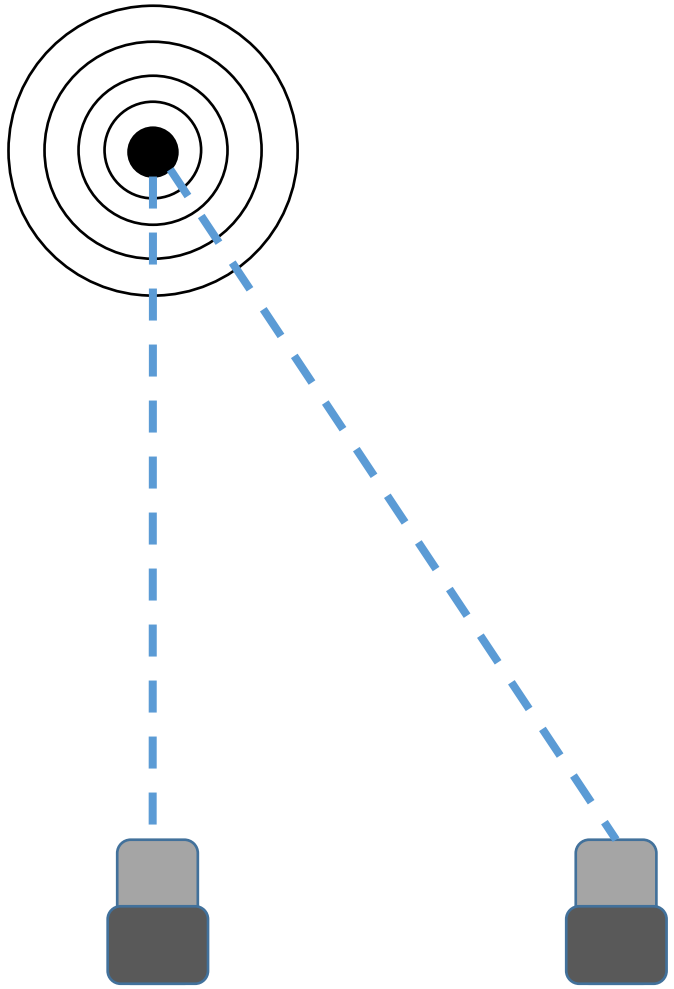
Tracking Sound

Joren Lauwers, Changping Chen



Goal:

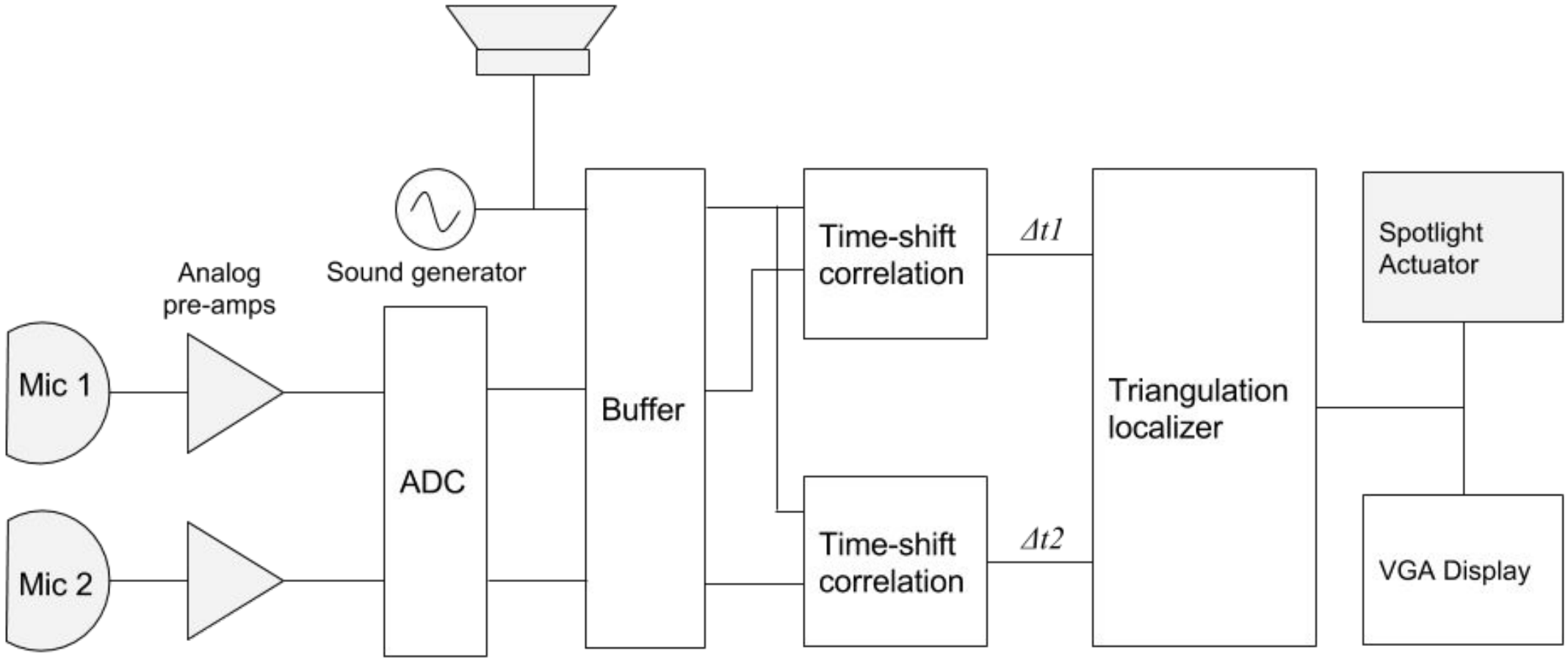
Locate the origin of a sound in the environment.

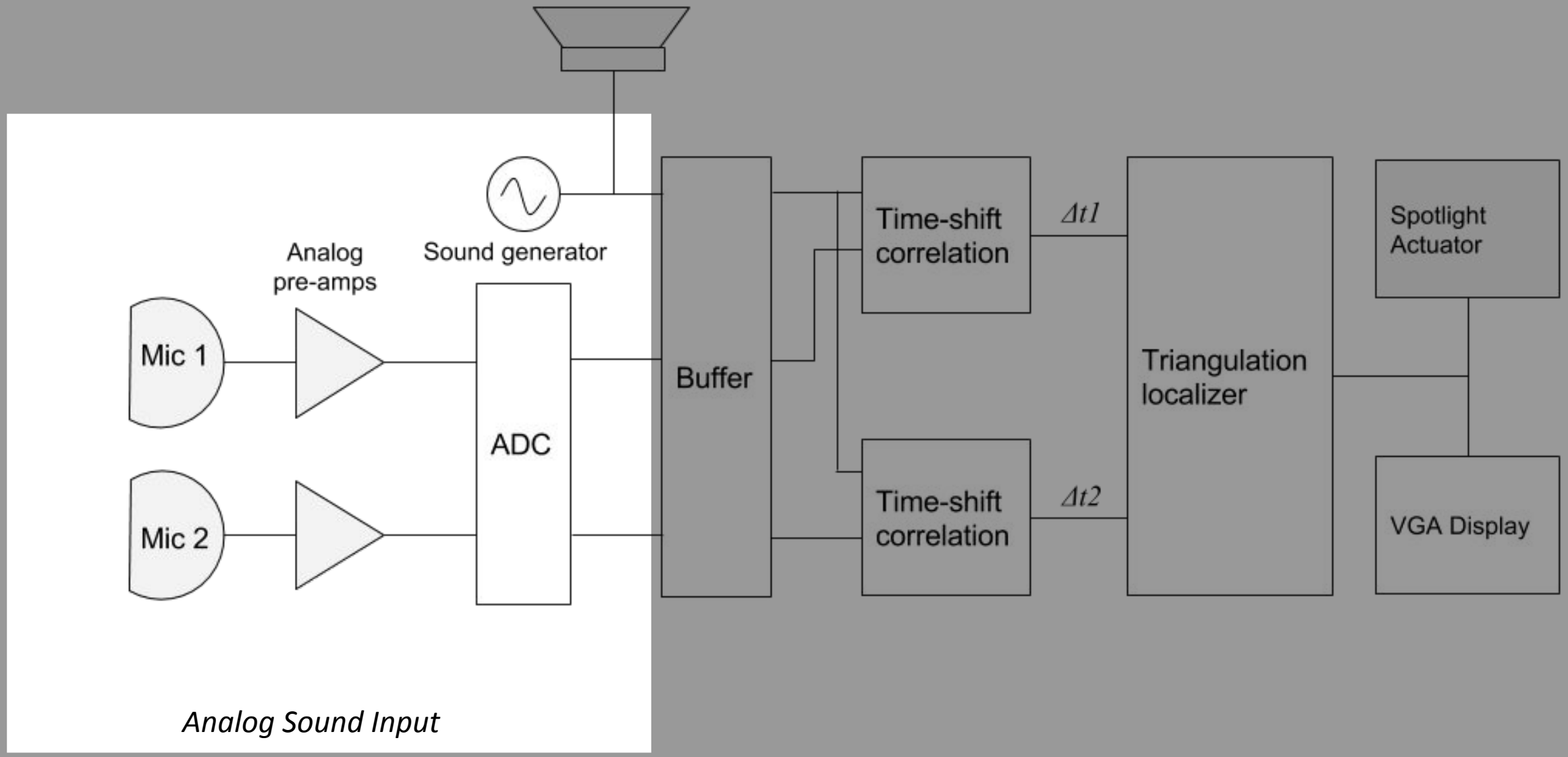
Output on 2D VGA display, or actuate a spotlight

Components

- Nexys4
- 2 microphones
- 1 speaker

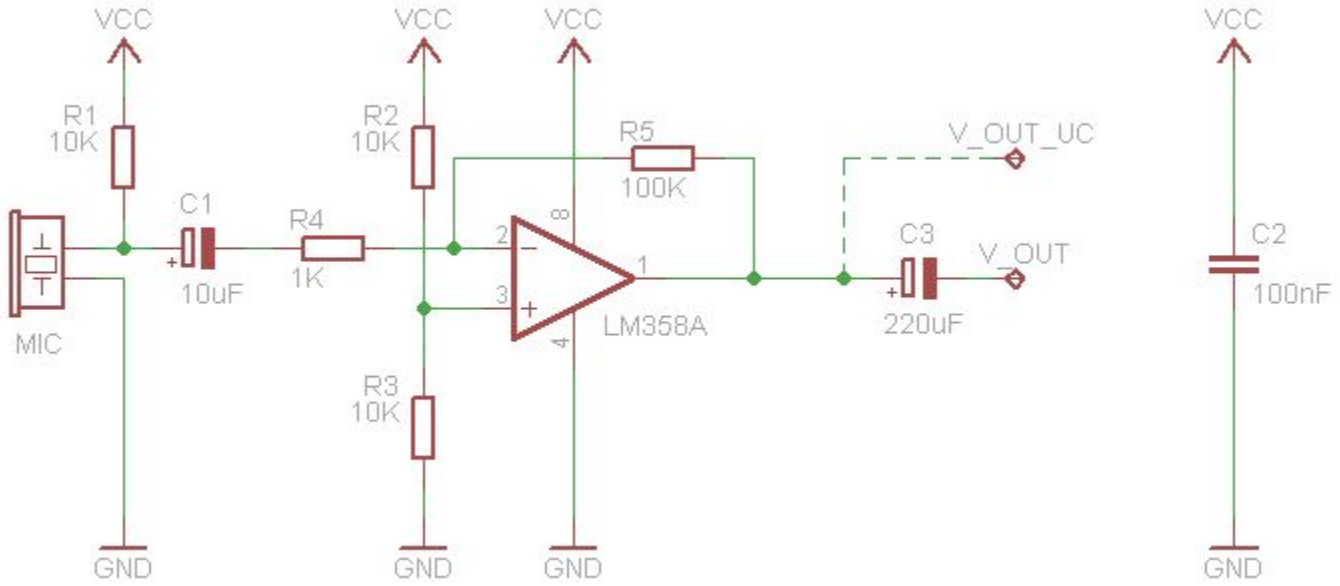
Block Diagram

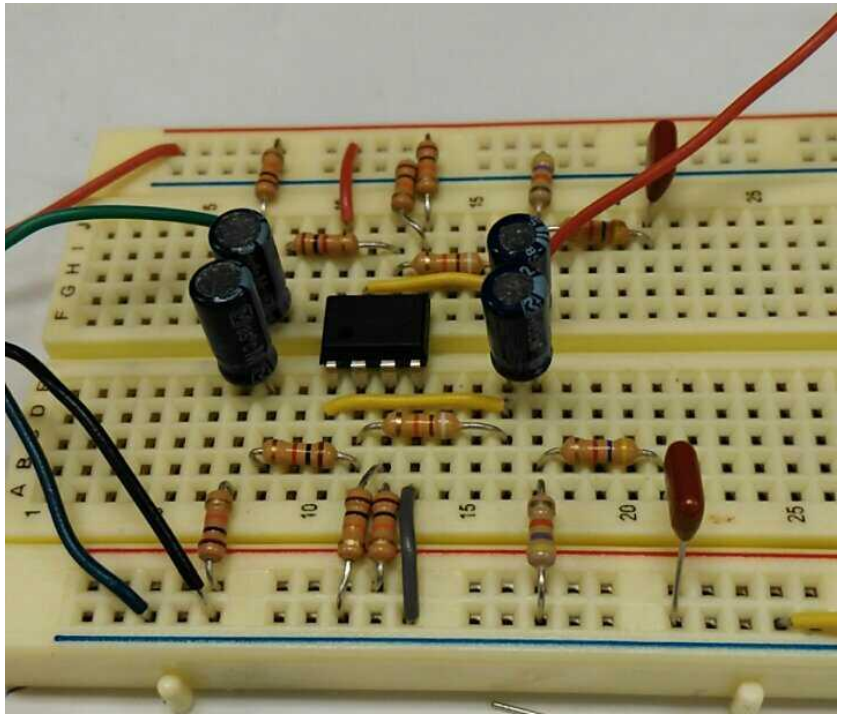




Analog Sound Input

Pre-Amp w/ LM358

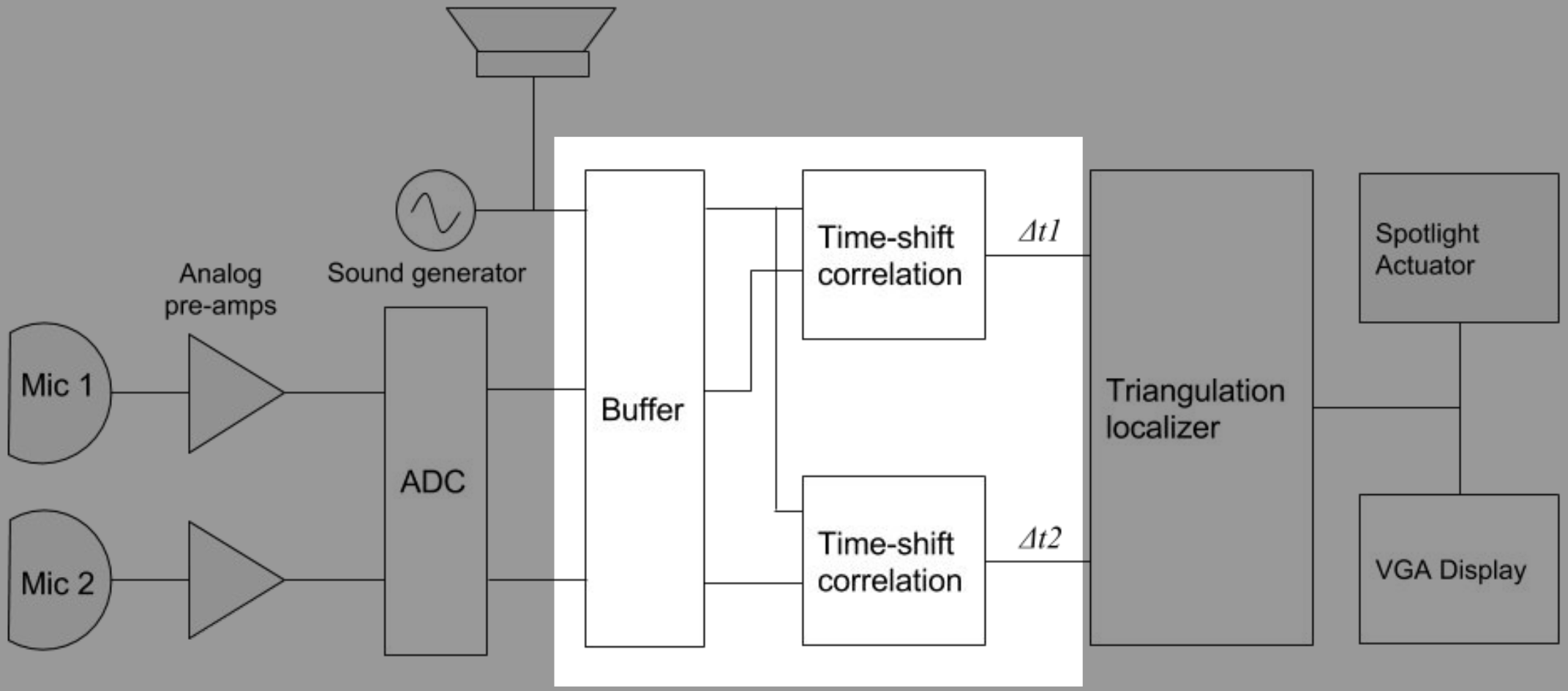




https://lowvoltage.wordpress.com/2011/05/21/lm358-mic-amp/

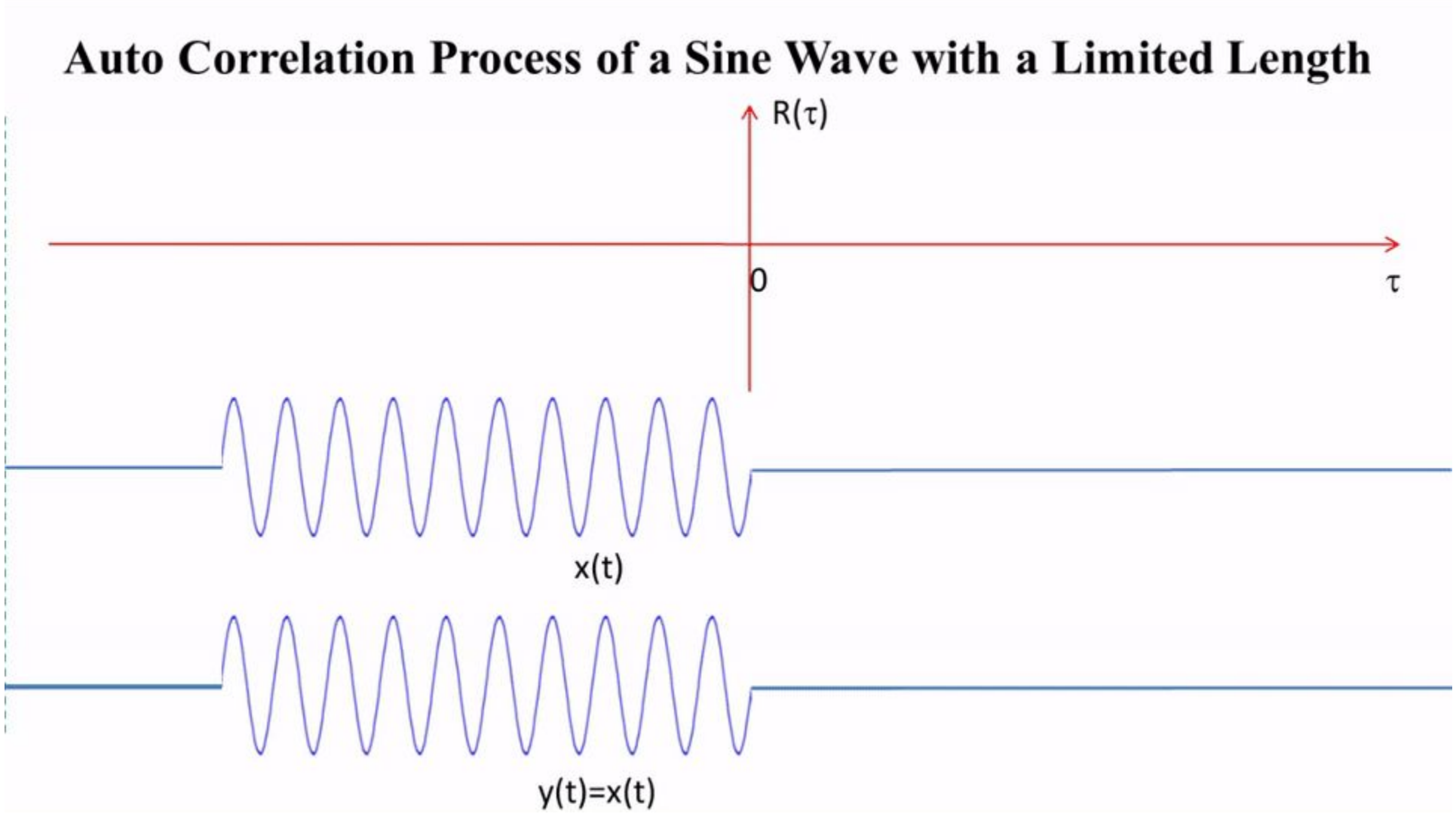
ADC

- 12-bit output
- Simultaneous dual channel sampling
- Up to 1MSPS


Analog
pre-amps
Sound generator
Mic 1
Mic 2
ADC
Buffer
Time-shift
correlation
Time-shift
correlation
Δt1
Δt2
Triangulation
localizer
Spotlight
Actuator
VGA Display

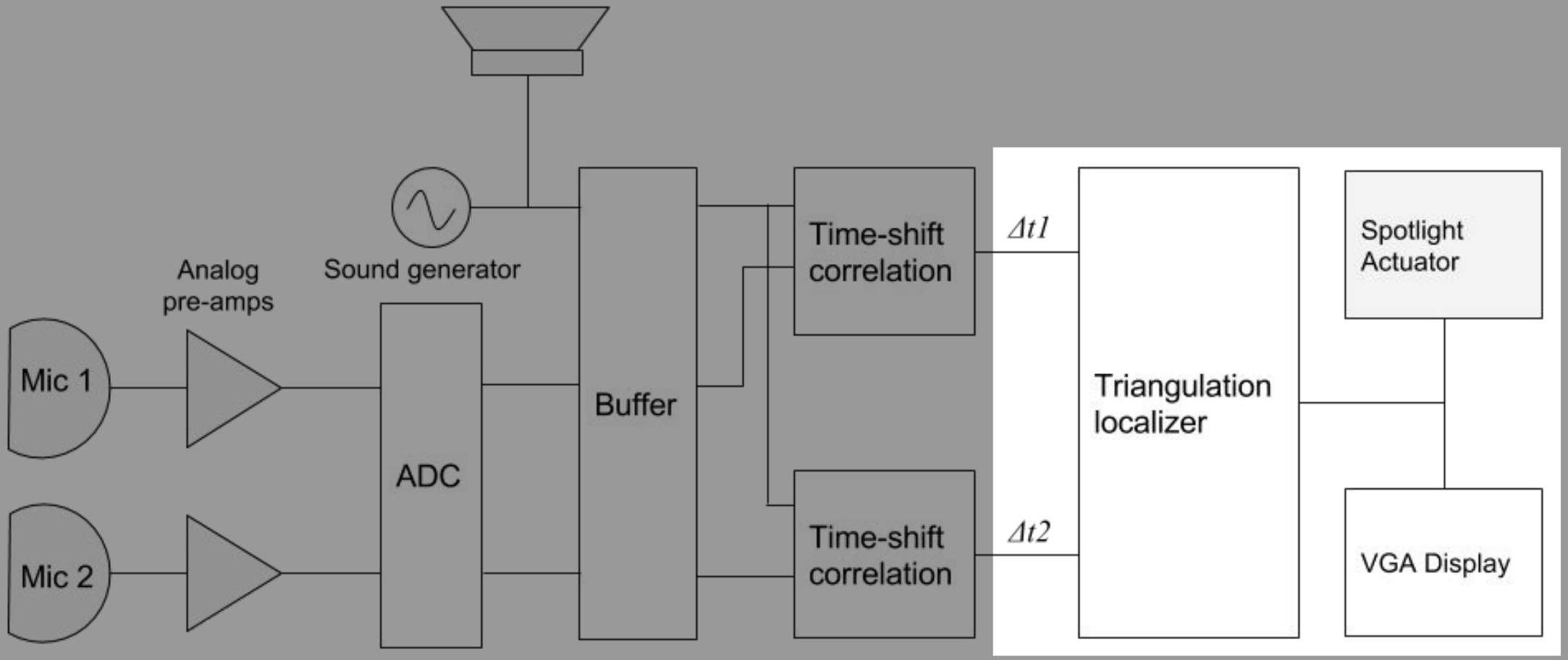
https://youtu.be/L6YJqhbsuFY?t=1m53s

Find Time Delay through Cross Correlation

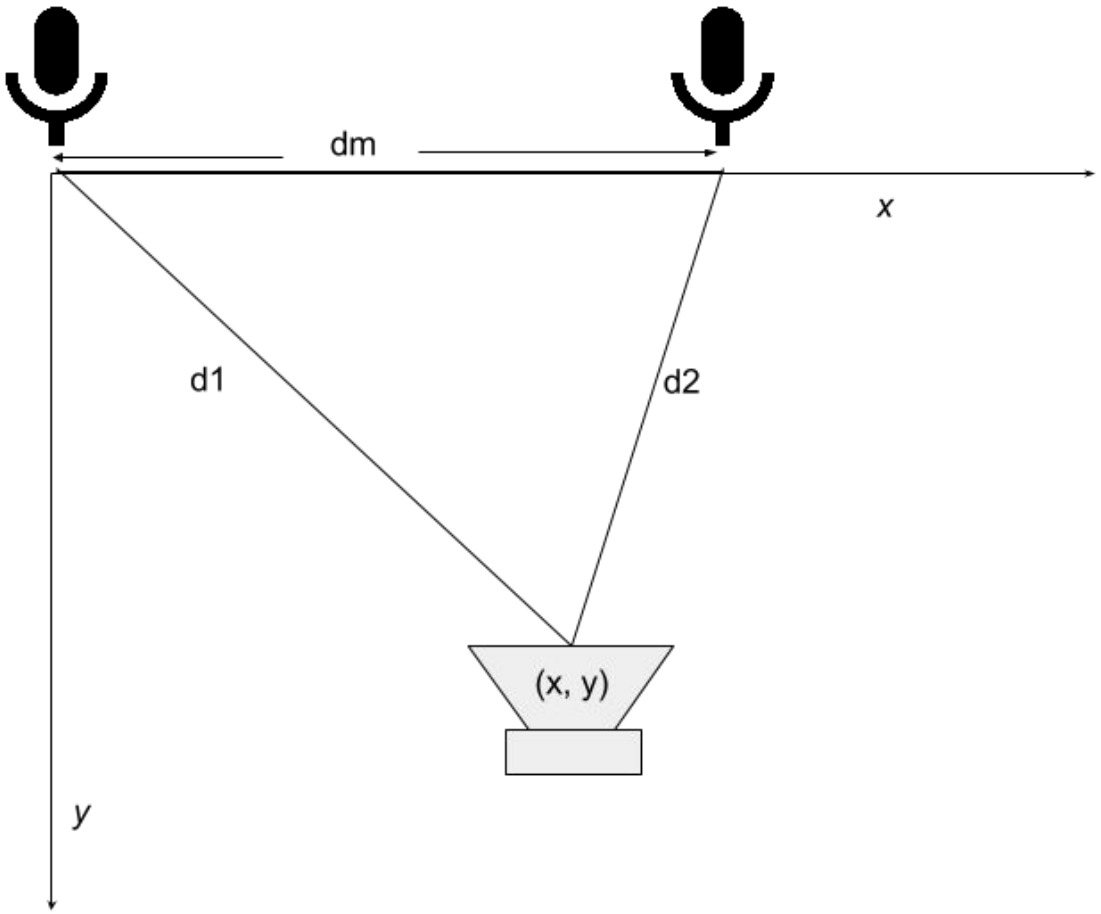


Find Time Delay through Cross Correlation

- Calculate correlation score for each possible time delay
- Total of ~600 correlations
- Pick the delay with highest score
- Implement with running sum of multiplications


Mic 1
Mic 2
Analog
pre-amps
Sound generator
ADC
Buffer
Time-shift
correlation
Time-shift
correlation
Δt1
Δt2
Triangulation
localizer
Spotlight
Actuator
VGA Display

Triangulation Module



- Trigonometry is hard
- Precompute a lookup table of
  `(d1, d2) -> (x, y)`

Timeline

- 10/30 - 11/04: validate mic pre-amp circuit
- 11/07 - 11/11: create dual-channel ADC sampling module
- 11/14 - 11/18: implement speaker output, cross-correlation
- 11/21 - 11/25: implement triangulation module
- 11/28 - 12/02: tweaking accuracy and performance
- 12/05 - 12/09: visual effect