Affordable Spectrum Analyzer

System Design

Background

Time Domain
- Signal Amplitudes
- Analyze Simple Signals

Frequency Domain
- Signal Frequencies
- Analyze Complicated Signals
- Power Analysis

Features and Benefits

Frequency Analysis
- Great for: Audio, Wireless, Hobby Electronics, Student, RF Hobby

Low Cost
- Current Full Solutions: > $500
- Current Headless Solutions > $50-250
- Our (Full) Solution < $200

Specifications:
- Up to 500KHz input bandwidth
- 150 Hz Resolution
- 300ms Screen Refresh Rate

Package Includes:
- Probes, Screen, Enclosure, Raspberry Pi Computer, Custom PCB, and 5V Wall adapter

Hardware

Hybrid Approach
- Divide and conquer approach
- Select bandwidths by multiplying by oscillator, then filtering
- Sample smaller bandwidth
- Digital circuitry is easily customizable and fast

Cost Saving Design
- Smaller input bandwidth allows for slower sampling rate (those in which low cost computer can obtain)
- Eliminate need for second oscillator to bring signal back to base band by using advanced sampling techniques

Software

Custom Device Driver
- Written in C
- High speed data acquisition
- Memory management
- FFT
- Oscillator and amplifier control

Custom GUI
- Written in Python
- Graphing
- User interaction
- Data analysis

Future Work

- Allow user to select different weighting schemes
- Improve user interface with more physical buttons / knobs
- Increase number of ways to output spectrum
- Add logic analyzer capabilities

Special Thanks:
Ted Bowen, Harrison Kinsley

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Left: System GUI
Right Top: Spectra Captured with 20KHz Square Wave
Right Bottom: Spectra Captured 20KHz Sine Wave