Radio Telescope

ITSP 2016 Project Abstract

Introduction:

The setup takes input in the form of sky coordinates, and rotates and inclines the radio telescope accordingly to get the waves and uses a Raspberry Pi to process and interpret the signal. We will mainly use the telescope for observing solar activity on the KU Band (12 - 16 Ghz).

Team Members:

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Motivation:

We have always been interested in astronomy and extraterrestrial events. This is an opportunity to learn how measurements are done in astronomy, how the data obtained by telescopes is interpreted, and basically doing work to further our knowledge and our interest in the subject. For the first time, we will be taking astronomical observations with our own equipment, organising the data and interpreting, rather than just reading posts on astronomy.

With the radio telescope we have planned to build, we plan to observe the sun and other objects, even when the Mumbai sky is unclear. We plan to record sunspot activity and solar flares, going by the known range of radio waves emitted during such events.

Working:

Mechanical:

- Assemble dish along with LNB (look into the wiring, etc)
- Assemble the rotators that the dish will be attached to, which have, as a whole, three axes of rotation, that will be used to position the dish and will be controlled by the Pi.
- Manual motor control (for positioning by ourselves)

Electrical:

- Get LNB output into the Pi
- Wire some Pi outputs that will drive the motors

Coding:

- Implement WolframAlpha API to get star position using Python
- Code how the Pi will get the setup rotated to match a particular angle
- Have some basic code handle the calibration of the setup (know what is north, zero inclination and normalise the speed)
- Make a program that will sweep across a given range of angles at a given speed
- Rotate axes in a small range so as to test maximum output in the region

Proposed Timeline:

Week 1: Procuring the equipment and assembling the parts of telescope

Week 2: Coding on RPi to set the orientation of telescope according to the input

Week 3: Processing the signal received and reducing/removing unwanted noise effects

Week 4: Debugging whatever has been done

Week 5: Interpreting the data in terms of actual activity of cosmological events, e.g., sunspots

Learning Outcomes:

- Learn about radio astronomy and the workings of a radio telescope.
- Learn how to read astronomical data and make sense of it
- Programming and interface of hardware and software on a Raspberry Pi.

Capabilities:

- Can study solar activity (sunspots, solar flares and the like)
- Can aim itself based on either manual input, or towards a particular astronomical body.

Things we have to work on:

1. The main assembly (mostly links [1] and [2], etc.)
2. The azimuthal and polar angle setting stuff (motor assembly)
3. Output from dish assembly to RPi and process it (also program it for long term data recording)
4. Wolfram Alpha queried from Pi (or some other service) and integration of our co-ordinates with stellar standard stuff
5. Code RPi to set given co-ordinates and also sweep across a given range of angles (at some programmable speed)

Estimated Cost:

- Satellite Dish, LNB and mounting stand ₹ 3000
- Satellite finder, coaxial cables and BNC connectors ₹ 500
- Raspberry Pi ₹ 3000
- Circuit components for making Amplifier Circuit ₹ 200
- 3x Motors ₹ 700
- Battery, wiring etc ₹ 700

Total Cost = 8100

References:

[1] Assembly along with estimated cost:

http://www.scienceinschool.org/2012/issue23/telescope

[2] Build a homebrew radio telescope:

http://www.arrl.org/files/file/ETP/Radio%20Telescope.pdf