

11<sup>th</sup> Annual



**Prevent  
Blindness**

Focus on Eye Health  
National Summit

# Eye-conic Approaches to Eye Health

**July 13–14, 2022**

*A Virtual Interactive Event*



# Open Collaborative Ecosystems for **Holistic Grassroot AT Innovation**

Dr. Kyle Keane

**Lecturer and Research Scientist**  
Massachusetts Institute of Technology

**Executive Director**  
With Participation Incorporated

# My Strange Career Path

- Age 2: Diagnosed with Retinitis Pigmentosa (degenerative eye disease)
- Age 15: Driving, Band/Drumline
- Age 16: No more night driving
- Age 17: Insufficient peripheral vision for band/drumline
- Age 18: No more driving
- Age 19-23 (undergrad): Physics student (machine shop, computational)
- Age 24-28 (PhD): Physics (computational quantum computing)
- Age 28-30: Software engineering at Wolfram
- Age 31-38: Working at MIT (computational science, machine learning)

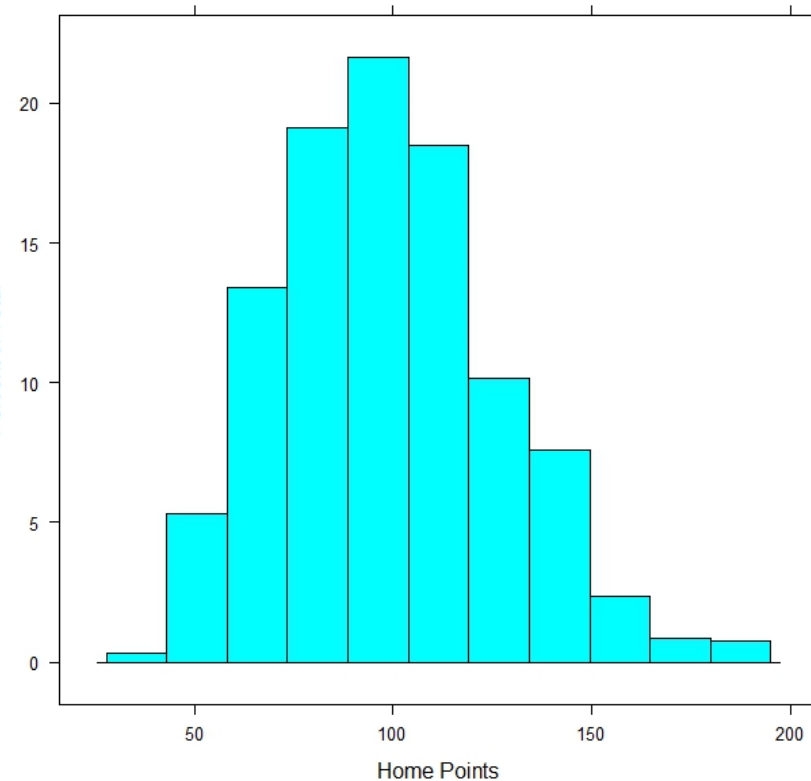
# Covert Career in Assistive Technology



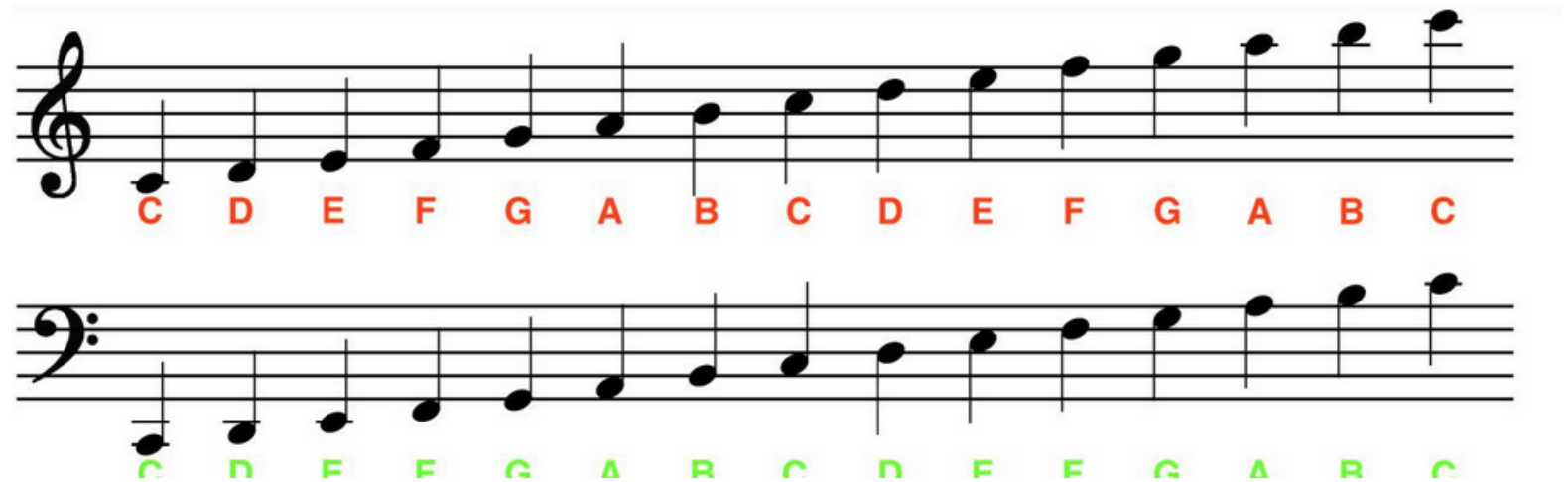
- Age 2: Diagnosed with Retinitis Pigmentosa (degenerative eye disease)
- Age 7-18: Junior Blind of America (VISIONS and Camp Bloomfield)
- Age 19-23 (undergrad): Consistently trying to get help from disability services, but physics is a strange degree with a lot of 2D math and Greek symbols
- Age 24-28 (PhD): Switched to computational work because electronics and machining were no longer possible. Began using color inversion and magnification on computers
- Age 28-30: Helped Siri speak WolframAlpha results, prototyped multiple techniques for doing science with a severe visual impairment, and learned the fundamental lesson that technology is much simpler than business
- Age 31-38: Teaching “Principles and Practices of Assistive Technology” and developing international programs for co-design

# 2D Formatted Information

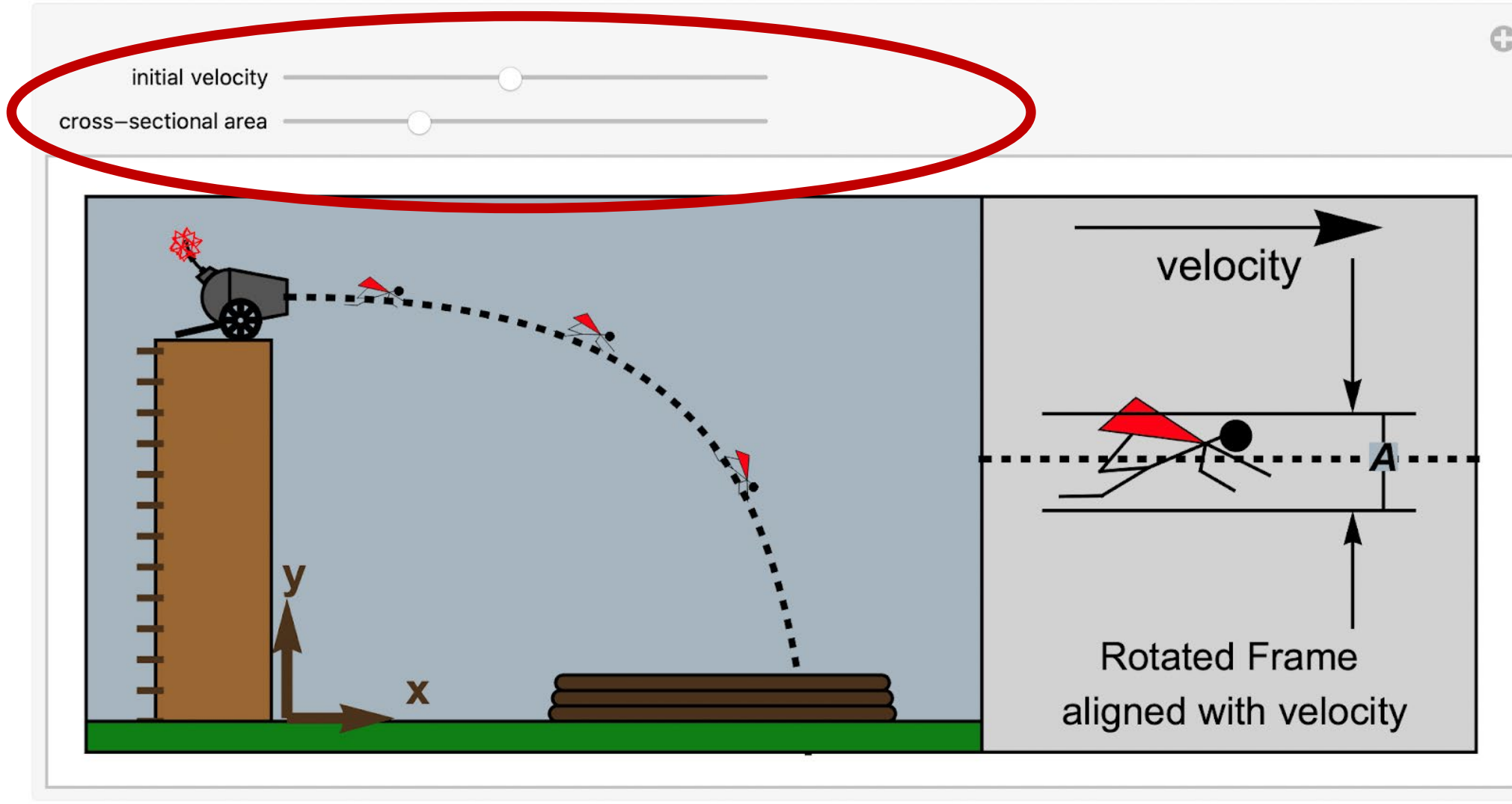
Histogram of Points Scored at Home  
AFL 2003-2007



$$x = \frac{-b \pm \sqrt{(b)^2 - 4ac}}{2a}$$



# Indirect Interactive Graphics



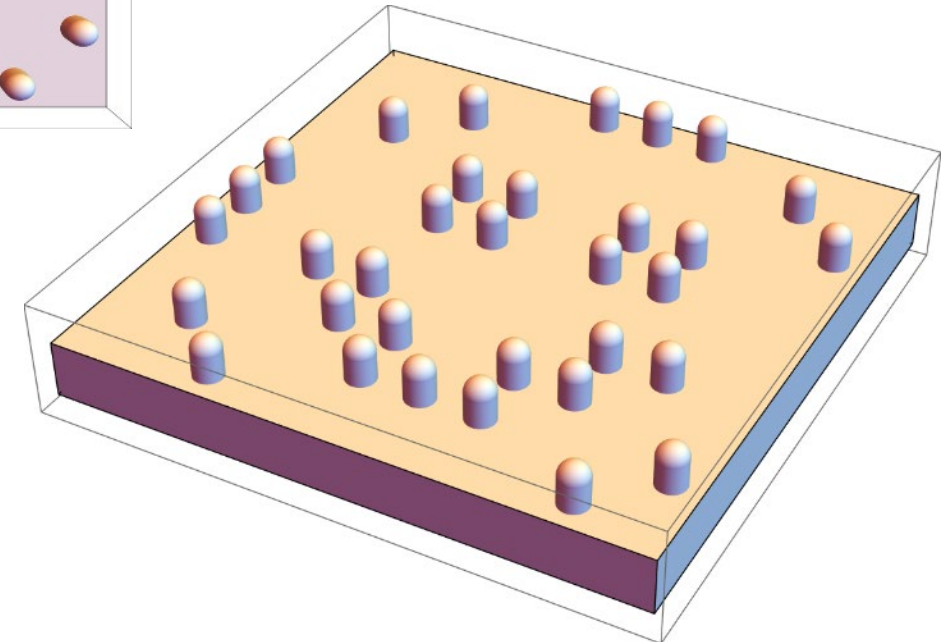
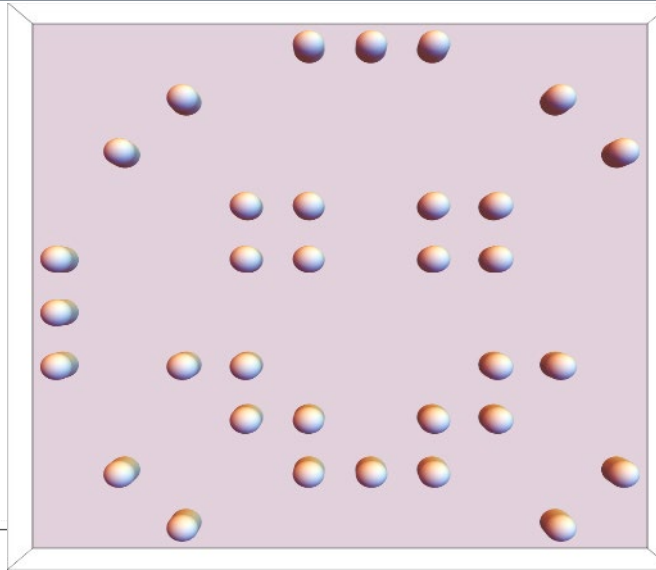
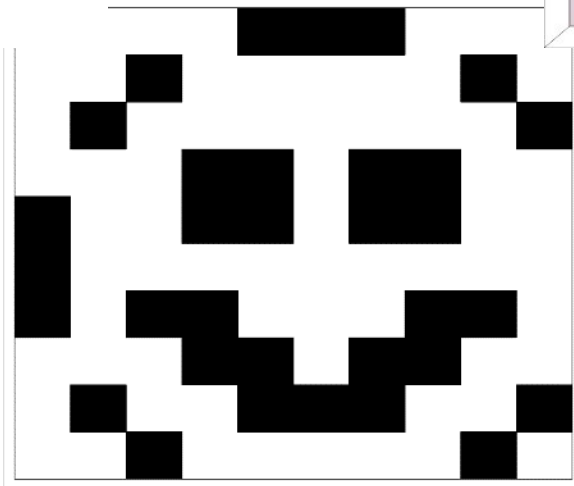


# Non-Visual Computer Representations



- Text
  - Time and space communicated through analogies that are sometimes not experienced with impairment in the same way
- Sound
  - Speech
    - Same as text, but with speech synthesis parameters like pitch rate, voice, ...
  - Sonification
    - Movie Style
    - Mouse- or Touch-Driven Sonification
- Touch (Haptics)
  - Vibration (Single Motor like in a Phone/Tablet)
    - Delivery is only on or off, and linked to single exploration point

# Pin Arrays





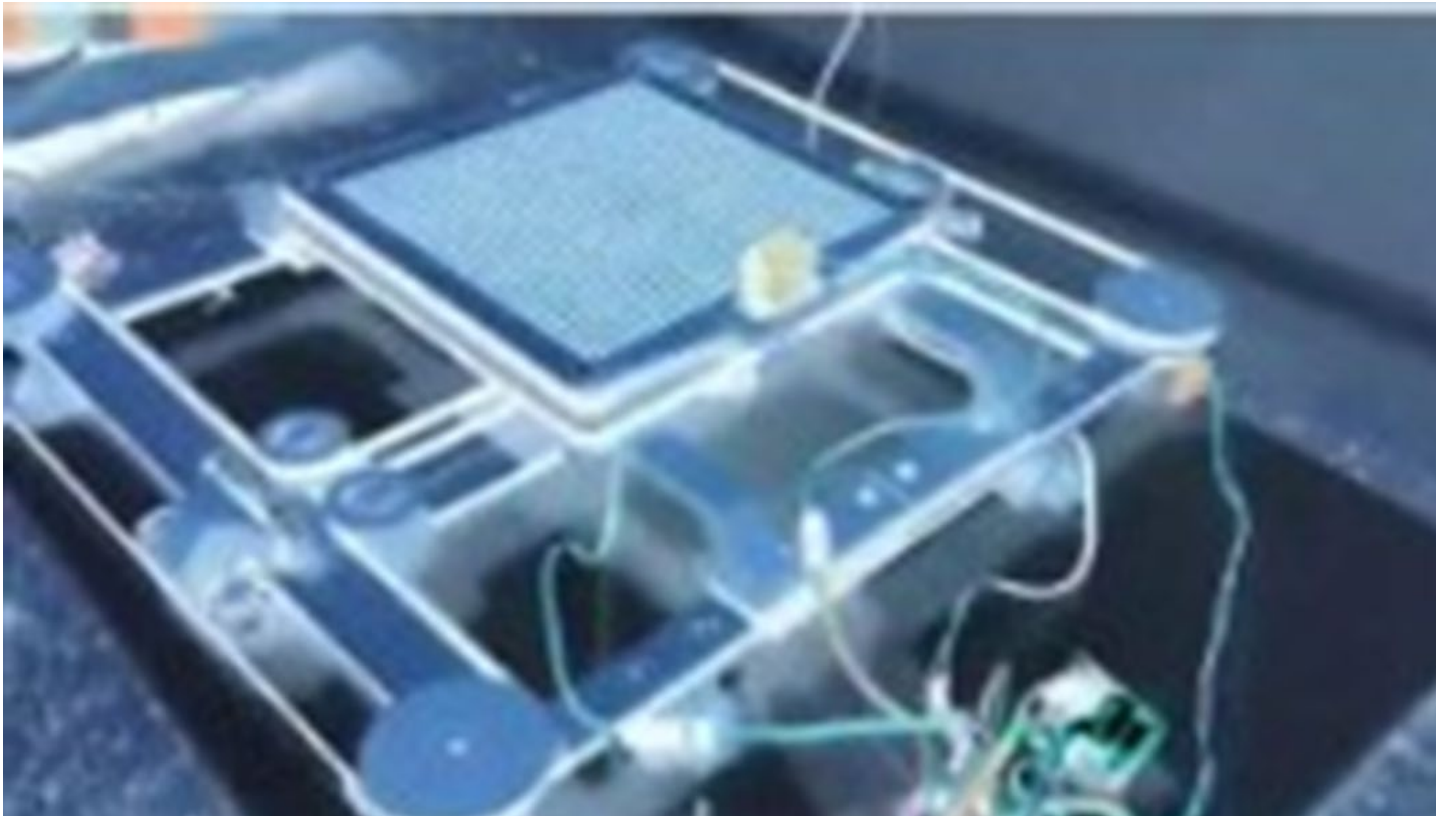
# Commercial Pin Arrays



- Array of pins arranged in a grid
- Current landscape is 40x60 pins
- 2400 individually controlled pins cost ~\$1/pin
- Additional costs like remaining parts, assembly, insurance, distribution, ...

***Current devices \$8k-\$15k***

# Our Design – Separate Electronics

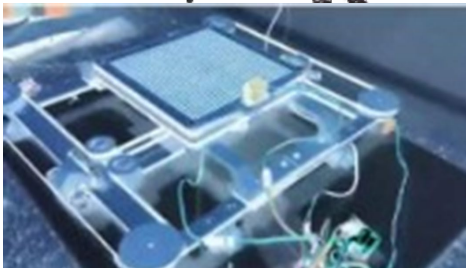


- Array of pins arranged in a grid
- Can scale to larger resolution
- 2400 passive pins cost ~\$0.00001/pin
- Additional costs like remaining parts, assembly, insurance, distribution, ...

***Bill of Materials = \$35***

# Open Ecosystem for Innovation

University #1



## Conference and Competition

Learn from each other while  
managing to navigate the  
complexities of local contexts  
for materials, labor, demand

University #2



# Business Models

## Traditional

Company must handle...

- Intellectual Property
- Legal issues
- Product Design
- Manufacturing
- Marketing
- Distribution
- Customer Support
- Iterative Improvements

## Distributed

Company must handle...

- Intellectual Property
- Legal issues
- Customer Support

International Competition

- Product Design
- Manufacturing
- Marketing
- Distribution
- Iterative Improvements

# Think Global, Act Local, and Coordinate



- Supply Chain
- Local Talent and Skills





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