About Low Contrast Acuity Test or Spot Test

Purpose

The purpose of this test is to provide an objective, quantifiable measurement of the user's ability to discern various low-contrast gray shades from the background. Discernment of low-contrast gray shades is important in several applications including medical imaging and satellite imaging. The test is dependent on the performance of several items, including the following:

1) The **Display**, including:
   a. Brightness
   b. Calibration (if any)
   c. Viewing angle
   d. Reflectivity
   e. Cleanliness
2) The **Ambient Lighting**, including:
   a. Overall ambient light level
   b. Presence of point sources of light (bright lights, white shirts, windows, sun, etc.)
   c. Reflection angle
3) The **User's eyes/perception**, including:
   a. Angle and distance to the eye
   b. Eye and concentration fatigue

The test can be performed quickly, at multiple times during the day, if desired. The performance can be established objectively by showing the success recognition rate for a particular digital driving level. This performance level can be compared over time, in various ambient light settings, and across different display platforms. It can provide confidence to the user that they are able to see and discern the level of recognition in one environment that they are used to seeing in another.

Design/Function

The browser-based version of this test is advantageous in that it can be used on any display device with access to a browser and the internet. The test can be used on a wide variety of display platforms, including medical grade displays and workstations, commercial grade displays, laptops, tablets, smartphones, etc.

The test places a known test spot in an unpredictable random location on the display screen. The user's job is to find the location of the test spot and click on the location using a mouse, touch screen, or other interface. If the user was correct in recognizing the location of the test spot, a green check mark appears, indicating success. The result will be recorded in the statistics and the spot will be moved to a new location. If the user was incorrect and clicked on the wrong location, a red X appears, indicating a failure to recognize the test spot. The miss will be recorded in the statistics and the spot will be moved to a new location.
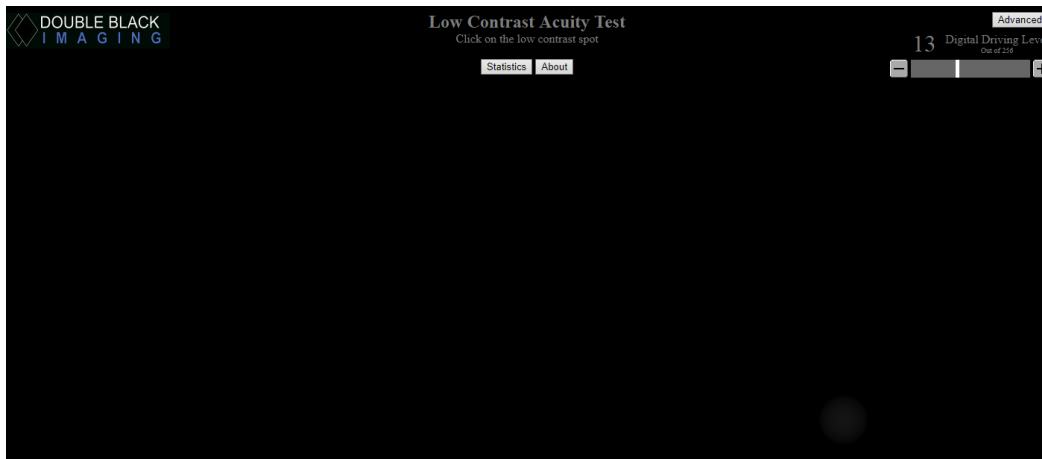
The spot is relatively small and round, with "fuzzy" edges (a straight hard edge is generally easier to discern).

The primary test uses a test area where the background is black (Digital Driving Level "0" out of 255, where white is 255). The test spot is a lighter shade of gray above black. The Digital Driving Level of the test spot can be adjusted by the slider bar (top right of above photo). The background can be adjusted only in the Advanced Section of Spottest.

Slider Bar

There is a slider bar in the upper right corner of the page. When the site is first entered, the default setting of the test spot is Digital Driving Level 13 (out of 255). This is representative of the 5% level used by other test patterns (see discussion below). The user can start clicking on the test spot at this level. If the test spot is not able to be seen, the user can adjust the brightness of the test spot by using the slider bar.

*User can click on a location on the bar to move to that point, can click on the "- "or "+" buttons on the ends of the bar, or click/hold/slide the bar to the desired location.

Tip: iPad users can use a "reverse pinch" gesture to enlarge the slider bar, make the adjustment, and use a "pinch" gesture to restore the original size.

The current Digital Driving Level of the test spot appears above the slider bar and changes as you move the slider bar. The maximum number is 32 (DDL 32 out of 256). The minimum number is 1 (1 DDL above 0, or black). There is a 5% mark along the slider bar, which notes the default location.

Statistics

As the user attempts to click on the test spot location, the number of hits and misses are recorded for each Digital Driving Level. By clicking on the "Statistics" button at the top of the page, the user is given access to these statistics. A table is presented with columns for the Digital Driving Level, Number of Hits, Number of Misses, and a calculated Success % rate. The user is also provided with buttons at the bottom of the screen to "Hide" the table, or to "Clear" the table of all data. Once cleared, the statistics are saved again starting from that point.

A user can view the table and quickly determine the Digital Driving Level at which they are having a high level of success, and the Level at which they are having difficulty, given the display and environment.

For example, in the data in the table below, the user would be confident in correctly identifying the test spot location when the DDL is at level 9 or higher. The user would say they could not identify the test spot location when the DDL is at level 6 or lower. And the success rate in level 7 and 8 is at 60% and 83% respectively.

The user could compare this objective data with the data produced in a different workstation, on a different device, or in a different ambient lighting condition, and have an objective way to make a performance comparison.

Low Contrast Acuity Test
Click on the low contrast spot

Statistics About

Level	Hits	Misses	Success
1	4	0	100%
3	3	1	75%
5	3	0	100%
6	9	2	82%
10	3	0	100%
21	3	0	100%

Hide   Clear

Comparison to other test patterns

1) **SMPTE**
There is a familiar 5% smaller square imbedded into a larger black background square in this test pattern. For years this has been a standard simple test – i.e. can you see the 5% square? The 5% square is at digital driving level 13 (out of 255). This is the same as the default location on the Test Spot slider bar which is marked by a 5% line and will display Digital Driving Level 13 above the slider bar.

2) **TG18 QC Pattern**
The American Association of Physicists in Medicine (AAPM) created the TG18 QC test pattern that includes a 5% square as well (at Digital Driving Level 13 out of 255). In addition, there are the letters in the words "QUALITY CONTROL" on a black background that start at DDL level 14 for "Q", 13 for "U", 12 for "A" and so forth, decrementing by 1 DDL for each letter until it gets to DDL 1 for "L".

The difference with the Test Spot test is the fact that the location of the test spot changes, so it forces a user to actually and verifiably be able to discern the low-contrast spot. In addition, the ability to change the DDL of the test spot and the statistics that record the performance, enable further refinement to assess how far a user can go on the DDL scale and be able to accurately discern the low contrast test spot.

How to improve your performance

There are several ways to improve the performance of your ability to discern the low-contrast test spot. We list some of them here, starting with the easiest:

1) **Clean your display** (Fingerprints especially on touch-screen displays like iPad tablets will reduce your performance, and similarly dirt and dust on all displays will reduce performance. Be careful of dust behind protective panels that cannot be cleaned.)

2) **Reduce the ambient light** (Anything to reduce ambient light will likely be helpful. Come inside, close the curtain, turn down lights, turn off lights…)

3) **Reduce point sources of light** (A lamp or overhead light may be a point source. Same with a bright white shirt.)

4) **Increase display brightness setting** (If your display is not set to its brightest setting already, turn it up.)

5) **Change the angle of the display** (Your display may have viewing angle dependencies, or there may be reflection from ambient light on the display that can be changed with viewing angle.)

6) **Calibrate your display** (If your display or graphics processor has the capability, calibrate the display for improved gray scale performance. Calibration per the Barten Model described in the DICOM 3.14 from American College of Radiology/NEMA will likely improve your performance in discerning low-contrast gray shades. If it has been calibrated once, verify, and recalibrate.)

7) **Reduce display reflection** (Be careful of buying displays where the front of the screen is highly reflective. Best performance is with nothing in front of the LCD panel. Touch screens and protective panels will increase reflection. If something in front of the display is absolutely necessary, specify anti-reflection and/or anti-glare properties and test if satisfactory.)

8) **Get a new display** (If the display is old, it may have lost brightness. Keep in mind the above considerations when buying a new display. Get a brighter display with good viewing angles. Test a new display with the Test Spot test before buying.)

Help

If you cannot see the test spot initially, try moving the slider bar all the way to the right (the Digital Driving Level number should be at 32). This is the brightest the spot can be. After finding and clicking successfully on the test spot, you can then move your way down to smaller Digital Driving Level numbers (dimmer test spot) and find the lowest levels where you can still accurately discern the test spot location.

If you are having additional issues, have questions, or would like to make a comment or suggestion regarding this test, please email: service@doubleblackimaging.com or call Double Black Imaging at 303-404-2222.

Advanced Tests

Advanced Tests are available through the "Advanced" button.

These include a mid-range background test, a white background test, an ability for the user to select both the background level and test spot level, and a random Digital Driving Level test.

Registration through the use of an active email and password is necessary to access advanced tests.

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