3d, a new dimension for interaction

Essay for Ambient Screens by Pieter Pelt.

Abstract

We are on the process of a revolution in interaction. One that fits neatly in the row of indicator lights to screens and black and white to color TV. I am talking of course about 3d input and output of media. In this essay I will discuss some history of interaction, to see how it will build up to full 3d. What the current situation is and how our lives are going to change in the future with new and revolutionary ways of interacting with the digital world.

The past and present

The first and second dimension.

Interaction started with the simplest form of indicating. The binary indicator, 1 dimensional, on or off, be it a line on paper, a candle or the indicator light. The indicator light allows for a quick check if something is enabled or not. A step up from this is the 2 dimensional screens. In essence an array of indicator light, but mostly used to display pictures or characters instead of using the actual pixels as indicators. The first screens where used to display pictures, like most new technologies usually to a larger group of people. This is because of their cost and bulk. Throughout the years screens have become less bulky and cheaper. This has led to that there is a TV in almost every household. Only later screens where cheap and small enough to be used in a large range of applications: kitchen appliances, watches, phones, clocks and other more 'indicating' applications than actually showing a picture. Small 2D screens have become ambient. They are everywhere and everyone is used to them.

Input devices have also become 2 dimensional. The input analog of the indicator light is of course the switch. But there are several technologies that allow for two dimensional inputs. One of the technologies we use every day for 2D computer input is the computer mouse. It enables us to give an x and y location on the screen as input. The same holds for track pads and tablets. Photo and film are also 2d input, but then more analogous to screens. Where a screen outputs an array of pixels, cameras capture the real world in an array of pixels. This information is usually displayed back on screens, or sometimes used for analysis to generate other forms of data.

3D displays

3D media has been around for a while, but it is all based on providing each eye with its own 2D image. Thus fooling the brain into thinking you are watching at something 3 dimensional. Be it red/cyan glasses, polarized glasses, active shutter glasses or TVs with the polarizing layer build in, you are still watching at two 2 dimensional images. This is the inherit fault with current generation 3d screens. There is still no real xyz data presented. This is also the reason that 3D screenings are often described as uncomfortable and distracting. The viewer can't focus where he or she wants. For some people the effect doesn't even works. This could all be solved with true 3D screens described in the next chapter.

There are also several 3d input devices; again there is a distinction between cursor like devices and devices that provide data over a range on the axes, instead of just a point. The cursor like devices often comes in the form of 3d mice, which captures its position in 3d by mechanical sensors, accelerometers and multiple infrared reference points. The Nintendo Wii controller, for example, is a form of 3d mice, as its relative 3d position is used as a gaming element
The more analogue to screens input devices are LIDARS (Light Detection And Ranging). These devices use for example a pulsed fast moving laser to scan the environments depth. Combined with a camera this allows for the 3d capture of an environment, abide from one point of view. The kinect controller from Microsoft is also a form of LIDAR, but the kinects projects an infrared laser grid and uses the distance between the points to calculate how far an object is.
Other forms of 3D capturing include medical imaging devices like MRI and CT scans. These devices, although with vastly different techniques, record 3D objects as a series of very thin slices and uses software to create the volumetric shape.
An inherent problem with capturing 3D data is that it is impossible to do from one point in space. With such a setup you can only see on side of objects, and objects might overlap and cast 3D shadows that are black spots on the sensor. Solutions for this would be to use more sensors, and move them around until every part of the environment is covered.

New and emerging technologies

Screens that do provide true 3D are perhaps LED cubes. These 3 dimensional arrays of indicator LEDs are capable of showing objects in 3D, just like a screen is capable of showing a picture in 2D. Although recognizable shapes can be created, the resolution stays low and the cube appears very cluttered, this is because when you are using 3D space there is no space left to hide the wires and connections.

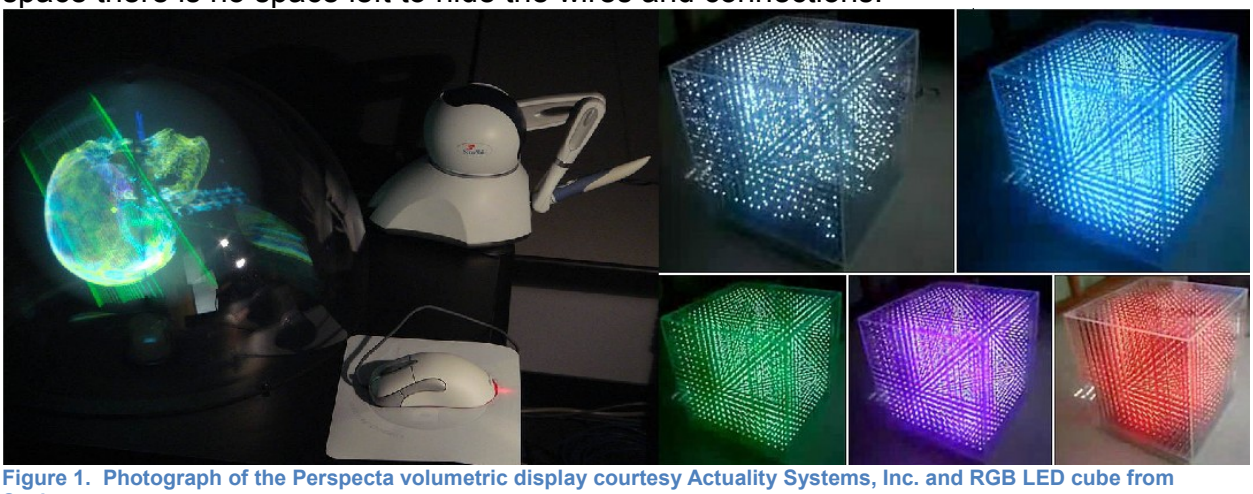

Figure 1. Photograph of the Perspecta volumetric display courtesy Actuality Systems, Inc. and RGB LED cube from Seekway

Other techniques include fast moving mirrors and prism to show planar cross sections very fast. For example the Perspecta volumetric display:

> *Every second, approximately 6,000 planar cross-sections of a 3-D volume are projected onto a spinning diffuser in the Perspecta volumetric 3-D display (made by the former Actuality Systems, Inc.). This is a 10" (25 cm)-diameter volume-filling image of an external beam radiation oncology image for brain cancer.*

This technique is a kind of reverse of the medical imaging technology. Instead of capturing the 3D object with many 2D cross-sections, the 3D object is displayed using many 2D cross-sections.
A problem that all 3d screens encounter is the amount of data that is needed for the 3D image is far greater than the data required for an image on a 2D screen. This results for the LED cube in a vast amount of data pins required, and for other techniques in a large file size to store the data.

With the release of the kinect and the subsequent hacking of it within 3 hours after the release the kinect has brought a cheap LIDAR to the hacking community. Spawning numerous new applications for these kinds of sensors, ranging from robot ‘eyes’ to real time video control. This has led to a situation where we currently have easier access to 3d sensors than 3d screens.

The future

One day full 3D displays will be invented. This will revolutionize the way we interact with media. If we for example want another viewing angle, we just go there. Or move the 3d object in space, abide via gestures or maybe even though control. Staying realistic of course 2D screens will coexist next to the real 3D counterparts. If you are sitting on a couch, there is no need for a full 3d display if you are staying in the same place. Just like we still use indicator lights and not give everything a 2D screen now. 3D displays could also be used to overlay real world objects with a 2d layer of information.

The world of truly ambient screens

Once we have mastered true 3D holographic displays in such a way we can mass produce them at low costs and energy isn't a problem anymore these screens will be everywhere. Think for example in advertising, you are standing in the supermarket, and the can of cola you just picked up is now displaying a commercial hovering above the can. Reviews floating in midair above books and other forms of media that you might want to purchase. Calling someone could perhaps go from a projector from you hand, or just projected in front of you. Whole building facades could be projected. If they would ever be indiscriminate from the real worlds no one will be able to tell what is real or not. Did the attractive person that just walked past really took an interest in you, or was it just advertising? Would it ever come to this point, the distinctly definable reality as it is today would not exist anymore. This could be a quite wonderful or very, very dangerous society.
Another interesting effect would be that all historic events would be recorded as they were. There would be no debate anymore to what really has happened. Conflicts would not start on false believes and accusations.
User interfaces would also need to change. The current generation is either based on 1D buttons with lights, 2D xy interfaces such as a button on screen and a mouse click, 2D captures of the real world and subtracting information from that (video monitoring) and 3D gestures to execute commands for 2D screens. With full 3D screens and input users will have to interact with these screens in a whole other way. Possibly via 3d xyz interfaces that use the position of a reference point such as your hand or finger to navigate, and gesture based commands for performing an action. Maybe even we will have Brain Computer Interfaces and don't need silly gesture based controls for our media.

Conclusion

In conclusion, we are living in the times where 2d screens start to become ambient and 3D screens are getting more popularity in the general public. We might even see true 3D screens in a matter of years, as they already exist in laboratories. Today's society is very focused on 2D media, but that is all about to change when the real 3D screens will start to appear. Information could be displayed anytime and in anyway in 3d space. GUI's will take forms that we can't even predict right now. And society will be even more information based than it now is.
We are on the brink of a major information overhaul of society, and I personally can't wait for it to happen.

Sources:
General information gathering:
http://en.wikipedia.org/wiki/3D_display
http://en.wikipedia.org/wiki/Volumetric_display
http://www.lucente.us/career/syn3d/volumetric.html

The Perspecta display:
http://www.actuality-medical.com/Perspecta.html
The large RGB LED cube:
http://www.seekway.com.cn/