OBSERVATORIO USAC – AQ'ANOQ

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Summary—Aq'anoq is an astronomical observatory that any person, using his computer, can gain access to. This Internet controlled telescope has two modes of operation: Manual and Automatic. Manual will provide complete movement and control of the telescope to the user, to be able to navigate at free will using the information provided by the streaming from the camera installed in it. Automatic will let the user select a celestial body from a catalog on the page and focus it automatically.

I. DESCRIPTION

Aq'Anoq is an astronomical observatory created using a Raspberry Pi, an Arduino Uno and our own constructed hardware.

A. Android App

We developed an app for android to get the information from the magnetometer, accelerometer and gyroscope as well as use the camera to directly stream to the web page. With this information we found the rotation matrix to align the relative frame of the telescope to the global reference (North and Horizontal Aligned). These information in degrees will be sent via a socket to the Raspberry Pi each time this submits a request.

B. Raspberry Pi

The Raspberry Pi works as the brain of the project by sending the commands to each device in the order required as well as working as a server for the web page. The first step is to get the telescope to home, so we will be sending a request to the smartphone, once done this we will convert the angles to steps and send this information to the Arduino.

The next step is to get the information from the user via the web page using a socket. We have two different options now, the first one is that the user is using the telescope manually, so we have to send how many degrees we have to move the telescope on the specified direction. The second option is when the user is using the automatic option. For this the user selects the celestial body to find from a catalog; we have to make a conversion of the equatorial coordinate to altazimuth coordinates using our position and sidereal time. After that we convert the angle to number of steps we want the telescope to move. This information is sent via serial from the Raspberry to the Arduino.

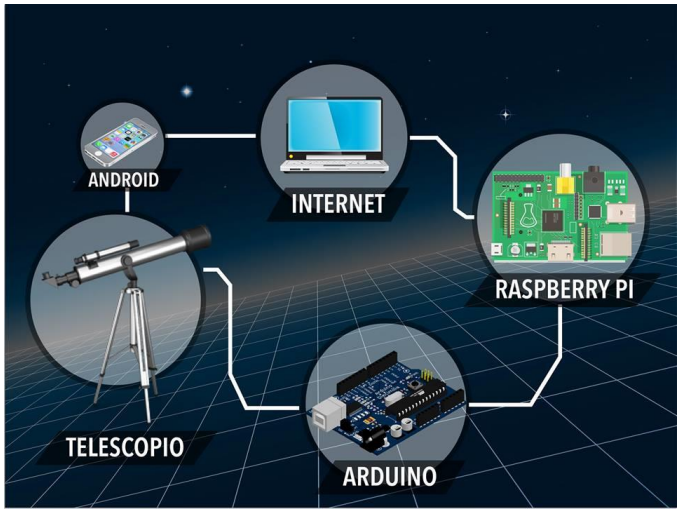
C. Arduino UNO

The Arduino Uno works only as a slave, knowing only how many steps does it have to move the selected motor and in which direction. We built all the hardware for this purpose and used a closed loop PID to get the required precision so we don't lose the reference at any point.

D. Hardware

We created a PCB motor driver using an L293D to control both motors for the telescope movement and another driver to control a Stepper for the autofocus. We as well created a PCB for the encoder to count the number of steps and got the relation of how many steps make a degree

II. METHODOLOGICAL FRAMEWORK



To use the project the user has to access the web-page and login, after this you will enter a queue to gain control of the telescope.

The streaming will always be live, and the first thing the user has to do, is select between manual or automatic. The manual controls will be displayed on the web page to move one degree per click on the given direction. The controls to adjust the autofocus will be provided as well.

The automatic control will display a catalog of known stars and their availability at the time of usage. The user must select the user to focus and the automated telescope will do all the work to find it.

III. PROJECT SCOPE

Aq'anoq is a maya k'ich'e word that means “above”. The observatory was called with this word because it is connected with our philosophy of “astronomy and science for everyone” considering that the mayan population in our country, until today, do not have enough access to education at any level. Some people in our team have worked on astronomy outreach across Guatemala, for that reason, the main motivation of our project was how to get people involved into astronomy if they do not have access to telescopes. Aq'anoq is not only an invitation to explore the universe above us, it is also a step towards development through education and science.

We intend to provide the automated telescope to anyone even entities who may need it at any given time by just login and entering a queue.

Every time a user creates their own automated telescope around the world, the network will grow and will even provide the option to focus any celestial body not limited by the time (day or night on the user place).