Imaging the Moon for the Public — Howard L. Cohen

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Using a telescope to output an image to a TV monitor provides many advantages for public viewing over observing through a conventional eyepiece. Although this adds to the cost and complexity of the observer's equipment, some may already own the necessary gear

On 2010 May 22 the Alachua Astronomy Club (AAC) brought out telescopes for public viewing at Kanapaha Gardens' annual Moonlight Walk. The AAC has a long history of public viewing at this event. However, the AAC had not done this outreach program since April 2004 when Kanapaha Botanical Gardens suspended this popular event, which often drew more than 1,000 visitors. Kanapaha Botanical Gardens has now brought back this widely popular event. We hope this recent will encourage the Gardens to continue scheduling future Moonlight Walks.

During this recent event I continued experimenting with using an electronic telescopic image of the Moon for public viewing rather than having guests view the Moon through an eyepiece. This video method used a Canon digital single lenses reflex (DSLR) camera with a HD output attached to a telescope to show an image of the Moon on a 22-in. LCD TV screen. Technical details for those interested are in the box below.

Technical Details. A DSLR camera (Canon EOS 5D Mark II) without any lens was attached to a 127-mm aperture TeleVue f/5.2 APO refractor (660 mm focal length). A TeleVue 4x Telenegative lens was used to increase the telescope's prime focal length to 2640 mm.

This focal length is nearly the maximum to image the entire disk of the Moon with this camera, which has a full-size 35 mm sensor, or 24x36 mm. Most SLRs have sensors 50–70% of a full size 35 mm frame. Therefore, a focal length of about 2640 mm would crop part of the lunar image if used with these smaller sensors. In addition, using the camera's 5x or 10x Live View magnifier simulates high and very high powers.

I personally find viewing a video image less satisfying than a direct view that yields a bright, sharp high contrast image of the Moon. A psychological factor also enters with direct viewing through an eyepiece. The mind seems to recognize that one is viewing or seeing an actual or real image of the object and not a photograph or electronic reproduction. Allowing the original light photons reflected from the Moon to enter the eye directly gives one a feeling like "really being there."

Nevertheless, the video method has several distinct advantages for the inexperienced guest observer over directly viewing the Moon with an eyepiece. Inexperienced observers may look but not see much when looking through an eyepiece. Such viewers may only look for a few seconds, perhaps utter a "wow," and then quickly

turn away having seen little. Directing an inexperienced observer peering through an eyepiece to find and see particular features on the Moon can be frustratingly difficult. No such problem arises with a video image. A video image makes it is easy to point out and describe lunar features while explaining their significance. And this can be done for several people all at once without each taking time to look through the eyepiece—a big time saver when long lines of people persist.

In addition, some people, especially beginners, the very young, elderly or physically challenged, may have difficulty observing through an eyepiece. Small eye relief (distance from eyepiece lens to eye) may restrict the viewing field, especially with eyeglass wearers. The focus may not be perfect for each person and astigmatism in their eyes may distort the image.

Furthermore, high power viewing is even more difficult for many, especially for those burdened by excessive floaters in their eyes, which can become very conspicuous at high powers and make it almost impossible to view the image. However, using the camera's magnification buttons allows higher power views without any of these problems. Also the magnification can be increased or decreased in almost an instant without fussing with different eyepieces. Changing eyepieces may move the telescope or require refocusing the telescope. Consequently, changing magnifications using different eyepieces when doing public viewing is often inconvenient.

Therefore, low power viewing is often best for public viewing. However, "high magnification" using the video image is now quick and easy, an advantage for guests who otherwise might have trouble viewing at high powers.

What Magnification? People often ask what magnification is being used? This is easy when viewing through an eyepiece. (Recall *visual magnification* is focal length of telescope ÷ focal length of the eyepiece.) If the visual magnification is 50x, the Moon, which appears one-half degree wide to the naked eye, will look 50 times larger, or appear 25 degrees across.

However, specifying magnification when using a video image is more complex because the size of the Moon on the TV monitor now depends on your viewing distance from the screen. For example, the lunar image on the 22-inch monitor was 10 inches tall, almost filling the screen's height (using the author's previously described setup). So, when one viewing the TV screen from approximately 24 inches distance, the Moon looked about 25 degrees across, or the equivalent of a visual magnification of 50x. If the camera's magnification button is pressed to enlarge the Moon 5 or 10 times more, the equivalent visual magnification would become 250x and 500x respectively. High power viewing is now possible with no effort! (Of course, poor "seeing" from turbulence in Earth's atmosphere limits detail.)

Morever, those in wheel chairs, who might find it difficult or impossible to view through a telescope's eyepiece, can now observe like everyone else. I was thrilled at the Kanapaha Moonlight walk when several people in wheel chairs were not only able to listen to my explanations but also could view the Moon despite their disabilities.

Figure 1. The Kanapaha Moonlight Walk Waxing Moon. Even a quick snapshot of the Moon by the author still shows many features that even beginners can see when pointed out on TV monitor fed by a camera attached to the telescope. (Can you find Rupes Recta? Valles Alpes? etc.) Also see Fig. 2.

Finally, the setup was used on a bright object (the Moon). However, use of video capture equipment especially designed for low light level work (e.g., the Mallincam) can also increase the sensitivity of the telescope. So, images can now become visible that might otherwise require a larger aperture instrument. Such equipment can thus display deep sky objects to groups of people. A small telescope can thus reveal details in clusters, nebulae and galaxies for outreach events while one points out interesting features in the object on the TV screen.

Interestingly, not everyone realized the image on the screen was real thinking the displayed image was a photo. So, I sometimes jiggled the scope to show it was a realtime image! I also pointed to the blurring motion from mediocre *seeing*. All this added to the thrill of seeing a "live image." Moreover, showing that a simple click of the shutter could capture a picture excited some guests, especially when the photograph replaced the real image on the TV screen.

Figure 1 shows such a result—the Kanapaha Moon many of us showed our guests. Keep in mind no particular precautions were made to produce a great picture (as refining focus, locking the DSLR's mirror up to prevent vibration, or taking multiple images). My objective was simply to illustrate simple lunar photography. Still, the results amazed most people.

Although Figure 1 is not a high resolution lunar photo, this image clearly exhibits several features I hope we showed visitors at the Kanapaha Moonlight walk. Besides obvious craters and their characteristics (as rebound peaks, flooded floors, terracing and ghost craters), this photo shows more subtle features guests would have missed if not easily directed toward them on the TV screen. These included Tycho's rays, nonuniformity of the Mare basalt, the Alpine Valley (*Valles Alpes*), the Alpes and Caucasus Mountains (*Montes Alpes* and Montes Caucasus), and the Straight Wall (*Rupes Recta*).

Can you find them?

Directing people to these features, if they were looking through an eyepiece, would have been more difficult. (Having a simple Moon map or photo by the telescope can help but can still frustrate beginners trying to follow your directions.) Although I personally prefer

eyepiece viewing for my own pleasure, video viewing the Moon remains an alternate and satisfactory method for public viewing.

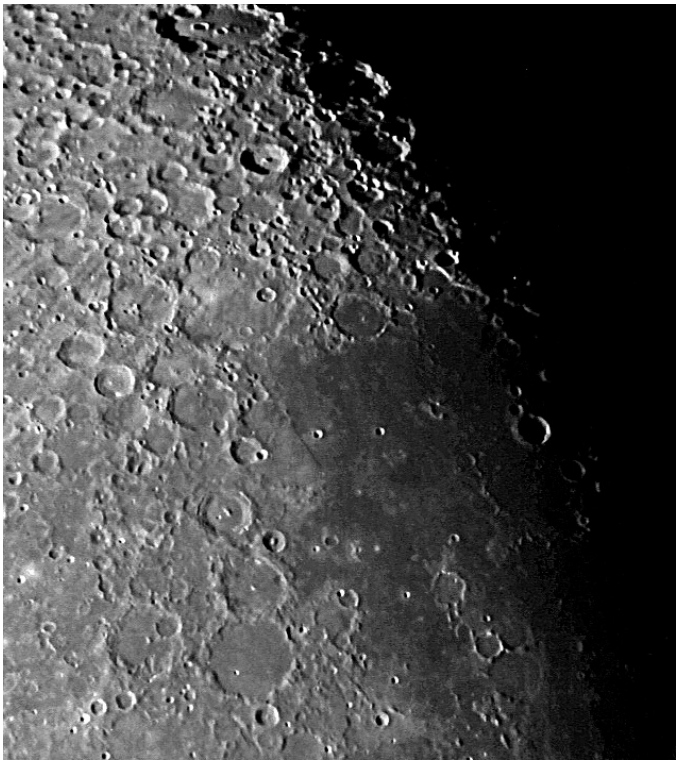

Figure 2. Rubes Recta. This enlargement from Fig. 1 clearly shows the “Great Wall” near the center to this imate, an approximate 70 mile long, 1000 ft. high linear fault line. This narrow line is made visible by its shadow. Viewing this image on a TV screen makes it easy to point out this remarkable feature.

Obviously, any video method adds complexity, requires a power source for the monitor, and increases one’s expenditure for equipment. However, I used both a conventional DSLR camera and a LCD TV originally purchased and intended for other uses so I incurred no additional costs.

Watching live TV images of celestial objects brings both joy and educational value with the ability to point out important and exciting features to a group. Add the capability of astronomical imaging and both outreach and private observing take on new meaning. Add advanced video equipment specifically designed for astronomical viewing makes this method even more tempting for those willing to spend a little extra time and money to enhance the observing experience. ☼