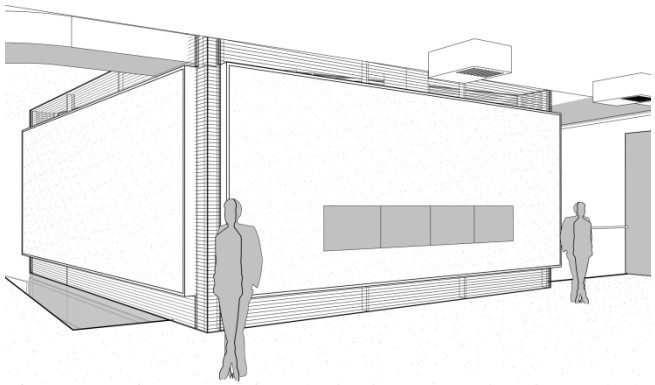

Figure 4. The CUBE, Zone 5 layout.

The computer infrastructure supporting all this interaction and visualization is also impressive. With a total of 48 High Definition displays, and 14 projectors, each two panels has its own SGI Super Graphics workstation. With the server requirements, there is a total of 64 dual 4-core Xeon CPUs.

The Multitouch panels are not actually 'touch'. The screens track fingers and hands through infrared image processing.

The Content

A number of video presentations of the CUBE content is available on youtube.

The Virtual Reef
http://www.youtube.com/watch?v=lBv4S4ogXdE

The Physics Playroom
http://www.youtube.com/watch?v=Tj92_36M4rg

A range of content has been developed for this installation. Two examples are offered above, via youtube. Other examples include the Flood Wall; an interactive map based exploration of the recent devastating floods in Brisbane.

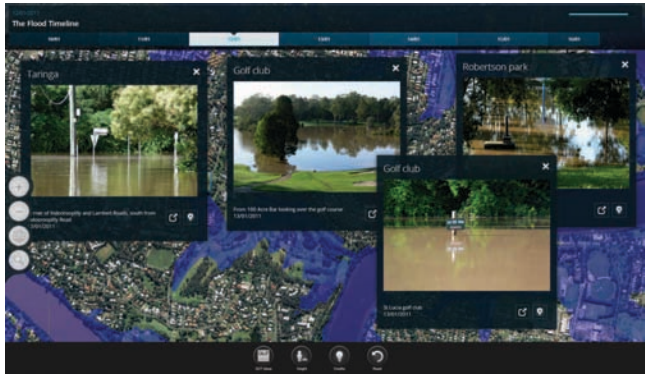

Figure 5. The CUBE 'Flood Wall' interactive screen design.

And Cubit, a touch gesture based personal presentation tool.

Figure 6. Interacting with 'CuBIT'

The Design Challenge

Each of these content projects can be seen as partially responding to the design challenge that large scale interaction and visualization presents.

The Flood Wall initially presents a map of the Brisbane River, covering the CBD and country. This wall of information is 8m wide, and 1.5m high. There are sections of the display that indicate to the user that they can select locations by name, that they can choose a particular day to view, and that they can get further information on design responses to floods, ect. And yes, it is Google maps, so users soon discover they can pan and zoom using two fingers. But with regard to the interaction paradigm; it is no different from a web page, point and click. Here it is point and touch, and swipe to zoom out, etc.

With the Virtual Reef, a new challenge emerges. How do we interact with such a large 3d virtual world? A virtual world that is digital and yet has a strong physical presence? The digital models in this world are all viewed at effective life size. When the Blue Whale swims into view with a calf, at full size, it is almost overwhelming in scale.

A glass screen offers users a two dimensional wall as a barrier into this very engaging world. There is point and hold, there is swipe to attract the fish; there are web base panels that appear and give you information on each of the species and more. The "glass wall of the aquarium" is your physical reference, but it is also a digital display surface.

Does this interaction design allow the user to really engage with this 'mega-touch', body sized interactive display? Although many people can stand together, the experience is still a solo exploration. Researchers have looked at body centered interactions in 3d immersive worlds, and questioned the nature of the body in 3d virtual worlds for some time, [1,2]. Although 'the CUBE' overs a unique blend of the virtual and the physical, and there is a large body of work on 3d interaction techniques, we have a long way to go in exploring these modalities in the Virtual Reef.

The Research Challenge

For the moment, the user cannot 'move into' that world, either virtually or physically. They are held at the front of the stage (or the fish tank glass), using simple hand gestures on a 'touch' surface.

The Physics Playroom starts to challenge this paradigm. Various 'virtual machines' can be controlled; the audio wave generator by hand size wheels, the sky and gravity by a medieval era model of the solar system. Here, multiple large scale and small-scale gestures are the norm. Blocks can be lifted and thrown across the 'room'. Users can work together, in this virtual world, to build the pieces high. The range of physics exemplars can all interact in this virtual room. Light, sound, fluid dynamics.

Is this the beginning of understanding what this technology offers? Collaborative interaction into a digital world, on a body scale? [3,4,5].

Figure 7. Students using the CUBE.

Figure 8. The official opening of the CUBE, March 2013.

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