WHITEPAPER

Optimal Character and Font Sizing for Video Walls and Other Control Room Displays

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Introduction

In Part 1 of my white paper *The Future of Control Room Visualization* I explore human visual space and acuity with a more detailed explanation of human visual acuity in the addendum.

In my white paper *Optimizing Visual Display in the Control Room* the focus is on pixel size: matching the display pixel size to the visual acuity of the viewer, 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 video wall and other displays, for text and numerical data. And if you are tasked with creating or formatting content, what font size should you use?

Character Sizing

To optimally match viewing technology to the viewer, the display pixel size/density should approximately match the viewers' visual acuity: which is 1/60th of a degree, i.e. one minute of the visual arc. Being angular means that the necessary pixel size to match our visual acuity will depend on the viewing distance.

The same holds true for character size. The minimum easily readable character height is 16 minutes of the visual arc and the optimal character height is 20 minutes of the visual arc.* (This contrasts with the absolute minimum readable character height of 5 minute of the visual arc when looking at a Snellen eye chart.)

However, whereas the optimal pixel size is matched to the closest viewer, the optimal character size should be matched to the furthest viewer.

To avoid the need to convert any units of measurement, the formulas below all adjust for the fact that pixel size/ pitch is typically measured in millimeters and (diagonal) screen sizes in inches, globally, while in the USA viewing distance is measured in feet.

Calculating Viewing Distance

To calculate the optimal character height for a given maximum viewing distance, simply divide the viewing distance (in feet) by 14, or to be even more exact divide the distance in inches by 172. (This is a trigonometrically derived factor).

Optimal Character Height (in inches) = Viewing Distance (in feet) divided by 14

For example, if the maximum operator viewing distance to the videowall in a control room is 25 feet, divide this number by 14 and the optimal character height should be ~1.8" character height. The same formula can be used for all display types and viewing distances.

However, if the required density of information requires a smaller font, the smallest advisable character height is 16 minutes of the visual arc and the factor is then 18 (or slightly more accurately 215 if you convert the distance to inches).

Smallest Character Height (in inches) = Viewing Distance (in feet) divided by 18.

So in the above example the calculation would be 25/18 = ~1.40" character height.

** See page 30 of the US Department of Defense MIL-Spec: MIL-PRF-87268D, revised September 2014*

An administrator could simply scale the content windows until character size was right, measured on the screen itself, 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 slight visual artifacts.

Pixel Size

Next step, one needs to determine or calculate the pixel size of the display (or in the case of a video wall the component display). Hopefully you have that information to hand, but otherwise in my white paper: Optimizing Visual Display in the Control Room I explored different display formats and how to easily calculate the pixel size, so long as one can determine or measure the diagonal screen size in inches, and know the graphical format (resolution/aspect ratio).

4:3 Aspect Ratio formats:

XGA (1024 x 768)
SXGA+ (1400 x 1050)

Screen Size (in inches) mutiplied by 20 then divided by Horizontal Pixels = Pixel Size (in millimeters).

16:9 Aspect Ratio formats:

WXGA (1,280 x 720)
HD (1920 x 1080)
UHD: '4K' (3,840 x 2,160)

Screen Size (in inches) multiplied by 22 then divided by Horizontal Pixels = Pixel Size (in millimeters).

16:10 Aspect Ratio formats:

WUXGA (1,920 x 1,200)
WQXGA (2,560 x 1,600)

Screen Size (in inches) multiplied by 21.5 then divided by Horizontal Pixels = Pixel Size (in millimeters).

So for an SXGA+ 67" (diagonal) projection cube the calculation is: 67 x ~20 = ~1,340 divided by 1,400 = ~ 1mm pixel. A 55" (diagonal) SNB full HD LCD panel 55 x ~ 22 = ~1,210 divided by 1,920 = ~ 0.63mm.

Please note: two of these factors are rounded. 4:3 exact factor is: 20.32, 16:9 is: 22.1. Also, the above calculations are based on horizontal measurements, but since today virtually all display pixels are square, it doesn't matter if you measure horizontally or vertically.

These and other factors in this white paper take into consideration the common units used for each measurement: diagonal inches for screen size, feet for viewing distance, millimeters for pixel size/pitch and inches for character height. (Outside the US, distance and character height are measured metrically, but screen size is still commonly referenced in inches.)

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. (Under Linux the relationship between pixels and font size is quite variable between OS versions and even applications.)

So in the above two examples:

The 67" SXGA+ cube has a pixel size of approx. 1mm. Let's say the maximum viewing distance is 25ft, so as we calculated above the optimal character size will be 1.8", the minimum recommended: 1.4". So, what font size(s) will that need to be?

The font size will be the character height divided by the pixel height x 0.75. However, since the character height is typically calculated in inches and the pixel size in millimeters, we can come up with a factor that takes this into consideration.

Windows Font Size = Character Height (in inches) divided by Pixel Size (in millimeters) then multiplied by 19.

Mac Font Size = Character Height (in inches) divided by Pixel Size (in millimeters) then multiplied by 25.

So using 67" SXGA+ cubes, the optimal font size in Windows would be 1.8/1 = 1.8 x 19 = ~ 34, the minimum recommended font size would be 1.4/1 = 1.4 x 19 = ~ 27. With 55" SNB HD panels the optimal font size would be 1.8/0.63 = 2.86 x 19 = ~ 54. Minimum recommended font size would be: 1.4/0.63 = 2.22 x 19 = ~ 42.

As you would expect you would need a larger font, when viewed from a given distance, when using the LCD panels because each pixel is smaller.

This method can be used to calculate the optimal font size for any LCD, projection cube or LED display, including desktop displays. With front projection, not typically used anymore in control rooms, pixel size is variable: a function of the projection lens and distance.

It should also be noted that the above calculations are for content that is displayed 1:1, not scaled up or down. Also, please note that the DPI control in Windows must be set to 100% (Under Displays in Windows 7).

Paul Noble, CEO of Activu, is an entrepreneur with a unique blend of tech and business experience. He founded Activu Corporation (formerly Imtech) over thirty years ago in New York, making it the first company to develop and sell video wall technology in the United States. Born in London, Paul attended the London Film School and had an early career in film and television before moving to the United States. He later went on to receive an MBA from Columbia Business School. He can be reached at paul.noble@activu.com.