Ariel University Observatory

Planner and Scheduler

Software Requirements Specification

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1. Introduction

1.1 Purpose

The goal of this project is to establish a robotic observatory in the new observatory facility in Ariel University. One of the needed elements for such a robotic facility is a self decision making abilities which can operate the observatory missions by itself. Our project will focus on the planner and scheduler modules.

The planner is the part of the system which helps the astronomer set and insert new observing plans via web interface. This part makes sure the observing plan is well defined and possible to schedule.

The scheduler sends astronomical imaging plans for execution. Prior to the execution phase, the scheduler chooses the most worthwhile plan by taking into account weather conditions, visibility, priority and other constraints.

1.2 Intended Audience

Researchers and students of the Astrophysics department in Ariel University. In the future the site would be accessible to the public.

1.3 Intended Use

Conducting automate astronomical imaging observing for research purposes, whether it is a continuous stars monitoring or Target of Opportunity , which are more urgent missions.

1.4 Scope

The planner and the scheduler are external programs to the control panel. They are the algorithmic component of a much bigger system which include databases , control software and machinery.
Those components turn a traditional observatory into a robotic observatory. This kind of facility allows the university’s researchers to conduct an observation plan within a minute , rather than relying on an external facility which requires them to send a observing request ,get approval and share the telescope with many observers.
This project can reduce dramatically the waiting time for experiment results as well as an option to conduct more studies.

1.5 Definitions and Acronyms

a. Target of Opportunity - Opportunity of optimal gazing conditions at a certain site. This kind of task is prioritised over any other routine observing missions. These missions are more urgent because they can provide us with quality data or data of rare cases.
b. Monitoring - An imaging plan which is set over a prolonged time period. The main purpose of these tasks is to measure changes within a certain target. This being done by data collecting of the same area over a couple of nights.
c. CCD - Charge Coupled Device - A physical component which receives photons from light rays and turns it into an electron which produces an electric current. This way the observatory measures the star's brightness.
d. Light pollution - The darker the environment is the better data achieved. So any light source in the observatory area is lowering the experiment results quality. Therefore we will try to avoid light disturbance as much as possible.
e. Air mass - Amount of air that one is looking through . formulated as the integral of air density along the light ray.
f. Zenith- an imaginary point directly "above" a particular location, on this case this is the vertical angle to the observatory location.
g. Plan - A set of observing, not necessarily overlap to each other in time.

2. Overall Description

2.1 User Needs

a. Access to data gathered from observations.
b. Ability to add missions from anywhere.
c. Execution of the most relevant plans.
d. Automated operation of the facility during night time if possible.
e. Ability to set constraints for observing.
f. Avoidance of light pollution ,low observing angles ,air mass and ect.
g. Abandon all tasks when weather conditions are dangerous.

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2.2 Assumptions and Dependencies

This project is defined as R&D which requires us to delve into observatory technologies so the demands, external sources and the architecture might change along the process. We have based our project on existing robotic observatories but we intend to adjust the product to the university needs. Also, we are dependent on the development of the control software which is being built parallel to the scheduler and planner modules.
The products will be open for further extensions and updates.

3. System Features and Requirements

3.1 Functional Requirements

Planner

- The planner will have a web user interface containing an observing request form and data display of past or future observing plans.
- Researchers will be able to set an observing plan.
- The user will set an exposure time and number of images of the plan.
- Every target will have an expected brightness value.
- The planner will provide celestial coordinates by inserting the target name.
- Interpretation of request form into a set of instructions.
- The planner will get data about star visibility, moon position and weather from the database.
- The planner will check the possibility of a request .If it is not rational , has a low chance to be scheduled or may collect poor quality data - the request will be rejected.

Scheduler

- The algorithm will choose the most prefered task among the plan list by taking into account constraints like priority , visibility , possible light pollution and execute it.
- Any task will have its own priority which will be taken into account in the decision process.
- If during observing the brightness of the star is not matched with the expected brightness - the system will change the exposure period.
- The scheduler will check the plans' constraints parameters updates from the database.
- If a site is not as visible as the database says, the scheduler will cancel the mission temporarily and run another task instead.
- Harmful weather conditions will end any observing task immediately.
- The system will prefer to observe toward 90 degrees but no less than 30 degrees in order to avoid disturbances.
- The facility will take the position of the Moon into account in order to avoid light pollution.
- ToO will always be prioritised over monitoring missions.

3.2 External Interface Requirements

a. Observatory - A facility which includes the system physical components , which are : Telescope , dome , filter wheel , mount , focuser imaging and guiding camera. Hardware components are not connected directly to the scheduler or the planner but indirectly.
b. Control panel - Control software which operates the system components and runs observing. Receives observing for execution from the scheduler.
c. Databases - Astronomic and atmospheric databases which provide information about important parameters about the environment's conditions.The scheduler uses the database in order to determine constraints. For now the decision is to use the SIMBAD database.
d. Weather - Reliable data source which notify the system when weather is problematic.

3.3 Nonfunctional Requirements

a. Safety - Harmful weather conditions will end any observing task immediately.
b. Maintainable - This system will be designed in a way that enables software updates and expansion.
c. Security - The system will not allow unregistered people to operate the system and to access the database files.
d. Efficient - Maximise the use of the machinery and avoid idle time as much as possible.
e. Available - The planner must be accessible and available to accept new missions anytime from anywhere.