Increasing Public Outreach in Astronomy through Digital Imaging Technology. M. Fauerbach[1], M. P. Lucas[1], M. J. Mon[1], and S. Schonberg[1], [1]Florida Gulf Coast University, College of Arts and Sciences, 10501 FGCU Blvd., Fort Myers, FL 33965-6565.

Abstract: One of the major goals of President Bush's education reform initiative is increasing public knowledge and interest in Science, Technology, Engineering and Mathematics (STEM). This is reflected in the amount of available funding for improvement in STEM education from the National Science Foundation. Astronomy has become an interdisciplinary science that combines aspects of Physics, Chemistry, Biology and Mathematics, and it is also at the forefront of Technology and Engineering (CCD cameras, opticaldesign). This, together with the fact that interest in astronomy is very high, makes it natural to present astronomy as a tool to increase the knowledge and awareness of STEM in the general public.

There are drawbacks to the traditional public astronomy event; only one person at a time can look through a telescope. Due to the large crowds which can assemble during public events and astronomy classes, it is customary to have to wait in line for rather short glimpses of celestial objects. To compound this problem , small children often have difficulties looking through only one eye, and the eyepiece location makes viewing uncomfortable – or sometimes even impossible - for disabled or elderly people. The goal of this project is to alleviate these difficulties through the use of inexpensive, readily available digital imaging technology. By using such equipment we striveto simplify the wide dissemination and replication of the techniques discussed.

Introduction: The occultation of Saturn by the Moon on the evening of February 20, 2002 provided an ideal occasion to generate an enormous amount of public interest in astronomy. The fact that this was the last occultation of Saturn visible from North America until the year 2014 heightened public awareness of this celestial event. The appeal of this event was used to involve the public in discussions about astronomy (Saturn, Moon, celestial mechanics), technology (telescope design, engineering, digital imaging technology), and NASA's Cassini mission to Saturn. However, it also presented a dilemma: How could over 150 people participate and observe an event that would only last for approximately two minutes? Obviously, the typical "wait in line" approach would not be successful for this event. Possible solutions to this dilemma needed to be inexpensive, as no funds were available for the project. To increase the feasibility of widespread dissemination of the educational results, the solution should use innovative, but readily available digital technology. Displaying the astronomical event on readily available television monitors was a suitable choice, as these are owned by our target audience of school and community groups. Furthermore, large TV monitors could be utilized to point out interesting planetary features to a large group. An additional benefit of using TV monitors is that small children, as well as the elderly or disabled, are able to observe astronomical events in real time, without any of the difficulties presented by observing through an eyepiece.

Methods: With the advancement of digital technology, CCD (**C**harged **C**oupled **D**evice) cameras have largely replaced traditional film cameras in astronomy. Their higher quantum efficiencies and the ability to enhance the images with image processing software are among their advantages. Disadvantages include: a small imaging area (chip size), the need for a computer to download the images and the relatively high price. Furthermore, only grayscale images can be captured with these cameras; to create a color image, three separate images taken with RGB colored filters need to be overlaid. Recent developments in both digital (still) cameras and digital video cameras have bridged the gap between very expensive and extremely sensitive CCD cameras used in astronomical research, and digital cameras used by the general public to snap everyday pictures. For our current study we used a multi-tiered approach that included three distinct imaging devices already owned by the FGCU Astronomy Department. The devices are:

- SBIG STV: a hybrid design that combines traditional video technology and cooled integrating digital CCD camera technology.
- ASTROVID 2000: High-resolution, real time video system optimized for video astronomy.
- KODAK DC240: Inexpensive digital still camera for the everyday user.

Results: The goal of this project was to discover a way to accommodate a large and diverse audience for an astronomical event, while also, engaging them in Science, Technology, Engineering, and Mathematics (STEM) research and education. This task was accomplished using readily available and inexpensive digital technology. This equipment is easily portable, allowing the FGCU Astronomy Department to accommodate events held at other locations, such as at K-12

schools and community groups. This equipment is inexpensive, making it available for school and community groups to purchase their own equipment.

The response from the audience was very positive, and similar events are planned for the future. Furthermore, the study involving the Kodak digital camera provided outstanding color photographs of bright planets and the Moon. Despite difficulties focusing the telescope, the image quality was excellent. This technique provides an inexpensive, quick, and enjoyable way to engage high school and collegestudents in digital astrophotography. Undergraduate astronomy students can gain valuable knowledge in image processing with their own pictures, which also improves STEM education.

Conclusion: No digital image or photograph can replace the powerful experience of observing a celestial object through the telescope eyepiece. However, in certain situations, it is necessary to seek alternatives. Disabled people, as well as the elderly and children, may have difficulties observing through a telescope. Large crowds may make lengthy individual viewing impractical or unfeasible, especially for short-duration celestial events. The approach presented in this project was extremely successful in accommodating both a very large audience as well as people who would otherwise have had difficulty in participating in the observation of the celestial event.