Quantum Automation TECH CORNER with Benjamin Russell Perry

June 1, 2010

Seeing Past the Glare:

Considerations, strategies and workarounds for increasing Human Machine Interface visibility in outdoor applications.

Introduction:

Today's Human Machine Interfaces (HMI's) are mostly touch LCD screens widely used in industrial settings to monitor and control applications from packaging to off-shore production, adding an important ease-of-use factor to projects of all sizes. About 94% of HMI's are used within factory settings, in environments conducive to easy readability, while the other 6% are outdoors. Unfortunately, moving an HMI to an outdoor environment throws a curveball at one of the most important aspects of an HMI – visibility. Multiple factors – the sun being the largest culprit – have negative effects on the readability of the display, creating the necessity for HMI's considered "Sunlight Readable." The purpose of this article is threefold: To examine what specifications make an HMI sunlight readable, provide strategies for potential workarounds when using a standard HMI in outdoor applications, and, presumably, help ease the transition from indoor to outdoor HMI applications.

Identifying the Dilemma:

In order to figure out solutions to degraded visibility, we need to pinpoint the problems and their causes. When an HMI is viewed indoors, the colors are clean, crisp, and, most importantly, visible. Outdoors, this is not always the case. Often, colors look washed out when viewed in sunlight, background and foreground begin to meld together as opposed to popping apart with contrast. This immediate degradation in color is an indicator of a low nit rating. (The term "nit" commonly describes the International System of Units' measurement for Luminance, which is officially the

candela per square meter [cd/m²]. In a word, *brightness*.)[1] Standard HMI luminance ratings hover between 150 and 350 nits. These screens will be comfortably visible indoors, and perfectly functional for mostly all indoor applications. Take one of these screens outdoors, however, and the instant change in visibility is dramatic. The sun produces an uncomfortable glare, veiling the information on the screen behind a layer of reflected light. This is caused by the greatly disproportionate ratio between the brightness of the screen (~200 nits) and the overpowering brightness of the sun (~60,000 nits)[2]. The overwhelming brightness has a definite hand in causing the low visibility on the screen, but through a different vehicle than one might think.

The luminosity of the sun actually serves to lower the *contrast ratio* (CR) of the images on the screen, rendering them hazy and unreadable. The contrast ratio of a screen is the luminance of the brightest color compared to that of the darkest color[3]; the higher the contrast ratio, the crisper the visuals on screen. Nit ratings become important here, because screens with lower ratings are more vulnerable to decreases in contrast ratio due to outside light sources. For instance, a screen with a nit rating of 200 has a contrast ratio of 300:1 in a dark room[3]. Because there is no other light to compete with the screen, the contrast ratio is extremely high, making for fantastic readability. The same screen, when viewed in sunlight, will have a contrast ratio of less than 2:1. To illustrate the severity of that point, text on a screen with a true contrast ratio of 1:1 would be impossible to decipher under any circumstances. Imagine trying to make out white text on a white piece of paper – it just will not happen, no matter how hard you squint.

Creating the Solution:

In order for a screen to be comfortably visible, a contrast ratio of about 5:1 needs to be maintained. Manufacturers hold differing opinions as to what nit rating will allow for a daylight readable screen, but the numbers tend to fall in the realm of 800 to 1500. A screen with a nit rating of 1500 is advertised to maintain a contrast ratio of 8:1 in direct sunlight, so it might be a bit overkill for many applications. Although the exact nit rating for daylight readable screens is a bit hazy, it is my opinion that 1000 nits will allow for comfortable viewing in most sunlight applications. You can see figure 1 that even 650 nits is fairly visible in the

Fig. 1 – Comparison of nit ratings in sunlight

daylight, but to get the true hue of the colors, you need to go a bit higher. Keep in mind different applications have different visual requirements.

Although this information will no doubt assist with the selection of future HMI's, there are also strategies that can be utilized in order to create better visibility with screens currently in use. A reexamination of color choice should be the first step. Images in the program, when possible, should contain contrastive colors. It might seem obvious, but it deserves attention. If color choice is questionable from the start, then the contrast ratio – an important factor in readability – has been limited not by the capabilities of the screen, but the choices of the user. (Using contrastive color combinations like black/white and blue/yellow is advisable.)[4]

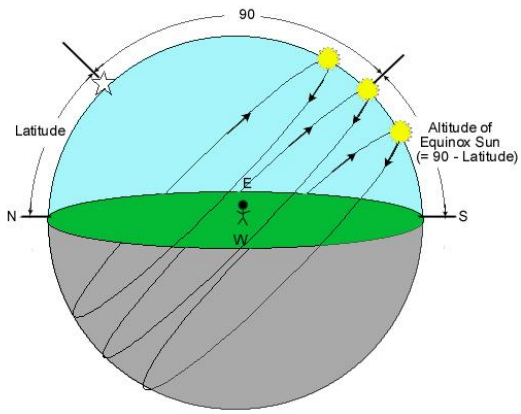

Fig 2 – Path of the sun

Unfortunately, users are not able to dim the sun to meet their needs, but they can use its known path to their advantage. Following figure 2, we can see that the axis of the sun's movement is aligned so that it actually tilts toward the south during the day, leaving clear skies in the north[5]. So, if it is possible to position the screen facing north, much of the competition from the sun will be eliminated from the start. If it is not possible to face the screen north, shrouds are also a popular workaround for eliminating competing sunlight. Mounting shrouds to shield the HMI from opposing light sources will result in a higher contrast ratio on-screen, increasing visibility as discussed earlier. If implementing a shroud is not desirable in a given application, anti-glare films are also available as overlays. It should be noted, however, that these workarounds are indeed *workarounds*, and have had differing levels of success for different people. The bottom line is, if a truly sunlight readable screen is a necessity, then you will want to focus on nit rating and maintaining a contrast ratio of at least 5:1 in order to get the desired performance out of your HMI.

Product Spotlight:

Pro-face currently offers two sunlight readable HMI units, 6 and 12 inch models, both rated at 1000 Nits. The 6 inch model, part number AGP3300-U1-D24, is the screen I used to test visibility in the Southern California sun, and it performed spectacularly. The images on screen were crisp

and vivid, and ultimately swayed my belief that a nit rating of 1000 is truly sunlight readable. The unit has a price tag of $2,045.00 list. The 12 inch model, part number AGP3650-U1-D24, lists for $4,075.00. (Please contact your QA Regional Sales Manager for special pricing opportunities.) Pro-Face plans to release more sunlight readable displays in the near future, but their units currently on the market should not be overlooked if the need for a high visibility HMI arises. Plus, with the technological power of current HMI units, you can consult with your QA sales representative on how to integrate SCADA (Supervisory Control and Data Acquisition) software into your application, allowing you to log and manage data of your choosing.

Notes

[1] "Candela per Square Metre." *Wikipedia, the Free Encyclopedia*. Web. 01 June 2011.

[2] Adaptive Micro Systems LLC. *Debunking "Brightness" Myths*. Adaptive Micro Systems LLC.

[3] "FAQ□s - Sunlight Readable LCD Monitors & Displays - Sunlight LCD." *All Weather Outdoor LCD/TV, Sunlight Readable Monitors, High Brightness Digital Signage - Sunlight LCD*.

[4] "Effective Color Contrast." *Lighthouse International*. Web. 01 June 2011.

[5]Freeman, Dan. "Altitude and Azimuth." *Www.oleanschools.org*. 13 Feb. 2007. Web. 2 June 2011. (Image Diagram of Sun's Path Taken From Same Source.)