Software Defined Radios (SDR) for RF Spectrum Monitoring Applications

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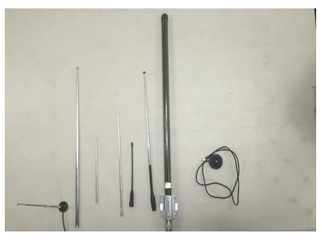
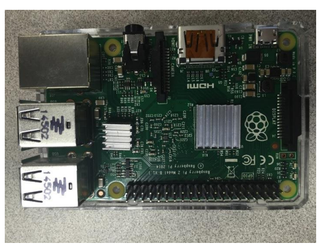
Introduction

SDRs are radio frequency monitoring systems that can be used for applications such as aircraft, ship and next-room electronics tracking . Our main goal is to implement such applications in order to optimize the monitoring systems in a highly RF congested area such as Puerto Rico's west and north coast.

Problem & Hypothesis

The biggest problem to overcome in order make SDR applications work would be to be able to deal with Puerto Rico's high RF congestion (see images located on the right). Creating a low cost SDR, choosing the right antenna and software will overcome this RF congestion problem.

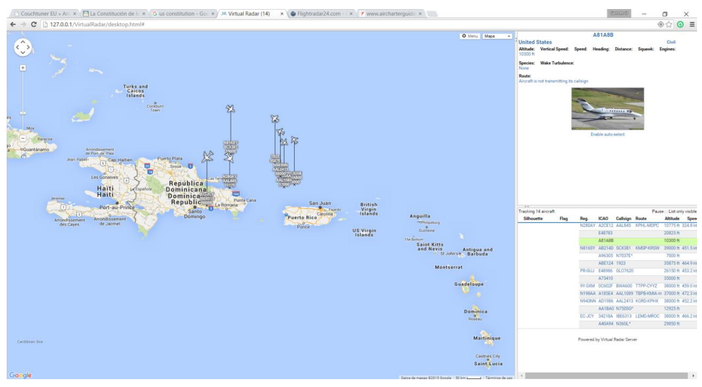




Objectives

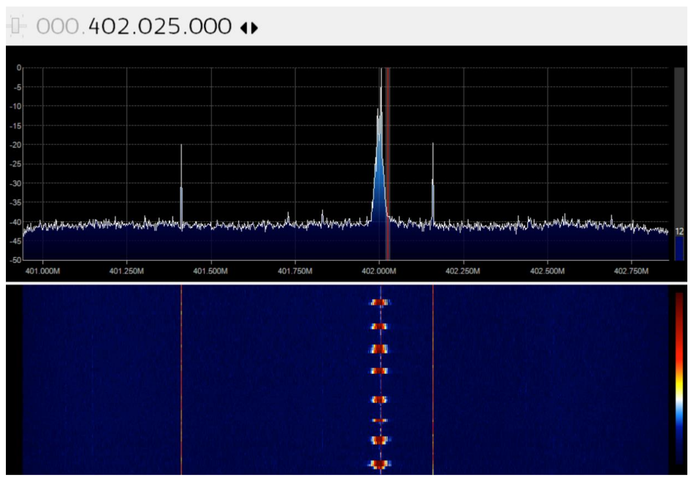
- Acquire a low-cost SDR receiver, capable of monitoring frequencies within the spectrum range coverage from 24MHz to 1.8GHz.
- To monitor aviation Mode S and marine traffic AIS transmission and map their position on Google Maps.
- To be able to detect electromagnetic signals emitted by electronic devices.
- To detect typing from another room on a laptop computer.

Our Biggest Challenge



Google Maps aircraft plotting

Google Earth ship plotting



Radiosonde signal tuning

Methodology

Implement spectrum monitoring system.

Track airplanes on airplanes on west coast and north coast with laptop computer and plot their position on Google Maps.

Track ships on west coast and north coast and plot their position on Google Earth.

Find and decode Radiosondes signals.

Detect electromagnetic radiation from electronic device inside an anechoic chamber.

Results

Aircraft Tracking

- After testing multiple programs to receive ADS-B signals, Dump 1090 was determined to be the best option to receive signals on Raspberry Pi.
- The equipment was tested from different places. As expected, the higher altitude, the better the reception was obtained, due to less RF noise present.
- From the evaluation of different windows applications to receive ADS-B signals, ADS-B Spy was established as the best option. Virtual Radar Server was used to interface the data with Google Maps.
- The ADS-B Signals were received with an Airspy dongle due to its increased sensitivity and superior hardware.

Ship tracking

- SDR# was used to tune the SDR to AIS signals, afterwards AISmon processed the received signal to receive position and finally Ship Plotter was used to display data, and Google Earth as an extension of Ship Plotter.
- The location had to receive signals had to be close to coastal areas because AIS signals are attenuated by the atmosphere.

Radiosondes

- Radiosondes were launched at the campus and we were able to receive the signals using SDR#, but were unable to demodulate the received signal

References

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