Refractor Telescope (Astronomy)

(OPTICAL PROJECT)

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Abstract: It is a type of optical telescope, which forms an image using a lens. It is also used for astronomy and viewing distant objects. It consists of primary and secondary 2 lenses. The focus and diameter of the primary lens is very large, while the diameter and focus length of the secondary lens are very small in its competition. A PVC plastic tube is used in this. Inside which all the lenses are adjusted according to their focus length. Reflecting telescope is a technique through which we reflect the incoming light to form a better image on the secondary lens. It can't see far in the space, but still can see all the planet satellite near our earth, like our satellite near our earth is moon, we can easily see it from this and around our earth We can easily capture the existing satellites and other things, we can see, there is also another version of it, which we call reflector telescope, it is capable of seeing very far in the sky and can make their best image. This is my first project of astronomy, so I will make it very carefully and also make its equatorial mount. I will show you the capture of moon, satellite, international space station etc. I will use 2 stepper motors and arduino to control the amount for controlling this telescope. Eye pieces contribute 25% to make the image perfect. Among eyepieces, 2X bar low, 3X bar low and 5X bar low are considered to be the best IPS. I will first design an eye piece of 15mm focus with the help of which I will look at nearby objects and try to focus on moon also, I will record the received image with my phone and after recording about 3000 frame I will Combine a great image with the help of PPI software and AUTO stakker and photo shop (POS).

- **Introduction**

It will be a refractor telescope, with the help of which we will be able to see many objects in space. First of all I will focus on the method of making it and for this I will cut PVC pipe etc. I will note down the performance of all the equipment involved in it on a chart, then design it accordingly, the calculation of reflector telescope is not very difficult, yet many things have to be taken care of while making it. In this I will use a plane mirror in place of the secondary lens with the help of which I will reflect the light upwards and after reflection, I will adjust the eye pieces upwards in it. The most important thing while designing a telescope is that the color of the pipe used can be different, but it is necessary that the inside of the telescope should be black. There is amazing science behind this too, having black part means that the reflection of light is less, the perfect black part absorbs the light completely to make the image, it will not allow the light to be reflected. That's why the inside of the telescope is kept black. The length of its focuser is kept according to its focus length. In the research paper, I will give accurate information about the telescope's focus, IPS, etc. and design everything with my own hands and show a great image. The Reflecting Telescope is the demo telescope I am currently designing. In the coming time, I will design a refractor telescope and also design a hybrid reflecting telescope, so that we can see much deeper into space. so that the nebula galaxy black hole can see all the planets.
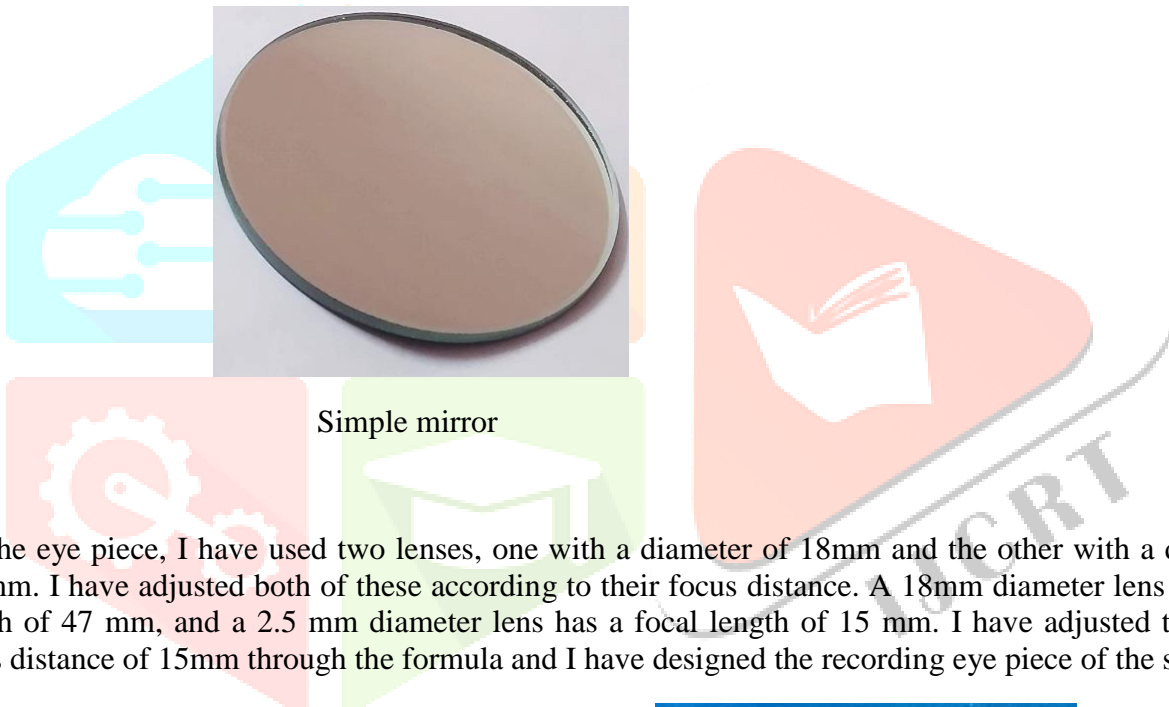
- **PROJECR PLANNING**

In planning the project first of all I will need primary lens, as primary lens I have used Plano Convex lens whose diameter is 75 mm and focus length is 1000mm.
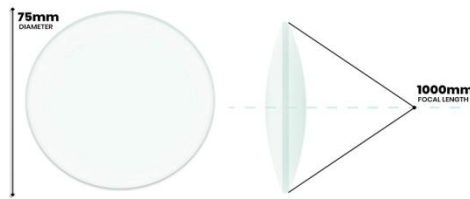
Plano Convex lens for primary lens

As secondary lens I have used a mirror, this simple mirror only reflects light at 135 angle.

Simple mirror

For the eye piece, I have used two lenses, one with a diameter of 18mm and the other with a diameter of 2.5 mm. I have adjusted both of these according to their focus distance. A 18mm diameter lens has a focal length of 47 mm, and a 2.5 mm diameter lens has a focal length of 15 mm. I have adjusted them to the focus distance of 15mm through the formula and I have designed the recording eye piece of the same.

Plano Convex 20mm diameter and focal length 47mm length 15mm

Plano Convex 2.5mm diameter and focal length 15mm

After assembling all the lenses, we now needed the PVC pipe. Inside which we can accommodate all the lenses.

90mm diameter PVC pipe for telescope

PVC pipe for focuser and

A connector is used to mount the focuser mask in front of the telescope's primary lens and to protect the lens from dust. Next to the PVC connector, we can cover the lens by putting a cover so that it is protected from dust and dirt.

Focuser

3. Project work

First of all I pasted the PVC pipe inside and outside with black paper, so that our PVC pipe becomes black and does not reflect the light. And this should absorb the total light inside. Then I put the primary lens in it and connect the joint connector on top.

Install the primary lens in the telescope

Before installing the secondary mirror, we have to calculate the length of the PVC pipe and the focal length of its lens. to make the image perfect.

: Calculation for secondary mirror

Focal length primary lens L1 = 1000mm

Length of focuser (F1) =70mm

Half diameter of PVC pipe (P1) = 45mm

Image formation inside telescope = [L1-(F1+P1)]

$$= [1000-(70+45)]$$

$$= 885mm$$

We have to place the secondary mirror inside the telescope at a distance of 885 mm, so that we can see the image above 70 mm.

Adjustable secondary mirror at 135 angle at a distance of 885 mm.

Installing a 70mm focuser above the secondary mirror

Designing the focuser

I took the pipe of the focuser and cut it into two pieces of 70 mm, one piece has a larger diameter and the other has a diameter of 25 mm, so that one pipe can light comfortably inside the other pipe and there should be no gap between them. Then I pasted the gear streak on top of the 20 diameter pipe, I cut the 25 mm diameter pipe according to the gear streak and then I took the gear of a motor and set it with the help of two iron streaks. So that it can slide smoothly over the gear stick. I cut all of them according to the image and fitted them and prepared the focuser and set it on the top of the telescope.

Focuser Designing Process

Designing the eye piece

To design the eye pieces, I took two plano convex lenses, one with a diameter of 21 mm and a focal length of 47mm, and another plano convex lens with a diameter of 2.5 mm and a focal length of 15mm. By combining these two, I have designed an IPS of focal length of 15 mm through the spacer, which I have designed by the following formula.

F'=47mm length

F"=15mm length

Spacer (C)=15mm length

Total focus length of eye piece = (F'*F")/(F'+F"-C)

$$= (47*15)/(47+15-15)$$

$$= 705/47$$

Total focus length = 15mm focus length

Eyepiece 15mm focus length

Mount designing for telescope

To design the telescope mount, I will need a stand and its mount will be a motor version, our advantage with the motor version is that we can set it at as many angles as we want and look comfortably in space, any object Can detect can connect to laptop with software. We have many advantages in motor version so I will design the telescope mount with the help of stepper motor. To design the mount, we will need two stepper motors and an Arduino Mega. I will be using push switches to control the Arduino, as well as counter weights to balance the mount. To program the Arduino, we will program it using the Arduino software.
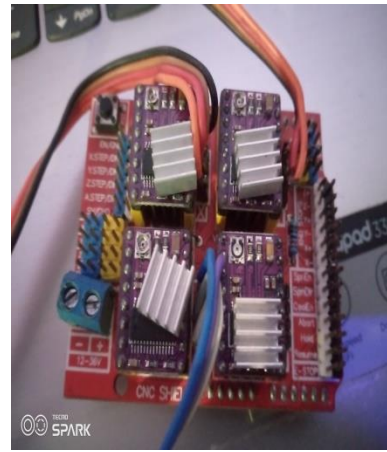

nema 17 stepper motor4. 8 kg-cm mechanical part for mount

- **Software arduino ide-**

 I have used Embedded C in making Tesla curiosity Rover. Aaduino supportes Embedded C. So in this I have used arduino IDE. The full form of IDE (integrated development environment). Me in doing complete programming of rover takes time one month.

Arduino mega   Stepper motor controlling board (shield)

Finally I have completed the mount and now I will set the telescope on top of it and look into space and take images of stars and satellites of International Space Station etc. and find out their positions. By connecting this mount to my laptop and turning it in the direction I want, I can take photographs of space. It has the ability to connect to Stellarium software, it can automatically capture all directions of space by easily connecting to this software


```
Star_Tracker
#include "src/config.h"
#include "src/control/control.h"

#include "src/core/motor_controller.h"

#include "src/core/camera_controller.h"
#include "src/core/canon_eos1000d.h"

#include "src/core/clock.h"
#include "src/core/rtc_ds3231.h"

RtcDS3231 ds3231;
Clock& persistent_clock = ds3231;

CanonEOS1000D eos;
CameraController& camera = eos;

MountController mount(MotorController::instance());

Control control(mount, camera, persistent_clock);
```
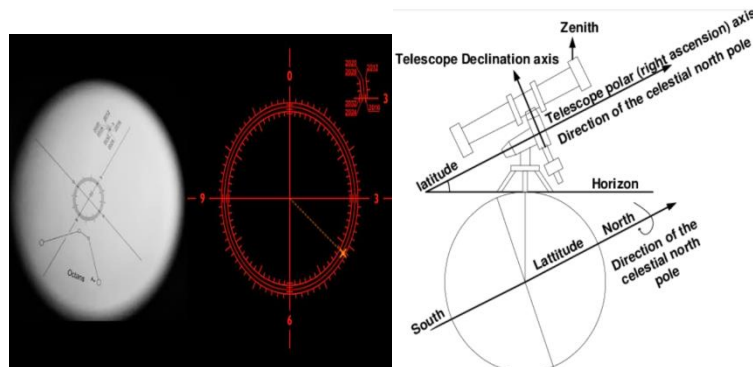
Programming software for arduino mega

Polar alignment for telescope

The location at which do polar alignment. The Latitude and Longitude of that location should be known. Latitude and longitude equality is the direction of North Pole and South Pole. So that we are able to focus on a place in space. Polar alignment of each place is different.

Polar alignment technique for astronomy

The latitude of the place where I am currently sitting is 27.493757 and the longitude is 80.996483. I have to set my telescope accordingly so that we can record better images from space.

- **Conclusion-**

  After completing the telescope, I tried to take some images in space but I failed due to bad weather. I had to wait for a few days. After the completion of the telescope, after 4 days the weather was clear and the moon is full in the sky, so today I will set the telescope on the mount and take pictures of the moon. After the completion of the project, I arranged everything. And then set the telescope in the front side and turn it towards the space then I set my mobile on the telescope and turn on its camera first I took pictures of moon and after capturing about 3000 frames I used PPI software and Converted these images into a single picture with the help of Photoshop. Then I filtered it on photo shop and made it much better received image. The refractor telescope gave a very good result according to its capability and its output was excellent. Focusing the object is a big challenge because our earth keeps on rotating with time, and all the objects in the space appear to move so that it is a big task to focus the telescope at one place, so I have used some advanced software. Focused the object using.

- **Reference-**

1. Astronomy is a very difficult task because it takes a long time to find even a small object in the sky. Space is very large and our telescope is very small. That's why it takes a long time to find the object and its polar alignment takes a lot more time.

2. Polar alignment is very important for telescope. The better the polar alignment, the better the image we can see. There are many techniques to do polar alignment, there are many software, with the help of these we do polar alignment of our telescope.

3. To set up the telescope mount we only need to look at the X and Y axes, which rotate from -x to x and -y to y. We don't have any work for Z Axis in this because we don't need to reduce or decrease the height in this. Our telescope remains fixed as much as it is mounted, we focus on any object using X and Y direction in space.

- **Result-**

In about 3:30 minutes our mobile recorded 3000 frames from the telescope, which is a very short time. To collect so many photos, I have recorded the photos in video format and then I have converted this video into image using PPI software. After converting to image I converted all the images into one image and filtered the image with the help of photo clear. After filtering this image, a very good result was obtained. In which all the creators and clean surface of the moon are visible. A lot of information was recorded in this photo which can be useful in the feature. It took me a lot of time to do this whole process and faced a lot of difficulties but seeing the final output image made my heart happy. This was a very good result, which I had never seen before, nor had I ever pulled such a good image from space before.