RIT Observatory Projects Fall Semester 2018

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***Abstract*—The RIT observatory currently does its best to host numerous students with the limited faculty and resources they possess. There is a plethora of smaller projects that would greatly improve the ability of the observatory while providing engineering experience to students in the realm of control systems, opto-mechanics, and instruments. This would also allow students to become familiar with the various equipment the observatory has to offer. The over arching wish of the faculty at the observatory is to complete a fully automated dome control, so that remote observing would become feasible. This task has been started, but is still missing a robust feedback system, some mechanical interfaces, and software interfacing with the telescope protocols. Select projects have been proposed for completion in the 2018 fall semester.**

I. Introduction

RIT SPEX has direct ties to the RIT Observatory though one of the primary advisors and a mutual interest in astronomy. Despite this, both groups have had little collaboration. The RIT SPEX Astrodynamics team has some equipment that is measurable to the equipment in the observatory, but has trouble with operation and lack of experience. The RIT Observatory has a need for students to work on engineering projects, which RIT SPEX Astrodynamics can provide. RIT SPEX has always had members interested in observing using various telescopes, but these members have little training. There have already been projects that gave the team insight into the equipment behind observing. These include: building and modifying a rolling mount for its 12" Meade telescope, building mounts for an Orion sighting scope, building a barn door camera mount, and general maintenance on all telescopes. The team is looking for more projects similarly to expand their skill sets.

II. Primary Objective

There are three projects selected to be worked on in the fall semester. These projects are the first steps towards improving the observatory's capabilities and a convenient fully functioning automated dome system.

A. Roll Off Motor Repair

The observatory has two domes, yet one is not very widely used because of the system to remove the roof. The current system is a hand crank which rolls the entire roof off of the structure. This is inconvenient and must be done with two people. Years ago, a motor system was installed so that the crank system would not be needed. This motor system was deemed too fast by RIT Safety and forbidden to be used. The faculty at the observatory would like to use this dome more frequently and believe this would be possible if the motor is repaired, slowed down, and a warning system installed. Work is currently being done to assess the state of the motor and SPEX students would take over where this is left off.

B. Latch Arm Repair

In an attempt to start the automation of the primary dome at the observatory, a MSD team began work on a system to be integrated into the current control system. Part of this system was a latch arm assembly which would pull on the chain that separates the upper and lower parts of the dome slit cover. Currently, a faculty member has to climb a ladder, lean over high voltage power lines, and unlatch the chain. This latch arm assembly would be mounted on the dome, and allow a user to remotely unlatch the chain when needed for observing. The assembly is all built, but there is a problem with power usage. The faculty at the observatory would like this assembly fixed and installed.

C. 12" Meade Modifications

The faculty have requested small modifications to the 12" Meade telescope that would greatly improve the convenience and quality of observing. One major modification is installation of LEDs onto the tube of the telescope to be used to take dome flat calibration images, which is currently done with an LED mounted behind the telescope on the dome wall. Adding another set screw to hold the heavy CCD camera that is mounted into the telescope has also been requested. Modifying the safety system for holding the CCD camera in case it falls is also a task that could be worked on.

III. Benefit to SPEX

By working with the equipment and the facility, SPEX students will have access to the observatory and gain experience with the equipment. Since SPEX is an organization for all students of all majors, students with an interest in astronomy and telescopes who may not have the opportunity to take astronomy classes will have access to the observatory. Ideally, this collaboration benefits SPEX, the observatory, and all students at RIT.

A. Engineering Skills

Firstly, these projects will help students develop key engineering skills, as do most projects that SPEX takes on. These

projects will take students through the engineering process from beginning to end, involving problem solving, slight planning, research, and implementation. Students will have the opportunity to be involved in every step of the way if desired. No high level engineering skills are required to complete these projects, but students may learn or enhance their experience with Arduino, circuits, hand tools, power tools, integration, and control systems.

B. Observational Skills

Secondly, while working with the equipment at the observatory, students will become more familiar with the workings of the telescopes. This will help students understand what happens behind taking observations, and directly affect their observational skills with the SPEX telescopes. They will become more comfortable with the equipment itself.

C. Accessibility

SPEX is an organization for all students of all majors. Students with an interest in astronomy and telescopes who may not have the opportunity to take astronomy classes will have access to the observatory. If steps towards remote observing are taken and eventually implemented, it will lighten the burden of observing on the faculty, which in turn opens the observatory to more students. A strong bond with the observatory also opens up more opportunities there for SPEX students specifically.

IV. Implementation

The projects can be worked on simultaneously, or one after the other depending on the number of interested members. Ideally, projects that require more work in the outdoors would want to be completed first to avoid weather concerns. If these main first projects are implemented, there are more projects that can be started in a new PDD, or these can be enhanced and continued in the spring. Being the first semester of these ongoing projects, the goal is to complete these smaller tasks and work out the process of collaborating with the faculty at the observatory.

A. Deliverables

Physical deliverables are the outcome of these projects. By the end of the semester the roll off motor should be repaired, slowed down, and an warning system installed. The motor latch arm should be installed correctly and its power usage limited. An LED for dome flat calibration images should be installed onto the 12” Meade as well as any other small modifications.

B. Milestones

The projects designated for this semester have been selected because it is expected that the tasks can be feasibly completed within one semester and without as much experience with the facility. Two potential timelines are outlined in Table I and Table II. The timelines depend on the number of people available to work on the projects.

V. Externalities

A. Prerequisite Skills

Leadership with the prerequisite skills has been determined. It would be beneficial for some students to already have basic

TABLE I
NOTIONAL TIMELINE OF PROJECT MILESTONES I

Phase	Task	Duration
0	Gather documentation on all equipment and preliminary work	Summer
1	Review existing designs and materials for roll off motor, telescope modification,and latch arm	2 weeks or less
2	Systems development	
	Repair existing roll off motor	
	Design Schematic to fix latch arm	
	Design mounting for selected LED	
	Determine placement of modifications	
	Solder modifications to latch arm controls	
	Design roll off warning systems	
	Order parts for schematics	5 weeks
3	Mount systems at observatory	2 weeks
4	Systems testing	1 week
5	Generate documentation and delivery to SPEX	1 week

TABLE II
NOTIONAL TIMELINE OF PROJECT MILESTONES II

Phase	Task	Duration
0	Gather documentation on all equipment and preliminary work	Summer
1	Review existing designs and materials for roll off motor	1 week
2	System development of roll off motor	Repair existing roll off motor
	Design roll off warning systems	
	Order parts for schematics	
	Install system at observatory	4 weeks
3	Review existing designs and materials for latch arm	1 week
4	System development of latch arm assembly	
	Get latch arm working in current state	
	Design schematic to fix power usage	
	Order parts for schematics	
	Solder modifications to latch arm controls	
	Install system at observatory	3 weeks
5	Review existing designs and materials for telescope modifications	1 week
6	System development of latch arm assembly	
	Design mounting for selected LED	
	Determine placement of modifications	
	Install system at observatory	2 weeks
7	Systems testing	2 weeks
8	Generate documentation and delivery to SPEX	1 week

engineering and hand tool skills. Knowledge of Arduino code and basic electrical circuits is also beneficial. These skills do not need to be present in all group members as these projects are an opportunity for new members to learn these skills. For the roll off motor repair, someone with some motor knowledge would be crucial.

B. Funding Requirements

Primary funding for these projects will come from the Observatory itself. If extra funds are needed, RIT SPEX Astrodynamics may apply for SG funding due to their newly developed SG club status. Table III outlines the estimated costs of the projects. The costs have been overestimated for planning purposes.

TABLE III
ESTIMATED BUDGET

Project	Cost
Roll Off Motor Repair	$500
Motor Latch Arm	$100
12" Telescope Modifications	$100

C. Faculty Support

Direct support from Dr. Richmond and Dr. Connelly is expected. Access to the facility is highly dependent on one of the above being present. Both faculty are very familiar with the equipment, telescopes, and facility. They also have experience with what is typical for systems at other observatories, which may be beneficial when working on these projects. Dr. Richmond has been modifying equipment at the observatory for decades. Dr. Connelly understands the structure and capabilities of RIT SPEX through being an advisor. Both are great resources for guidance during the completion of the projects. As all professors, they are juggling multiple responsibilities at one time, which can complicate scheduling time for this project. Even so, they understand the needs of the observatory and can also be seen as the primary customers for these projects, so it is important to keep them informed through the engineering process

D. Long-Term Vision

The long term goal of these projects is to work towards a fully automated dome system. This would enable remote observing for the Observatory and enable increased access to more students. Students will get familiar with the technology behind observing and enhance their basic engineering skills. As projects get completed, a strong bond between the RIT Observatory and RIT SPEX can be established.

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