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Optimal Font Size

Character Sizing for Large-Scale Display

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This paper explores the minimal optimal character size to use for text and numerical data for large-scale display* based on viewing distance and the appropriate font size to use when creating or formatting custom content.

Introduction

A recent white paper: *Visual Space in the Control Room*, published in the November 2009 issue of vuPoint[1], examined human visual space and visual acuity as it relates to choosing the optimal display technology in terms of pixel density and overall size, to match operator viewing positions.

The focus of the paper was on pixel size which is critical to making the appropriate core display technology buying decision. However, in a control room environment, operators don't look at pixels; they look at a mix, typically, of data and video sources.

The next step to consider is the optimal character size to use on your display wall for text and numerical data. And if you are tasked with creating or formatting content, what font size should you use?

Character Sizing

The Visual Space white paper looks at human visual acuity which is angular: someone with 20/20 vision or appropriate corrective lenses should be able to see, in their central three degrees of Foveal vision, a pixel approximately one minute (1/60th of a degree) of the visual arc across. To optimally match viewing technology to the viewer, the display pixel size/density should approximately match the viewers' visual acuity. Being angular means that the actual pixel size will depend on the viewing distance.

The same holds true for character size. The minimum readable character height is 16 minutes of the visual arc, optimal character height (i.e. the minimum character size that can be *comfortably* read) is 20 minutes of the visual arc.

<insert an illustration here>

(Click here to read the CALS Performance Specification: MIL-PRF-87268A or visit http://www.dt.navy.mil/tot-shi-sys/des-int-pro/tec-inf-sys/cal-std/doc/s87268a.pdf)

Calculating Viewing Distance

To calculate the minimum distance to comfortably read characters at a specific viewing distance, use the Optimal Character Height for Viewing Distance is / 172, which derives from a trigonometric function. For example, if the operator viewing distance to a large screen in a control room is 12 feet (144 inches), divide this number by 172 and the optimal character height should be 144/172 = 0.84" high. The same formula can be used for all display types and viewing distances.

An administrator could simply scale the content windows until character size was right, but it would be far more efficient to be able to use the appropriate font size when programming or formatting the data to be displayed. There are two additional benefits: content windows can exactly fit one or more component displays, and be displayed 1:1 (pixel for pixel). Scaling the content after the fact can result in visual artifacts, except when scaling by an integer amount, i.e. x 2, x 3 or x 4.

If one has selected a display with a pixel size approximately corresponding to one minute of the visual arc of the viewer then a character height equivalent to 20 minutes of the visual arc is 20 pixels high.

Font Size and Pixels

Now let's examine the relationship between font size and pixels. Under Windows OS the font size is 25% smaller than the vertical pixel count. Using the Mac OS the relationship between pixels and font size is 1:1.

So if the display (pixel size) itself is already optimally scaled for viewer distance, the character size, to be comfortably read, should be at least 20 pixels high or 20 x .75 = 15 point font size. (or 20 point if you are using Mac OS).

But what if the display pixel size/density itself is *not* optimally scaled for viewing distance? Can the best font size to use be calculated? Yes, as long as one knows the display pixel size and actual viewing distance.

Let's say you have a 65", 1920 x 1080 pixel panel. The display height of a 65" 16:9 (HDTV) aspect ratio panel is 65" x 0.495 = 32.18". So each pixel is 32.18" / 1080 = 0.03" high (and wide).

Using the formula developed in the other white paper (pixel size / 0.00029), 'optimal' viewing distance for a 0.0.3" pixel size is 0.03 / 0.00029 = ~ 104" = 8 ft 8 in. And indeed at 8 ft. 8 in., the optimal character size would be 20 pixels high and one would therefore use a font size of 15.

Typically display pixel size is not perfectly matched to viewing distance, but you still want the font size to be a perfect match. If the viewing distance is greater than 8 ft. 8 in., then characters would logically need to be in a larger font size than 15. If closer the font size would be smaller. But by how much?

Use this formula to determine optimal font size (in Windows OS):

Optimal Font Size = (Optimal Pixel Size / Actual Pixel Size) x 15.

We know that actual Viewing Distance x 0.00029 = Optimal Pixel Size and we have already calculated the actual pixel size (screen height / vertical resolution in pixels).

So let's assume the 65" panel is being viewed from 15 ft away = 180 inches.

180 x 0.00029 = 0.05" So Optimal Font Size = 0.05/0.03 = 1.67 x 15 = a font size of 25.

For panels, this calculation is simple, but if you are using a matrix of seamless projection cubes or near seamless LCD panels you might want to display the content across multiple displays, so make sure to factor the magnification into your font size calculation.

Example: you did the calculation for a single 67" SXGA+ cube. Screen height is 40.2 inches. (SXGA cubes are 4:3 aspect ratio so screen height is the diagonal of 67" x 0.6.) There are 1050 vertical pixels per cube so pixel size (height) is ~ 0.04". At the same 15 ft viewing distance, Optimal Font Size is now 0.04/0.03 = 1.33 x 15 = a font size of 20. But if you are creating content in the same 1400 x 1050 SXGA + format, but want to magnify and display across four cubes, then you would need to use a font size of 10, not 20.

Please note: in vectored SCADA display, view ability can be further constrained by font legibility. Whereas modern computer fonts are perfectly legible down to a very small font size most vectored SCADA fonts are quite crudely drawn and become quite illegible in terms of basic character recognition at less than 8-9 pixels of character height, even when viewed close up.

[1] http://www.activu.com/news-and-events/VisualSpaceintheControlRoom.html

*Valid for all screen sizes, including desktop displays