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Polar Pointing Pillar

M. R. Voelzke[1], A. J. L. Pereira[1,2], F. A. Spina[2], & J. C. Oliveira[2]

[1] Endereço(s) do(s) autor(es) deve(m) ser fornecido(s)

Abstract. This paper describes the design, construction and installation of the Polar Pointing Pillar, which consists of a vertical column on which a green diode laser was installed, oriented towards the South Celestial Pole, in order to assist amateur astronomers who frequent the Observatory and set up their telescopes there, specifically those with equatorial mounts. The Polar Pointing Pillar is part of the most recent initiative aimed at amateur astronomy installed at the Prof. Dr. Leonel Moro Astronomical Observatory, which belongs to the Astronomy Complex of the Paraná State College. The equipment has even been useful for pointing and calibrating the main telescopes at this observatory. The installation of the Polar Pointing Pillar was a long-standing request from amateur astronomers who frequent this observatory and who greatly assist in the monthly observation activities aimed at the general public. The Astronomy Complex also has the Astronomy Club of the Paraná State College, which brings together amateur astronomers who dedicate themselves to astrophotography. Perfect polar alignment of the telescopes is required for this activity. In order to increase the laser's lifetime, an Arduino interface was attached to it to control the time the diode remains on and a time interval for cooling, with the device being activated by a switch. As a contribution, we suggest installing this equipment in other observatories to assist the work of amateur astronomers, astrophotographers and the general community who frequent these spaces.

Resumo. O trabalho relata o projeto, a construção e a instalação do Pilar de Apontamento Polar, que consiste em uma coluna vertical, sobre a qual foi instalado um laser de diodo verde, orientado para o Polo Celeste Sul, visando auxiliar astrônomos amadores que frequentam o Observatório e instalam seus telescópios no local, especificamente os dotados de montagens equatoriais. O Pilar de Apontamento Polar integra a mais recente iniciativa voltada à astronomia amadora instalada no Observatório Astronômico Prof. Dr. Leonel Moro, pertencente ao Complexo de Astronomia do Colégio Estadual do Paraná. O equipamento tem sido útil até mesmo para o apontamento e calibração dos telescópios principais desse observatório. A instalação desse equipamento era uma solicitação antiga de astrônomos amadores que frequentam esse observatório e que sobremaneira auxiliam nas atividades mensais de observações voltadas ao público em geral. Também há no Complexo de Astronomia o Clube de Astronomia do Colégio Estadual do Paraná, que congrega astrônomos amadores que se dedicam a astrofotografia. O perfeito alinhamento polar dos telescópios para essa atividade é requerido. Com o objetivo de aumentar o tempo de vida do *laser*, foi acoplado a ele uma interface Arduino, para controle do tempo que o diodo permanece ligado e um intervalo de tempo para resfriamento sendo o dispositivo acionado por um interruptor. Como contribuição, fica a sugestão da instalação desse equipamento em outros observatórios para auxiliar os trabalhos de astrônomos amadores, astro-fotógrafos e a comunidade em geral que frequentam esses espaços.

Keywords. Techniques: miscellaneouss - Methods: miscellaneous – Diffusion

1. Introduction

To begin any direct astronomical observation procedure, it is essential to align the telescope (Ribeiro & Ottoboni 2017). Telescopes used for astrophotography, to overcome field rotation, are equipped with equatorial mounts (Nicolini 1987) and these, for correct operation, must be perfectly aligned with the north-south line, with their right ascension axis perfectly parallel to the celestial equator and perpendicular to the polar axis, as shown in Figure 1.

2. Theoretical Reference

Traditionally, perfect alignment of an equatorial mount is achieved using the drift method (Matos 2013), which, even for an experienced astronomer, takes several minutes to calibrate correctly.

In order to facilitate and speed up the process of aligning equatorial mounts, especially for amateur astronomers at the Astronomy Club of the Paraná State College, the Polar Pointing Pillar, was implemented, as can be seen in Figures 2 and 3.

To preserve the diode, Arduino programming allows a sequence of ten 30-second activations, interspersed with the same amount of rest time for the laser, so as not to damage the device due to overheating. Figures 4 and 5 show the programming protocol and the design scheme of the laser control interface:

3. Results

The use of the device has proven to be very satisfactory and telescopes equipped with laser pointers with their optics properly adjusted and calibrated have been pointed with good accuracy, allowing amateur astronomers, members of Club of the Paraná State College, to offer the general public who visit the Observatory, static images when observed. Astrophotographs with perfect images, without field drift for several minutes, had the calibration time by the drift method reduced. Figure 6 shows an example of pointing and the public waiting to observe the telescope.

4. Conclusions

The agility and accuracy of telescope pointing using the Polar Pointing Pillar brought dynamism to the pointing work of equatorial mounts at the Astronomical Observatory of Parana State College, reduced the time and range of movements during the application of the drift method and increased the number of amateur astronomers dedicated to astrophotography after its implementation. Due to the advantages listed here, we

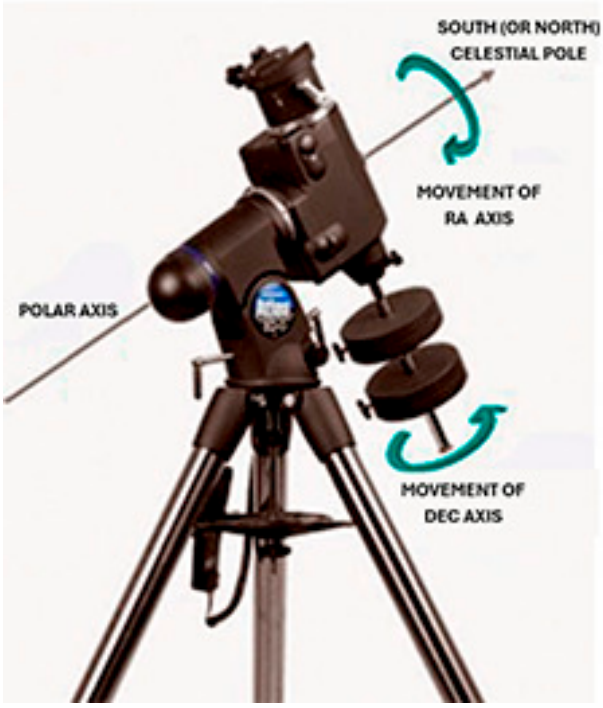

Figure 1. Equatorial mount

Figure 2. Observatory and Polar Pointing Pilar

Figure 3. Lasers of Polar Pointing Pilar and telescope

recommend the installation of Polar Pointing Pillars to all observatories that offer activities to amateur astronomers and the community in general.

```
#define Button 4
#define Laser 5
int ButtonState = 0;
void setup(){
pinMode (Laser, OUTPUT);
pinMode (Button, INPUT_PULLUP);
}
void loop(){ // reads the button state
ButtonState = digitalRead(Button);
if (ButtonState == LOW){ // if the button is pressed
digitalWrite(Laser,HIGH); //turns on the laser
delay(2000); // waits 20 seconds
digitalWrite(Laser, LOW); // turns off the laser
delay(60000); //waits another 60 seconds to release
the button again
}
}
```

Figure 4. Program in Arduino

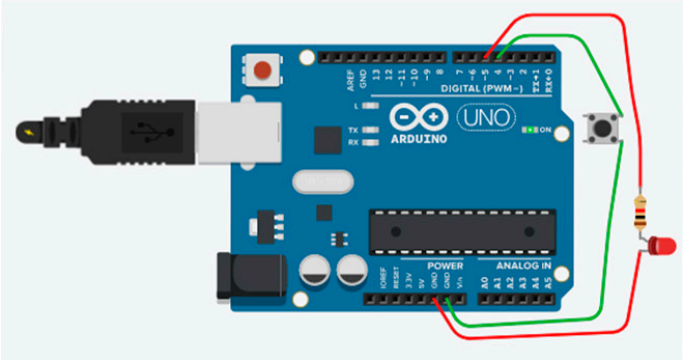

Figure 5. Connections of Polar Pointing Pilar on Arduino

Figure 6. Alining the telescope by Polar Pointing Pilar

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