Alternative Image Viewing Devices

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Introduction:

Currently, there are several alternative devices available for viewing electronic images. This article attempts to discuss some of the pros and cons of such devices. The essential question is whether display devices primarily intended for content consumption can be effectively used for critical content evaluation and creation.

First, we need to examine: a) what are our motivations for viewing images b) what we expect to achieve in viewing images, and c) whether the device and environment for view images are compatible with our expectations.

There are many reasons for wanting to view an image, including:

1) Content consumption: e.g. Information, record of events, places or people, entertainment
2) Education for improvement of photos
3) Artistic and creative appreciation.
4) Image editing

For 1) image quality typically is not a high priority as long as the essential information, such as text or a recognizable person are there. This is the most common use for smartphones, tablets, laptop computers and TVs.

For 2), 3 and 4)) image quality can be of utmost importance. Our expectation here is that the image represents accurately what the maker intended. In viewing images for these latter reasons there are a number of considerations that can be broadly placed in three categories:

Objective: Technical qualities including: composition, lighting relationships, sharpness, noise, contrast range, colour range

Subjective: Aesthetic and/or artistic value, mood, story telling, impact or “wow” factor

Combination: Creativity, innovation, quality of execution

All of these qualities are important to evaluation or editing of an image, but display quality and the viewing environment strongly affect many of these considerations, particularly in the subjective and combination categories. The size of image, the colour and contrast range and subtle shadings of colour

or tone become quite important in the image assessment.

Viewing Environments

The image viewing environment is as important as the display quality in viewing and evaluating images for educational and artistic appreciation and in image editing. The ideal environment for such purposes is similar to that for viewing movies; that is a totally dark room. This kind of environment is also used by most photo clubs for projected still images to get the maximum contrast range and accurate colours as the image maker intended, provided that the image maker used a similar environment in viewing and editing their image. For the movie environment, the SMPTE standard for image brightness is 55 nits, whereas for photo editing monitors the recommended brightness is 100-120 nits in a darkened room.

Professional image and video editors ,as well as serious photographers, edit their videos or still images in a darkened room and can achieved close to the maximum contrast range and colour accuracy as a fully darkened room. Professional image editors and serious photographers also use displays larger than 21" diagonal and with calibrated colour gamuts suited to the end application. If the end application is for Internet use and electronic displays, the standard for colour gamut is sRGB. If the end application is printing an image, then the Adobe RGB colour gamut is preferred.

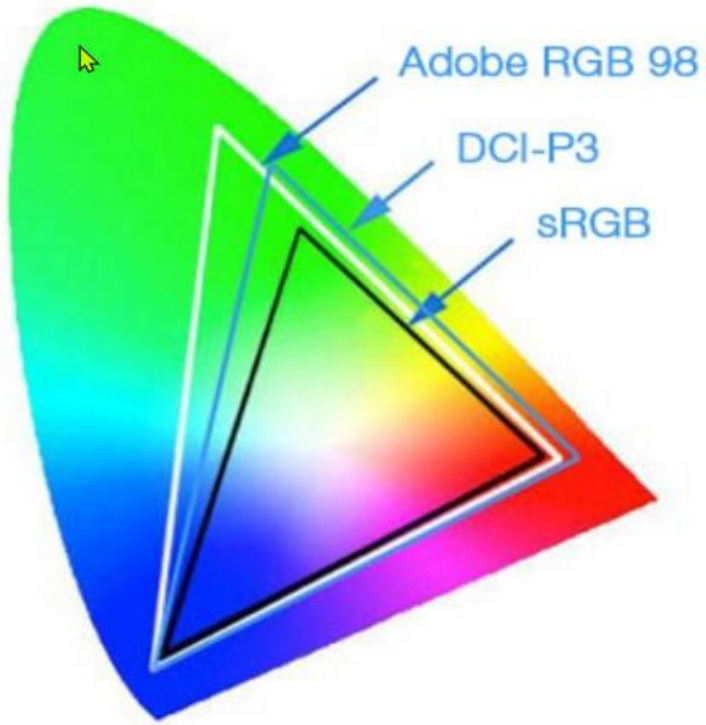
With the wide availability of electronic image viewing devices, other than video or still image projectors, many people are using devices such as smart phones, tablets, laptop computers and even TV screens in relatively bright environments to view images. These devices are mainly used for content consumption. Regardless of the display device, the main problem with using any kind of a device in a bright environment is reflection from the surface of the display. Uncoated glass reflects about 4 to 5% of the light incident on the glass. Anti-reflection coating are typically not used on devices such as smartphones because such coatings are too fragile. These reflections cause a number of problems, including: reduction in contrast range of the image, desaturation of colours and creating a colour cast on the image

In a bright environment, the reflection from the glass surfaces of the display can substantially reduce the contrast range, desaturate and alter colours and create a colour cast on the image. In fact in bright sunlight, the light reflected from the sun can be greater than the maximum brightness of the display and an image can not be seen on the display. This also applies to the LCD screen on the back of digital cameras. Even in less bright environments such as open shade or in a brightly lit room the reflection from the glass surface of the device can significantly reduce the contrast range from say 1000:1 In a fully darkened room to less than 30:1 in a brightly lit room or in open shade. Likewise, colour accuracy, particularly subtle shading of colour is greatly affected. This means that image evaluation criteria such as mood, aesthetic value, and impact can be seriously affected and no serious judgements on these criteria should be made in bright environments. These comments also apply to images viewed on TVs in non-darkened rooms.

Display Quality

Display quality is driven largely by the market place and competition. Both of these factors dictate that manufacturers cater to the perceived largest market and the peculiarity of those markets, rather than in small specialized markets, such as serious photographers. The result of all this is smartphones and TVs tend to have better quality displays than laptop computers. People tend to buy the cheapest laptop computers as the primary purpose tends to be to view information such as a social media site , documents and messages. These cheap laptop computers tend to have poor quality displays with low contrast ratios, a poor range of colours(colour gamut) and inaccurate colours. Contrary to popular belief, calibration can not fix these issues as the problems are inherent in the laptop display. Most laptop screens have a narrower range of colours than the sRGB Internet standard, whereas most smartphones and modern TVs tend to have a P3 video colour gamut which exceeds the sRGB colour gamut and is close to the photographic Adobe RGB colour gamut.

The figure below pictorially show a comparison of the colour gamuts mentioned above.



The outer ellipsoid represents the colour range extent of human vision. Note that the sRGB colour gamut covers less than half the range of colours of human vision. This also means that fully saturated colour can not be presented in a sRGB compliant display. Most laptop computers, and cheap tablets, laptop computer and TVs do not cover even the sRGB colour gamut and typically only cover 60%

to 70% of the sRGB colour gamut. This means that users of these devices are depriving themselves of the full visual experience obtainable with a device with a larger colour gamut.

The best kind of displays tend to be OLED displays that are found in many smartphones and better quality TVs, but are almost non existent in desktop computer monitors and laptop computer screens.

One of the problems with the displays on most smartphones, laptop computer and TV is the following. All these devices are intended for use in relatively bright environments rather than in darkened rooms. For bright environments the default screen brightness must be bright enough to try to overcome the screen reflection from the ambient light and all of these devices typically have brightness levels from 200 to 1000 nits - much brighter that the recommended brightness level of 100-120 nits for a computer monitor in a darkened room. Unfortunately, most people do not alter the screen brightness for use in a darkened room. This excessive brightness can destroy the mood, aesthetic value and impact of an image. Consequently, such devices should not be used at the default brightness for critically evaluating images in a darkened room; that is, to visually achieve the colour accuracy, and contrast range and accuracy that the maker intended. So if you are going to try to evaluate photographic images for educational or artistic purposes on a casual basis, you should turn down the brightness. Some display devices measure the ambient brightness and can automatically adjust the display brightness.

Another consideration in using alternative devices for viewing and evaluating images is the size of the display. Small screens such as smartphones and small tablets may be OK for display of information and to depict a record image, but usually are not really suitable for critical educational and artistic use, partly because the immersive feel of a larger image is missing. Also, images primarily intended for small display devices have enhanced(exaggerated) contrast, colour saturation and sharpness partly due to image processing for small devices and partly because the device operating system has been set up to enhance (excessively) contrast, colour saturation. and sharpness. This is also true for many TVs set-ups as many people mistakenly think that high contrast, high colour saturation and edgy sharpness represents high quality, but in reality this is actually the opposite. In addition, many TVs are too large for the viewing environment as the image can not be seen in its entirety without scanning.

Display Calibration

Smartphone and TV manufacturers attempt to manufacture display screens that conform to the P3 video gamut. Most manufacturers of laptop computer and desktop monitors generally do not use display panels that conform to a quality standard such as sRGB, Adobe RGB or P3. Calibration can not convert a non-compliant screen into one that complies with one of the colour gamut standards for images or videos. So in buying a computer system, whether it be a laptop computer or a desktop computer, it is vitally important that the screen be at least sRGB compliant. If the colour gamut compliance is not listed in the computer system specifications, it is most likely that the display is not compliant with any of the standards, in particular, the minimum sRGB Internet standard.

Even if one buys a computer system that claims to be compliant to a colour gamut standard, such as sRGB, variations in the manufacturing process means that for truly accurate colours, the screen must be calibrated using a high quality hardware calibrator, such as the Datacolor X Elite or Xrite i1 Display Pro.

Unfortunately, user calibration of the screens on smartphones, tablets and TVs is not possible because the manufacturers of these devices disallow any such operating system enhancements. So the only image controls are things like brightness, contrast and colour saturation but not colour accuracy.

Apple mobile devices have an additional complication caused by their color tone feature which is turned on by default. This feature is intended to overcome the color cast caused by reflection of ambient light from the screen and hence, the apparent white balance. This means that the image colour changes according to the device environment. For example, you would likely see different color casts if you wore a bright red sweater versus a bright green sweater. While this color tone feature can be turned off, the screen reflections in bright environments still persist.

Below is a summary of the pros and cons of various image viewing devices.

DISPLAY TYPE	PROS	CONS	COMMENTS
Cheap smartphone or cheap tablet	Low cost	Likely to have poor contrast and colour ranges. Calibration can not fix these problems	Not suitable for critical viewing/evaluation of images for photographic education or artistry
High quality smartphone or tablet	Likely to have a P3 compliant colour gamut	Operating system enhances contrast, color saturation and sharpness Can not be calibrated; hence colour and contrast accuracy can not be adjusted.	Default brightness too high for darkened room Small screen limits usefulness for critical education or artistic evaluation. Editing operations are global – may be suitable for social media , but precise local adjustments are difficult

Cheap laptop computer	Low cost	Likely to have poor contrast and colour ranges Calibration can not fix these problems	Not suitable for critical viewing/evaluation of images for photographic education or artistry
High quality laptop	Choose a laptop computer with a screen with sRGB, Adobe RGB or P3 compliance, i.e. compliance must be listed in the laptop specifications An OLED screen is highly desirable for large contrast and colour ranges	Cost – likely more than $1500. Screen still needs to be calibrated.	Default brightness too high for darkened room – need to reduce brightness in a darkened room Small screen size may limit usefulness for photographic educational, artistic evaluations, image editing. Serious photographers attach a large external monitor to the laptop to overcome the large screen problem and to gain the colour gamut and contrast range afforded by a photographic quality monitor.
Cheap desktop display	Low cost Usually comes “free” as part of the computer system	Likely to have poor contrast and colour ranges Calibration can not fix these problems	Not suitable for critical viewing/evaluation of images for photographic education or artistry
High quality desktop monitor	Some or all of sRGB , Adobe RGB and P3 colour gamut may be available. Colour gamut compliance must be in the specifications OLED screens are desirable but not widely available	Expensive but the monitor is the most important component in the computer system.	Needs to be hardware calibrated for best colour accuracy. Should be used in a darkened room. Should sit far enough away to avoid having to scan the image. Best device for image editing and for critical evaluation of images for photographic education or artistic appreciation

Cheap TV	Low cost	Likely to have poor contrast and colour ranges. Can not be calibrated	Not suitable for critical viewing/evaluation of images for education or artistry
High quality TV	Available in multiple sizes Most likely to have P3 colour gamut compliance	Can not be calibrated on the TV for increase colour accuracy. Default settings are too bright, too much contrast and too much colour saturation	Use Movie mode to get best colours and contrast range for photos. Need to reduce brightness if room is darkened. Need to sit far enough away so that the image does not have to be scanned. Wide colour gamut TVs tend to be less expensive that wide colour gamut colour monitors and so some people use a TV as their computer monitor, but the brightness needs to be reduced and the screen calibrated using a hardware calibrator with the computer used to drive the TV. One must also sit far enough away from the screen to avoid having to scan the image.

Summary

For critical viewing, editing and evaluation of photographic images a high quality desktop monitor, compliant to end use colour gamut standards and fully hardware calibrated is recommended as is viewing, editing and evaluation of images in a darkened room.

Inexpensive smartphones, tablets, laptop computer and TVS are unlikely to have high enough quality display screens to critically view images for photographic education or artistry and for image editing. Users of such devices are depriving themselves of the full aesthetic, artistic and educational content of an image.

Higher end smart phones typically will have good colour gamut, but the operating systems is usually set up to enhance image contrast, colour saturation and sharpness, all of which are detrimental to critical viewing and evaluating images for photographic education and artistry. In addition, the small image size does not allow the immersive experience that a large display provides.

Smartphones, tablets, laptop computers and TVS are primarily intended for content consumption in bright environments and the default brightness is too high for critical viewing of images

in a darkened room for photographic education or artistry. Likewise image editing results will be adversely affected.

The images on large screen TVs may be too large for proper image viewing and evaluation in a small room. However a quality TV can be used as a computer monitor provided that the brightness is adjusted and the screen hardware calibrated with the attached computer.

Acid Test: Take some of your images that express mood, aesthetic value or high impact and first look at the images on a large calibrated, colour gamut compliant monitor in a darkened room. Then look at the same images on your proposed viewing device and proposed environment to determine if you feel that the aesthetic and/or emotional appeal has been preserved, and then decide if the device is suitable.

Conclusion:

If you want consistent and accurate viewing of photographic images then your best choice is a large, calibrated monitor in a darkened room. However for casual, non-critical viewing of images, devices intended for content consumption and entertainment can be used with caution not to make critical judgments, especially in the default way in which these devices are commonly used.