Drone Scout

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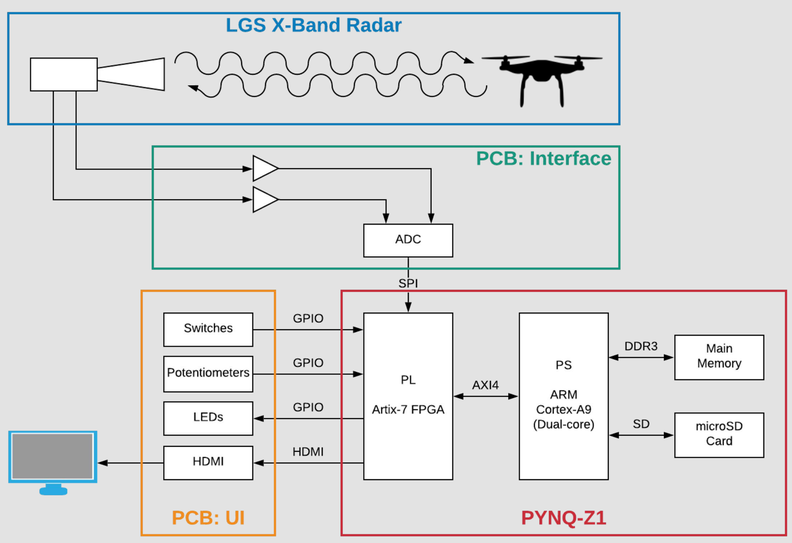
Background

UAV capabilities continue to improve as the drone industry and the technology develops. With malicious intent, drones can pose a serious threat to national security as well as personal privacy. Drone Scout is an X-band radar system capable of detecting a small drone and identifying several of its features.

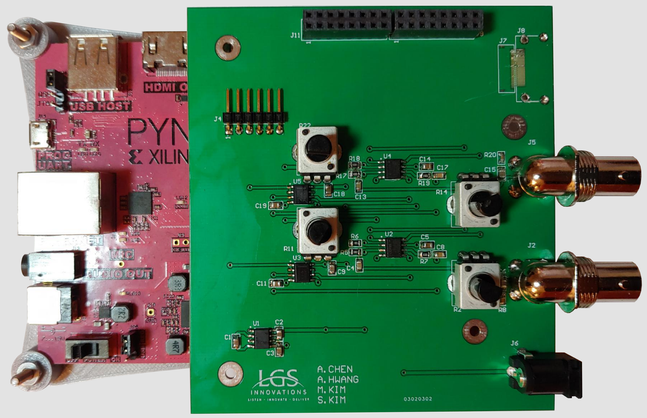
Design Specification

- Operates X-band radar at 9 GHz
- Performs Short-Time Fourier Transforms (STFT) on the incoming radar data
- Analyzes the STFT results to determine drone presence in the radar's target
- If a drone is present, further analyzes the results to extract features of the drone such as propeller tip velocity, blade length, and RPM
- Continually updates display with results

System Block Diagram

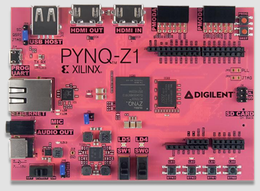


Printed Circuit Board

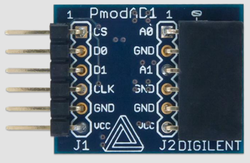


- Radar signals are amplified and routed to the PYNQ
- Potentiometers allow adjustments to the gain and DC offset of the amplifier circuits
- UI switches and LEDs are routed through the board

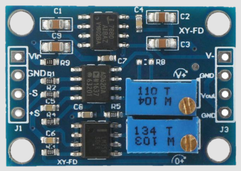
Key Components



PYNQ-Z1 Development Board
- Dual-core ARM Cortex-A9 CPU
- Artix-7 FPGA
- 512MB DDR3 memory

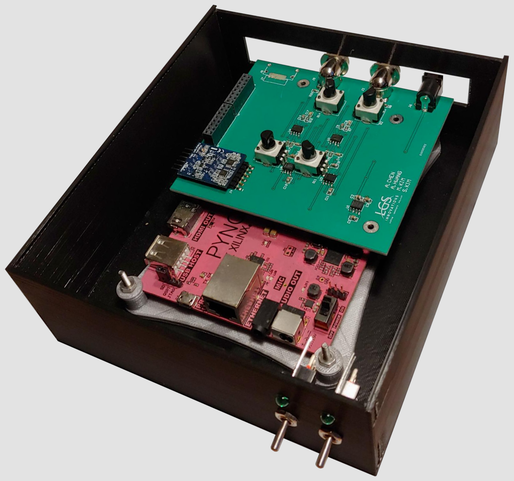


Pmod AD1
- Two channels, 12-bit precision
- 1 MSPS throughput rate
- SPI interface protocol



AD620
- Gain range of 1 to 10,000
- Adjustable ground reference voltage at output
- Potentiometers set the gain and DC offset for one channel

Final Product

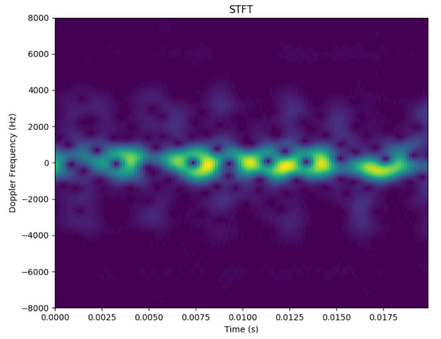


- Our PCB mounts directly to the PYNQ-Z1 board
- The two communicated via the Arduino shield connectors and the PMOD ports on the PYNQ

Feature Extraction Results

DRONE SCOUT

Drone:	True
Max Doppler:	3900
RPM:	15000
Tip Velocity:	64 m/s
Blade Length:	3 in



- The plot above shows the STFT, a 2D representation of the radar signal's frequency magnitudes over time
- By identifying patterns in the STFT, we determine the presence of a drone, along with some of its features

Acknowledgements:
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