Practical Off-the-shelf satellite tracking system using SDR

**I. Introduction**

Generally telling what has been done in this research

**II. System overview**

One diagram to explain how to manipulate the system

Antenna design

There are several kinds of antenna designs for satellite receiving signal. The frequency bands should vary from VHF, UHF, S-band…. Frequencies, polarization will define the structure and types of suitable antennas. Some may be integrated forming more than 1 frequency called multi bands antennas.

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| --- |
| Yagi-Uda antennas are used widely in Amater Radio community for communication. The antennas can be home-brewed easily with given open source shared designs. Martin Steyer who is a famous amateur radio operator has worked on the Yagi-Uda deisgn |

Then most suitable antenna for satellite communication in this case is Yagi (CITE which one) “1”

Yagi antenna has a good directivity and gain, easy to calibrate and be manufactured (Cite what) “2”

We choose the design: 6 elements because following budget link:

(Budget link here to prove the antenna gain) – calculating the budget link “3”:

Simulation result points out max gain is xxx dBI – simulation result “3”

After building the antenna, using VNA for recalculating the result. It was calibrated by changing the length of elements and driven position with respect to the reflector at the origin -> show the table of length move and new elements length “4”

Simulation results on gain and radiation pattern of yagi antenna

Optimizing process: re calculating the distance between elements

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Introducing to LNA

LNA is a device which increases the gain but not noise of signal

Introducing to SDR and interfacing software: SDR sharp

A RF diagram

**III. Cost estimation**

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| --- | --- | --- | --- |
| Type | Item | Price (USD) | Note |
| Antennas | Aluminum rods | 7 | Yagi antenna elements, |
|  | Mild steel box | 3 | Antenna booms |
|  | Element holders | 10 |  |
|  | BNC Female socket | 1 |  |
|  |  |  |  |
|  | Cabling (RG174, RG6) | 3 |  |
|  | SMA couplers | 3.5 |  |
|  | RTL-SDR | 18 |  |
|  | Low noise amplifier | 6.25 |  |
|  |  |  |  |
|  | Tripod | 19 | With load of 5kg |
|  | Couplers | 5 | Antenna to tripod |
|  | Smartphone | 40 | For tracking |
|  | Laptop | 262.5 | For capturing raw IQ data |
|  |  |  |  |
|  |  | 75.75 | 378.25 with smartphone and laptop |
|  |  |  |  |

**IV. Tracking mechanism**

Explaining how satellites caught: TLE, positioning, AZ/EL

Introducing to tracking software in PC and android: ISS tracker and Gpredict

Procedure to track one satellite

Comparing to automation tracking mechanism or complicated advanced spacecraft scanning techniques (cite GS. Spacecraft scanning technique ), manipulating the antenna manually have some advances: directly sweep and see, avoid the buildings.

**VI. Experiment result**

Case study 1: Listening to downlink FM

Case study 2: Decoding CW beacon

**VII. Conclusion**