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Mechatronics

ME 2984

“When you want to know how things really work, study them when they’re coming apart” - William Gibson

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ADMINISTRIVIA

What is Mechatronics?

- The combination of Mechanical and Electrical design of a system

- Integration of sensors can involve electrical and mechanical accommodations

Sensors

- Sensors are how a robot perceives the world
  - Much wider range of information available than human senses
  - Data is not perfect
  - Must be translated into machine readable information
  - Must be processed, people are a lot better at it

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Analog vs Digital

Video Credit: Warner Bros

Analog vs Digital

- Analog sensors provide continuous valued data
  - Not less “advanced” than digital
  - Can be very robust
  - Signals must be converted to digital for computers

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Analog vs Digital

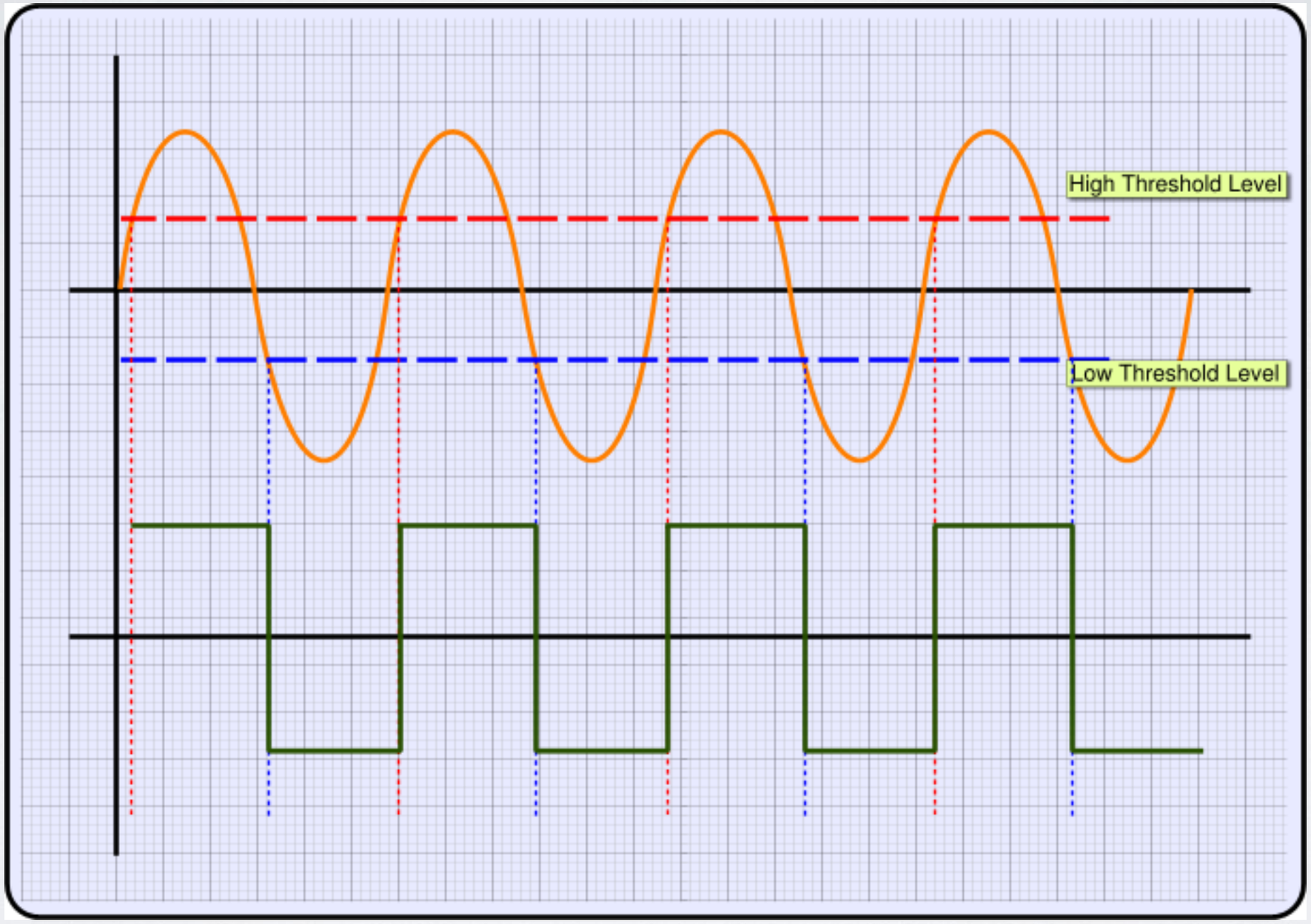

Image Credit: Bugra

A to D

- Resolution
  - Determines how finely you define the signal
- You must also scale for sensor range

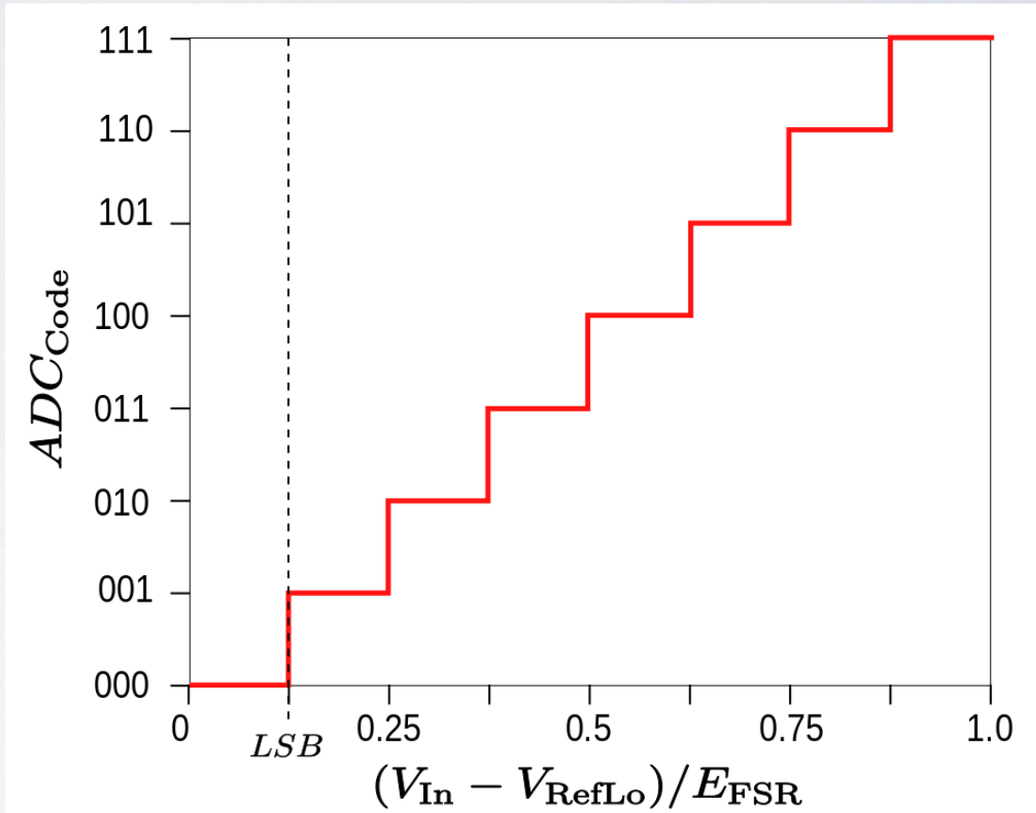

Image Credit: Courtesy Spinningspark

A to D

- Update rate
  - Tied to “bandwidth”
  - How fast does information change?

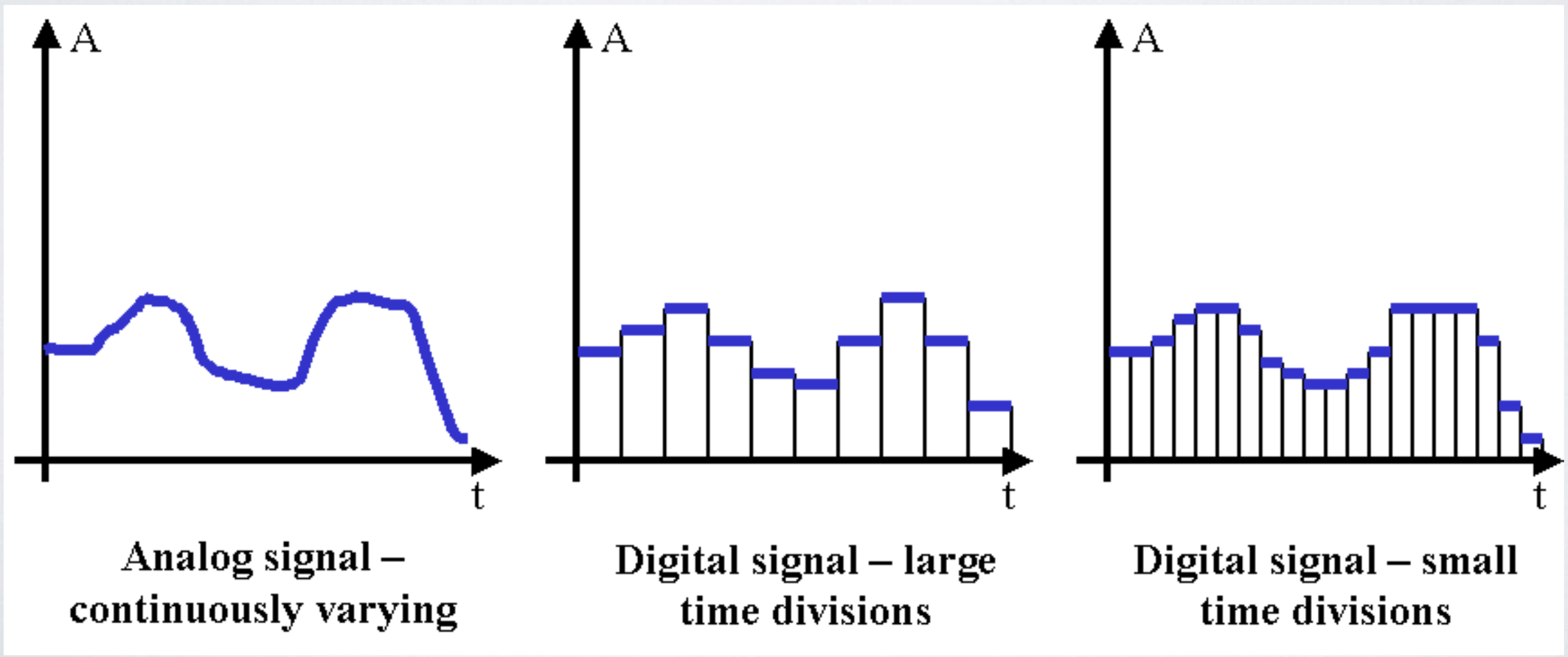

Image Credit: Doris Jean Wagner

What the Heck is $\sqrt{Hz}$?

- Sensor Selection can be hard
- Data sheets don’t spell out what you need to know
- The same sensor type may have different fields
- Everyone is selling something (Literally)

Datasheet: Analog Devices

Where do I plug this in?

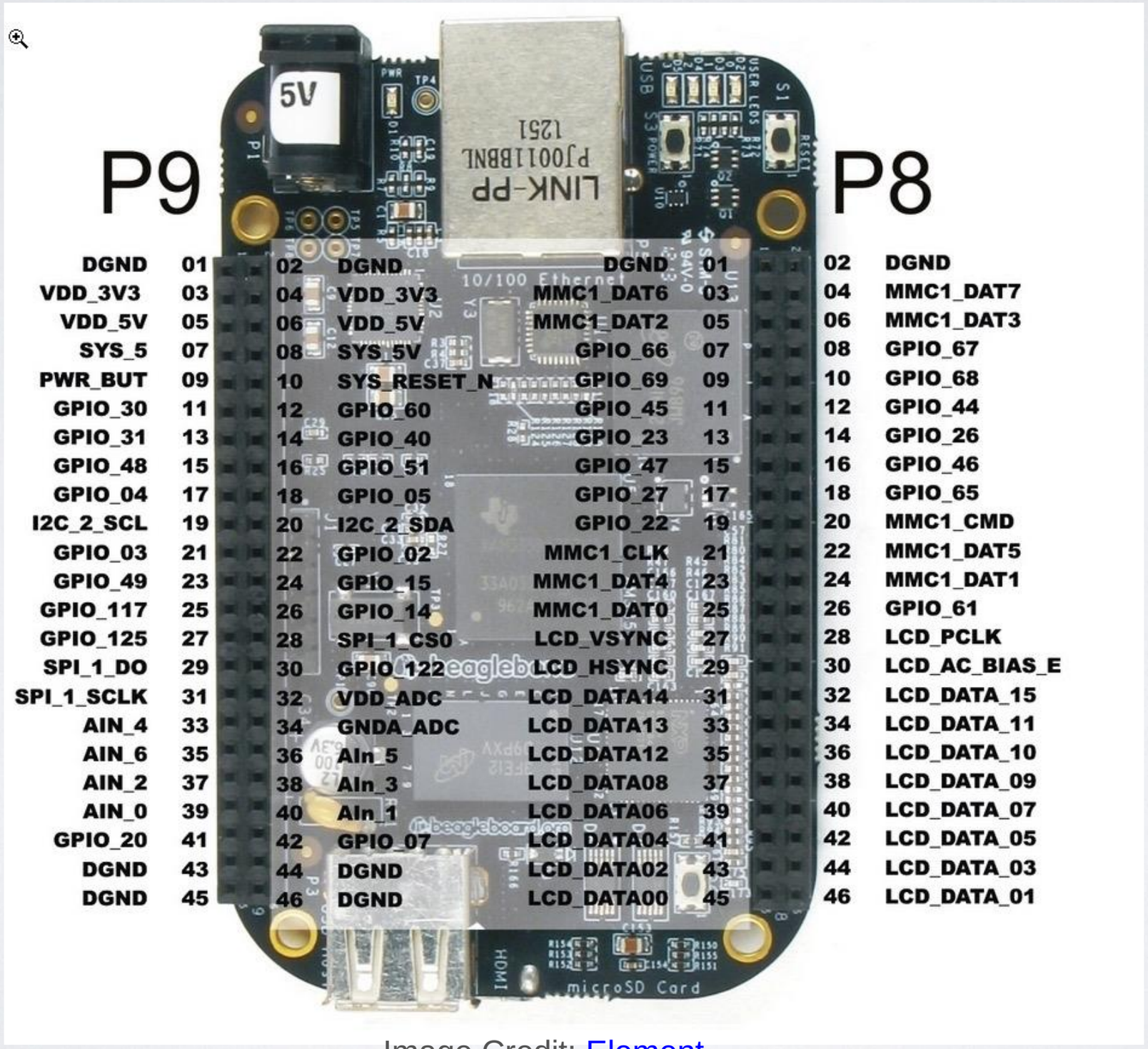

Image Credit: [Element 14]

Powering Your System

- All power to the shields
- Season 3, Episode 15 - Yesterday's Enterprise. It begins more or less exactly at the 2:45 til end of episode mark.

Powering Your System

- Systems are powered by a “bus”
  - Often you need multiple buses
  - Common power buses are 3.3, 5, 12, 24 and 48V

- Separate Motors and Sensors!
- Don’t mix Voltages!!

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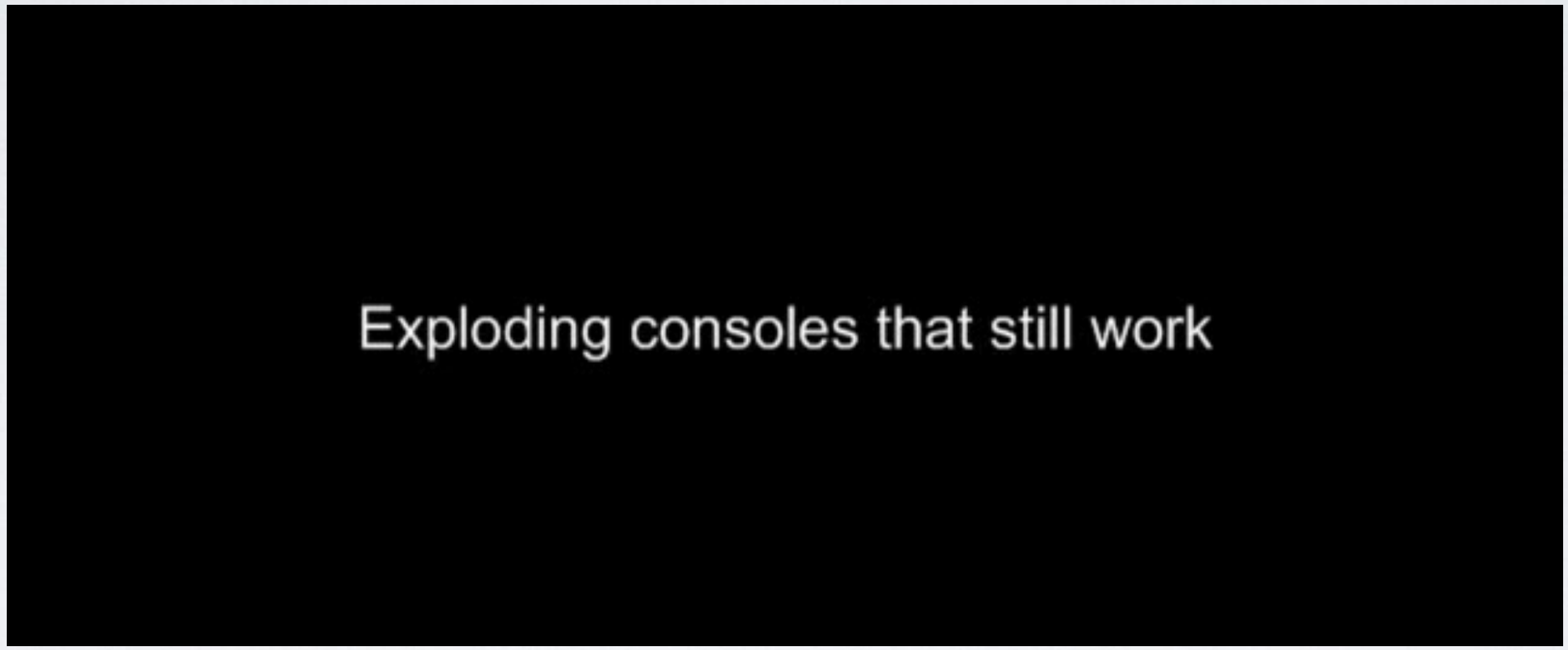
Powering Your System



Video Credit: Youtube

Your Sensors

- How they work
- How they fail

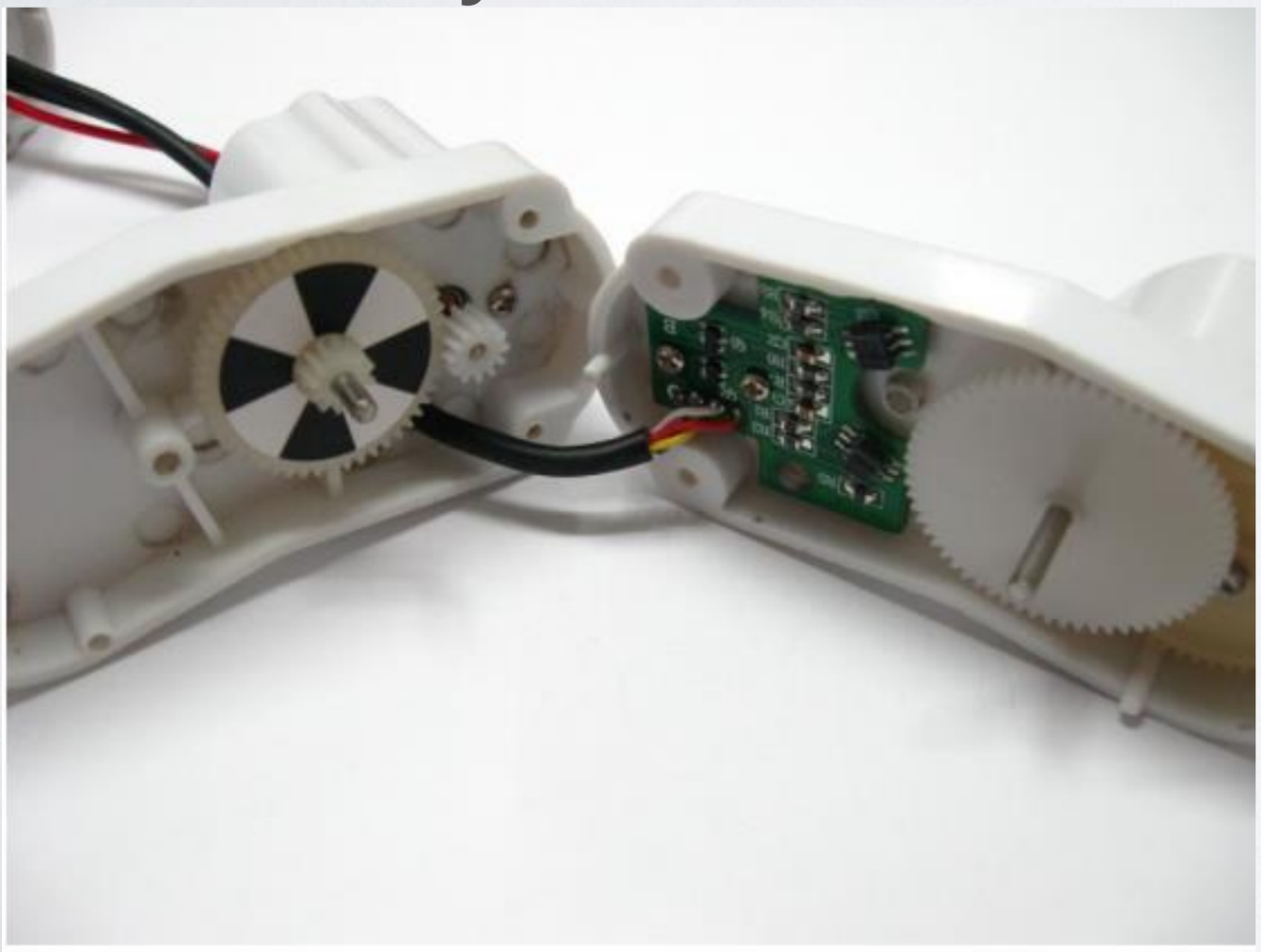


Image Credits: Dagu & Sparkfun

Encoders

- Measure position of rotating joint
  - Can determine Velocity and Acceleration through differentiation, in theory
- Errors Accumulate Rapidly

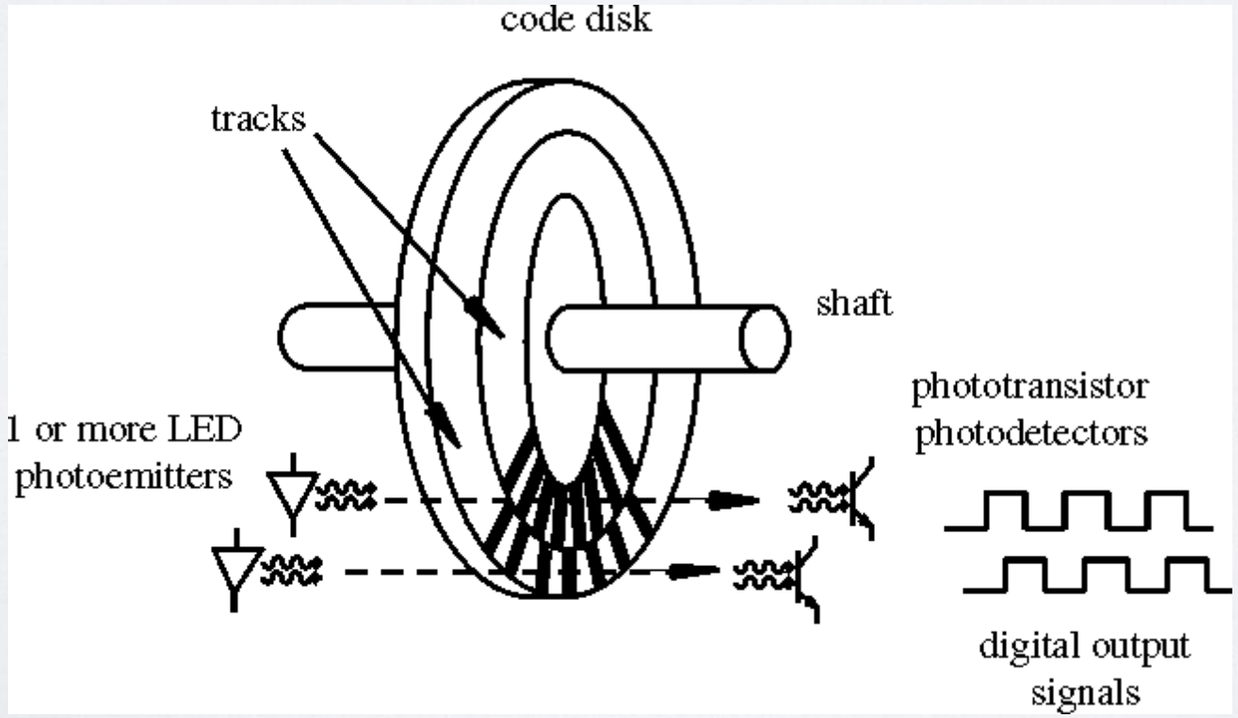
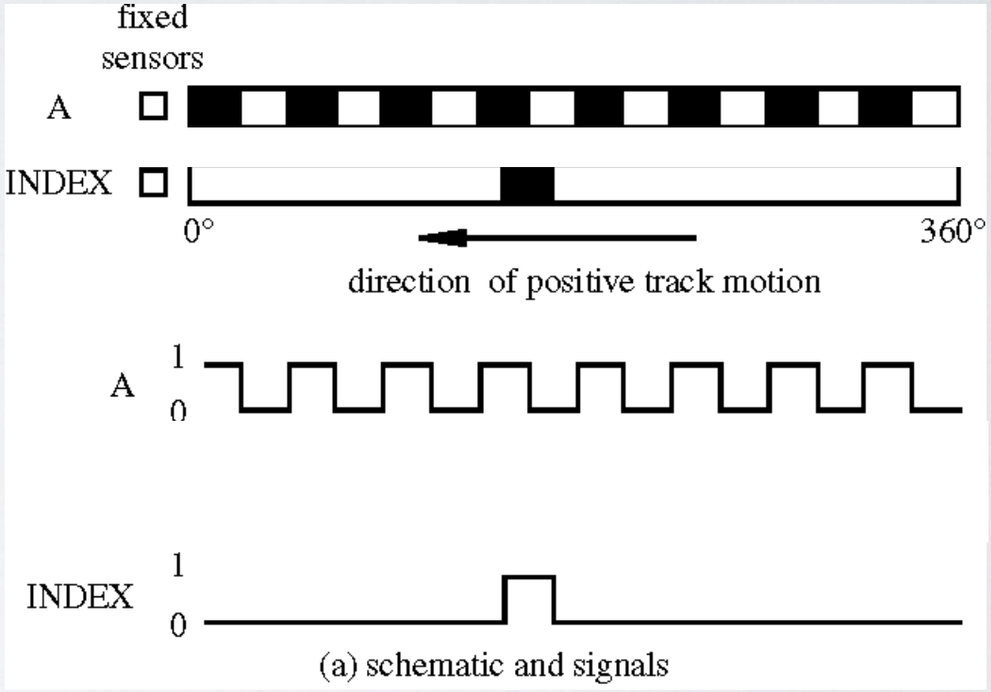


Image Credit: Dr. Leonessa

Incremental Encoders

- Signal order determines direction of rotation



- KHAN uses 1000 ticks/3rev

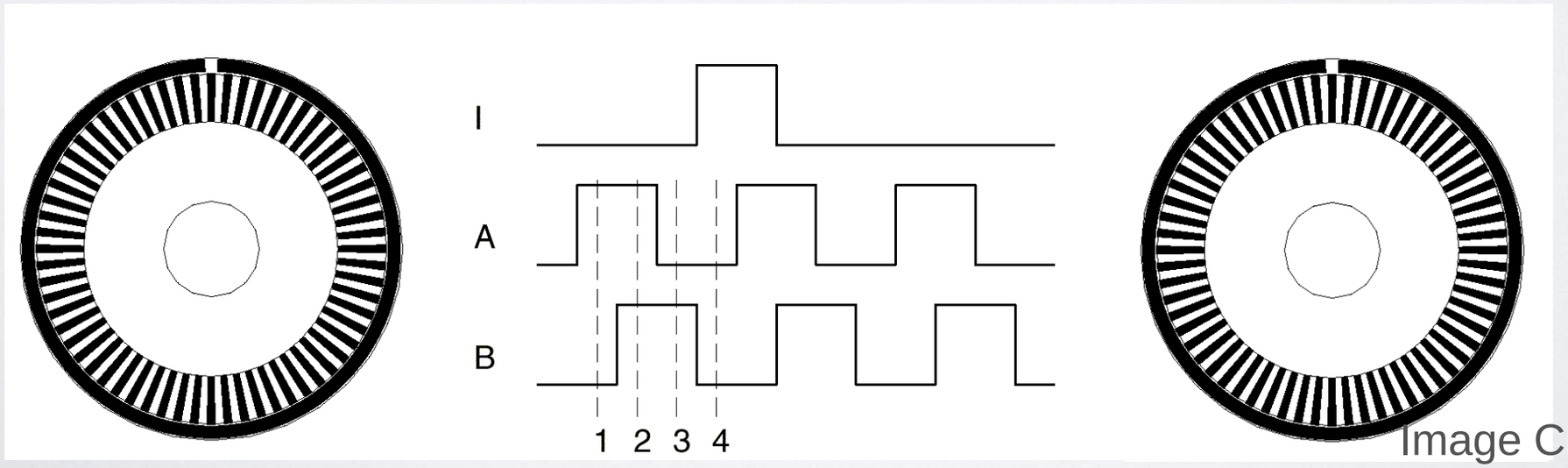


Image Credit: Dr. Leonessa

Quadrature

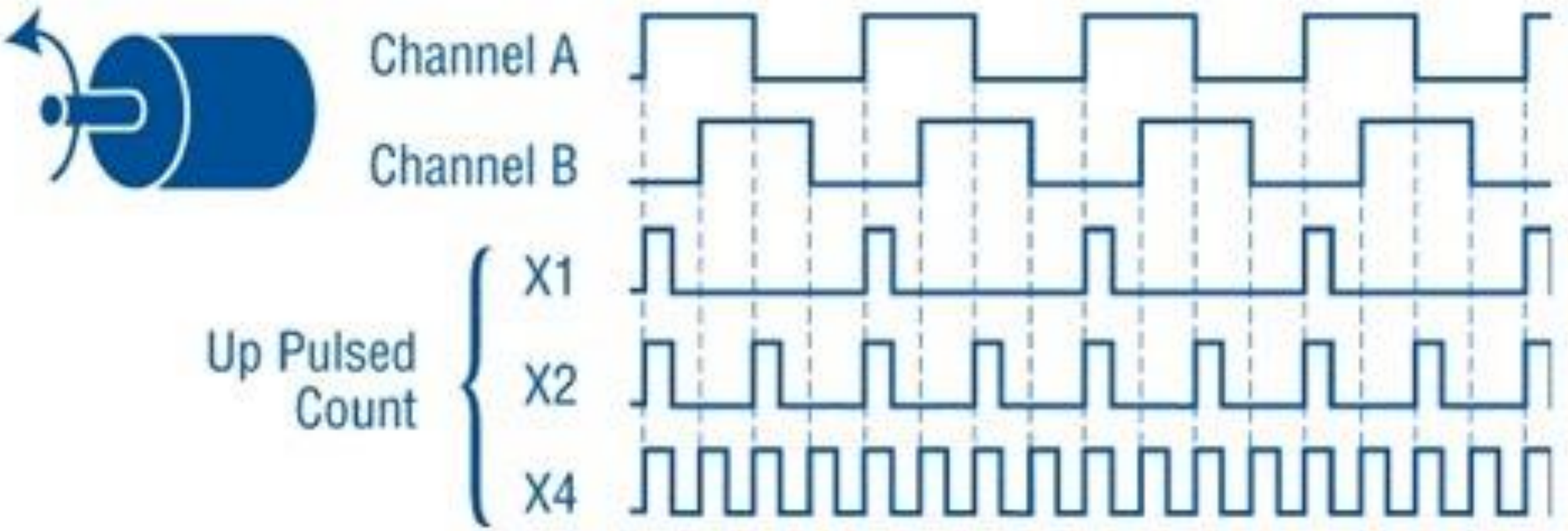


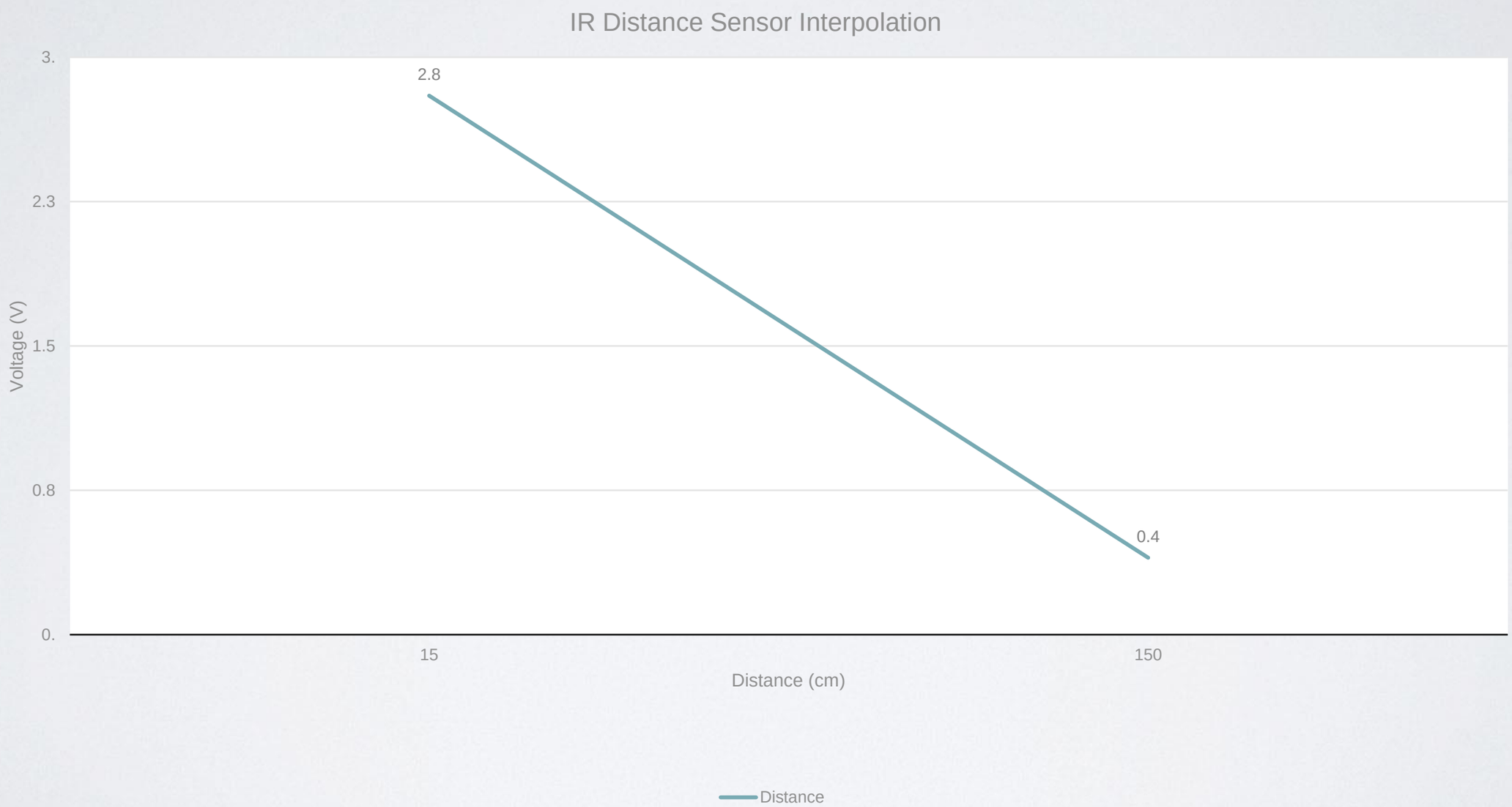
Image Credit: Dr. Leonessa

IR Distance Sensor

- Input – 5 VDC
- Output – 0.4V to 2.8V
- Range - 15cm to 150cm

Image Credit: Sparkfun

What's My Output Look Like?



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What's My Output Look Like?

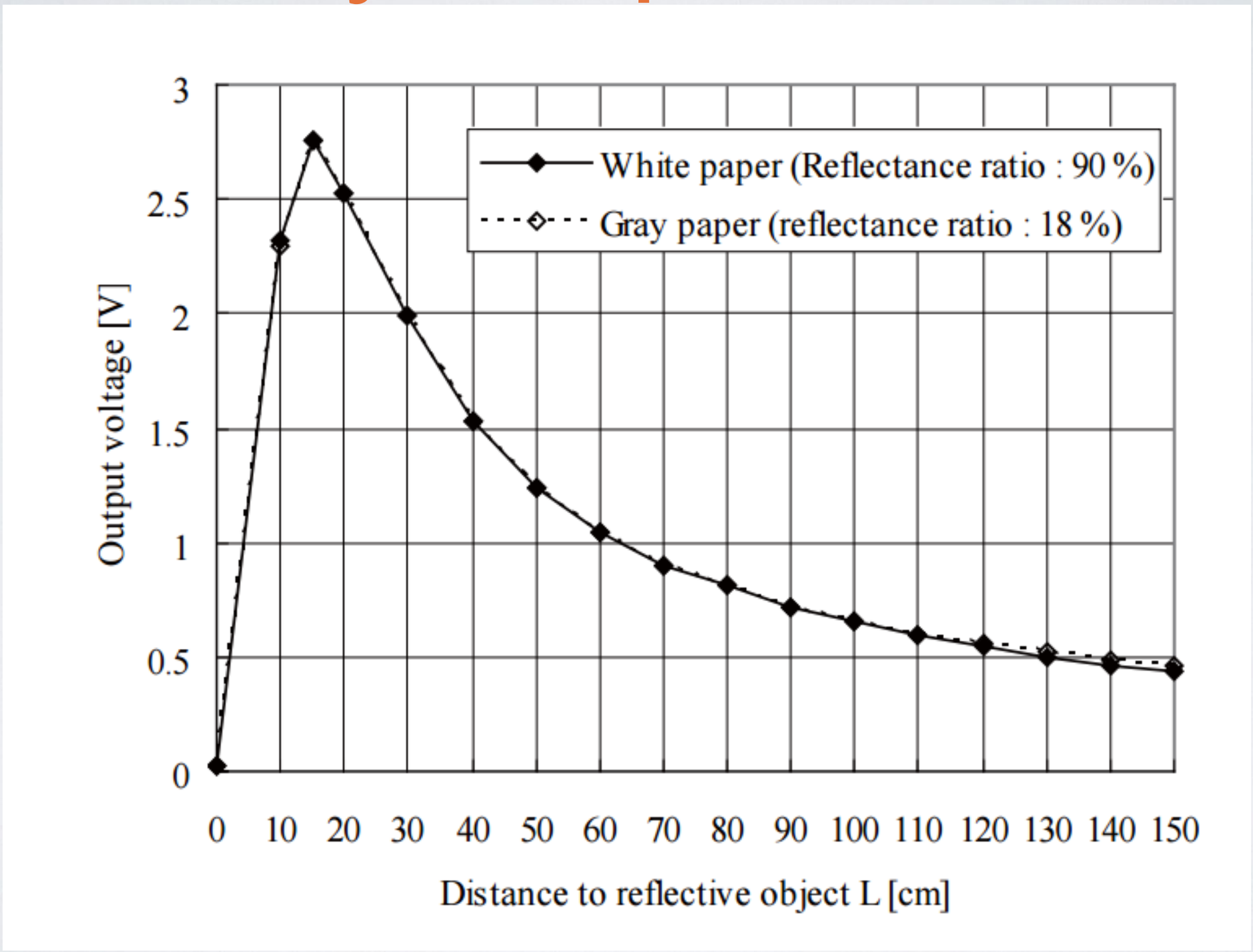

Image Credit: Sharp

Software Integration

- Translating data will be automated by KHAN's software (You will write some of it)
- Often a driver or ROS package for this will exist

Noise

- You cannot assume perfect data
- Errors in the signal are referred to as noise
- Can be reduced, but not eliminated

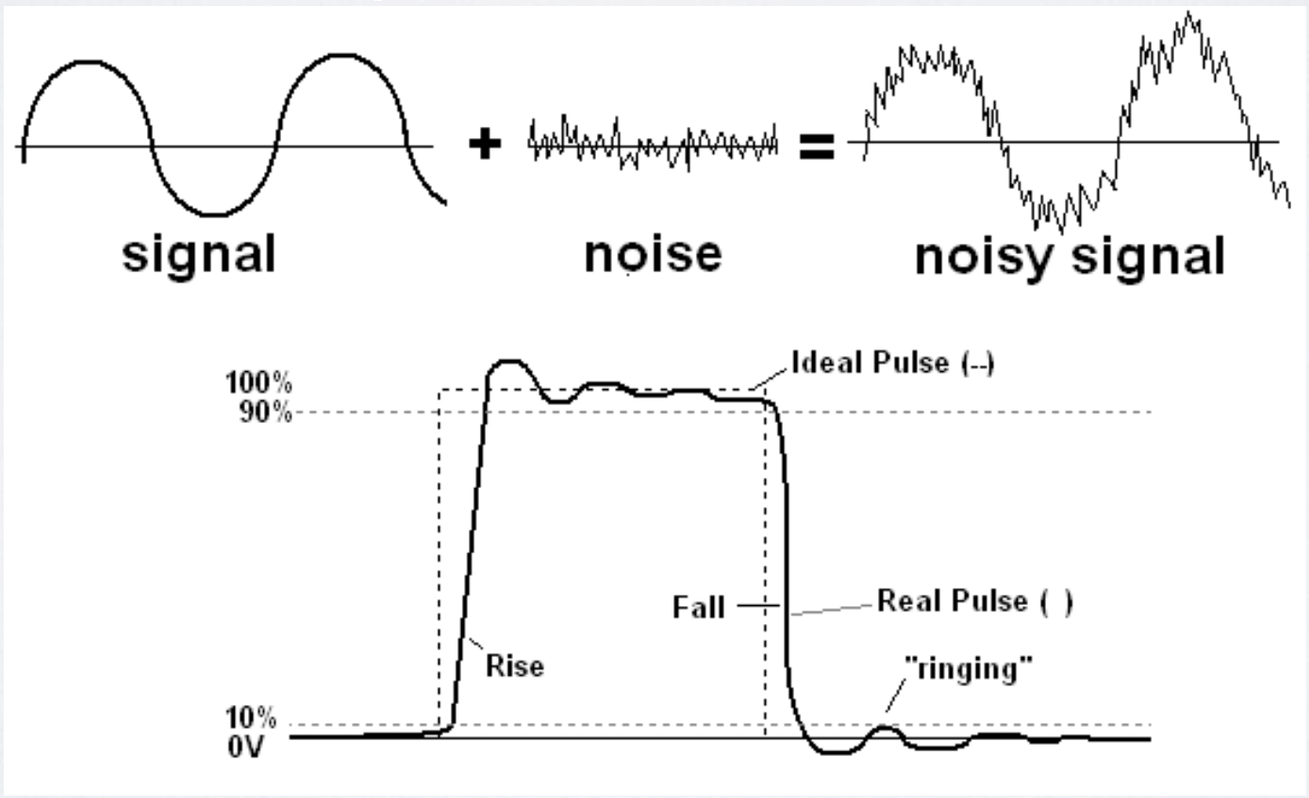

Image Credit: Electronics for Beginners

What Does All This Tell You?

- Adding a sensor to a robot can be much more complicated than just bolting it on
- The best sensor may not be the highest performing
- Good system design up front can save a lot of heartache

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Assignment 1

- Due at 11:55 Tonight
- Upload video to Scholar Dropbox
- Submit assignment as well
- If you can’t get everything working show what you have installed, and what problems you’re experiencing

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QUESTIONS?