ACIT: AN INTERNET-CONTROLLED TELESCOPE FOR ASTEROID AND COMET RESEARCH.
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Introduction: Life-threatening weather make traditional year-round astronomical studies impossible in North Dakota. To gain astronomical access to the sky during our long and cold winter nights we are developing a small observatory that will be completely controllable from anywhere in the world using a standard Internet browser. Although telescopes and CCD cameras are now available that can be remotely controlled, they are useless unless the entire observatory facility can be as well; thus we are addressing many issues such as meteorological sensors, roof, remote troubleshooting, security, etc.

We are developing the ACIT (Asteroid and Comet Internet Telescope) system with support from the North Dakota Space Grant Program [1] to expand research opportunities in the state. This facility will be used by faculty and students at various North Dakota educational institutions and also by students in 40 states and 15 nations enrolled in SPACE.EDU [2] our online M.S. program in Space Studies. As always, funding is limited and we have designed much of the facility using students and commercially available hardware. The design and implementation is a wonderful, if often frustrating, educational process.

The Facility: ACIT is located ~10 km west of Grand Forks in a remote location with minimal light pollution. A Meade LX200 16" Schmidt-Cassegrain telescope [3] is housed in a boxlike structure with a motorized roof which is opened to expose the telescope to the sky for observations. ACIT is equipped with a ST-8 CCD camera from the Santa Barbara Instrument Group (SBIG) for digital imaging [4]. To maximize resolution the SBIG AO-7 Adaptive Optics Accessory will be used to correct the telescope pointing during exposures. Observations can be made through any of four filters including red, green, blue, and clear which are housed in the SBIG Color Filter Wheel.

A weather station has been installed at the observatory to monitor local conditions. Temperature, wind speed, wind direction, cloud cover and precipitation levels are measured and read out to the computer display. Such information is critical for determining whether the environment is safe and/or favorable for observing. If conditions fall within acceptable ranges then the user may proceed to operate the telescope.

For security purposes an alarm system has been installed to deter vandalism and other criminal activity since the telescope is unattended during operation. If laser beams, projected approximately one foot above the floor of the observatory, are intercepted, an alarm is activated. We are immediately notified by an automated phone call of any security problems at ACIT. A Connectix camera [5] within the observatory provides visual confirmation of the telescope position.

Operations: All of the logistical operations are controlled with LabView software [6] and Virtual Instruments (VIs) which are small programs we wrote to ingest data, evaluate it, and issue commands to servomotors. The telescope is directly connected to the ACIT PC computer located at the observatory, and controlled through the software programs "The Sky" and "CCDSoft" from Software Bisque [7]. "The Sky" displays celestial objects on a virtual sky map as an interface for the user to control the pointing of the telescope. "CCDSoft" controls the CCD camera and allows filter selection. From the ACIT computer at the observatory all this software can be operated to control logistics and telescope /camera operation. To allow Internet users the same control we use the program "PCAnywhere" [8], which allows a distant observer, through a web page, to completely control all software running on the ACIT PC computer.

An observer's first step is to check weather conditions at ACIT using the VIs. If conditions are favorable, the user confirms that the telescope is still in the horizontal stowed position using the Connectix camera and then proceeds to open the observatory by activating the VI which then rolls open the motorized roof. The CCD camera and telescope are then turned on, and "The Sky" and "CCDSoft" are started. Users now have direct control of the telescope and camera and acquired images are directly downloaded to their web browser.

Future Research: ACIT will be used primarily for the study of asteroids and comets. We plan to routinely image all visible comets brighter than 19th mag to look for possible brightenings or other changes. Similarly, we will routinely observe Chiron and other bright Centaurs looking for evidence of coma. Near Earth Asteroids (NEA) will be a major focus of our studies. We plan to search for new Atens at 30-40 degrees from opposition [9], to do followup astrometry for NEAs discovered by others, and to attempt photometry of brighter NEA and comets to determine rotation rates. A second significant research goal is to develop ACIT as a prototype for a worldwide network of Internet telescopes that will permit 24 hour observing of phenomena, and daytime observing, using telescopes on the night side hemisphere. The same control capabilities would be appropriate for controlling telescopes on the Moon.

References: [1] www.space.edu/spacegrant [2] www.space.edu [3] www.meade.com [4] www.sbig.com [5] www.connectix.com [6] www.natinst.com/labview [7] www.bisque.com [8] www.symantec.com [9] Boattini, A. and Carusi, A. (1998) *Vistas Astron. 41*, 527-541.