

## Motivation

- **Visual impairment:**
  - 285 million worldwide, 7 million in US
  - Requires navigational assistance
- **Current navigational aids** have limitations:
  - **White cane:** Limited reach and resolution
  - **Guide dog:** Very expensive (>\$40,000)
  - **State of the art solutions:** Impedes daily tasks, limited resolution

### Mission:

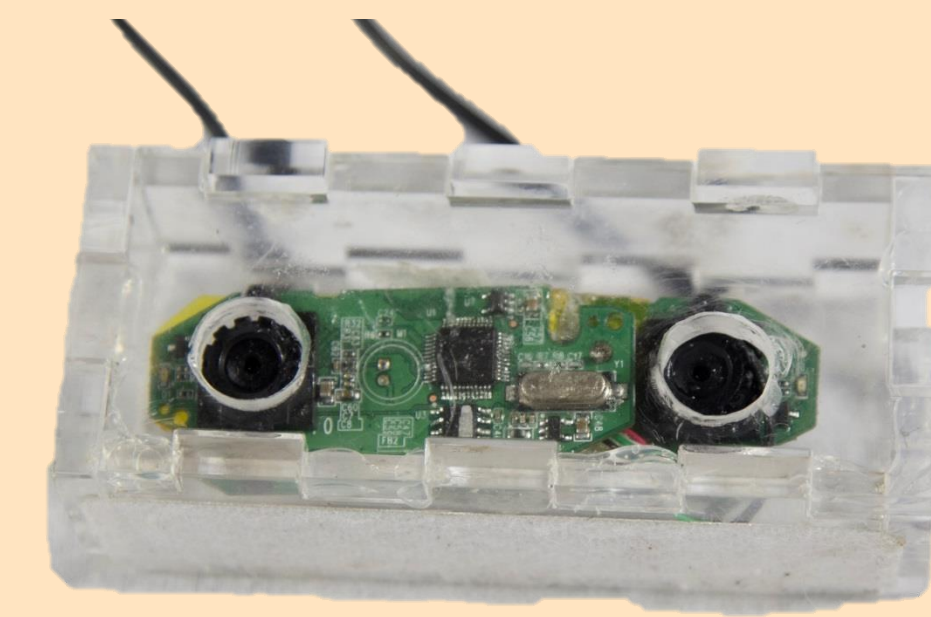
Supplement the white cane to warn users of otherwise undetected hazards

### Key Design Criteria

Ability to detect objects	Detects objects >12 feet away & 1-7 feet high	✓
Ease of use	< 5 minutes to equip	✓
Versatility	Works outdoors and indoors	✓
Durability	Withstands everyday use	✓
Lightweight	< 5 pounds	✓

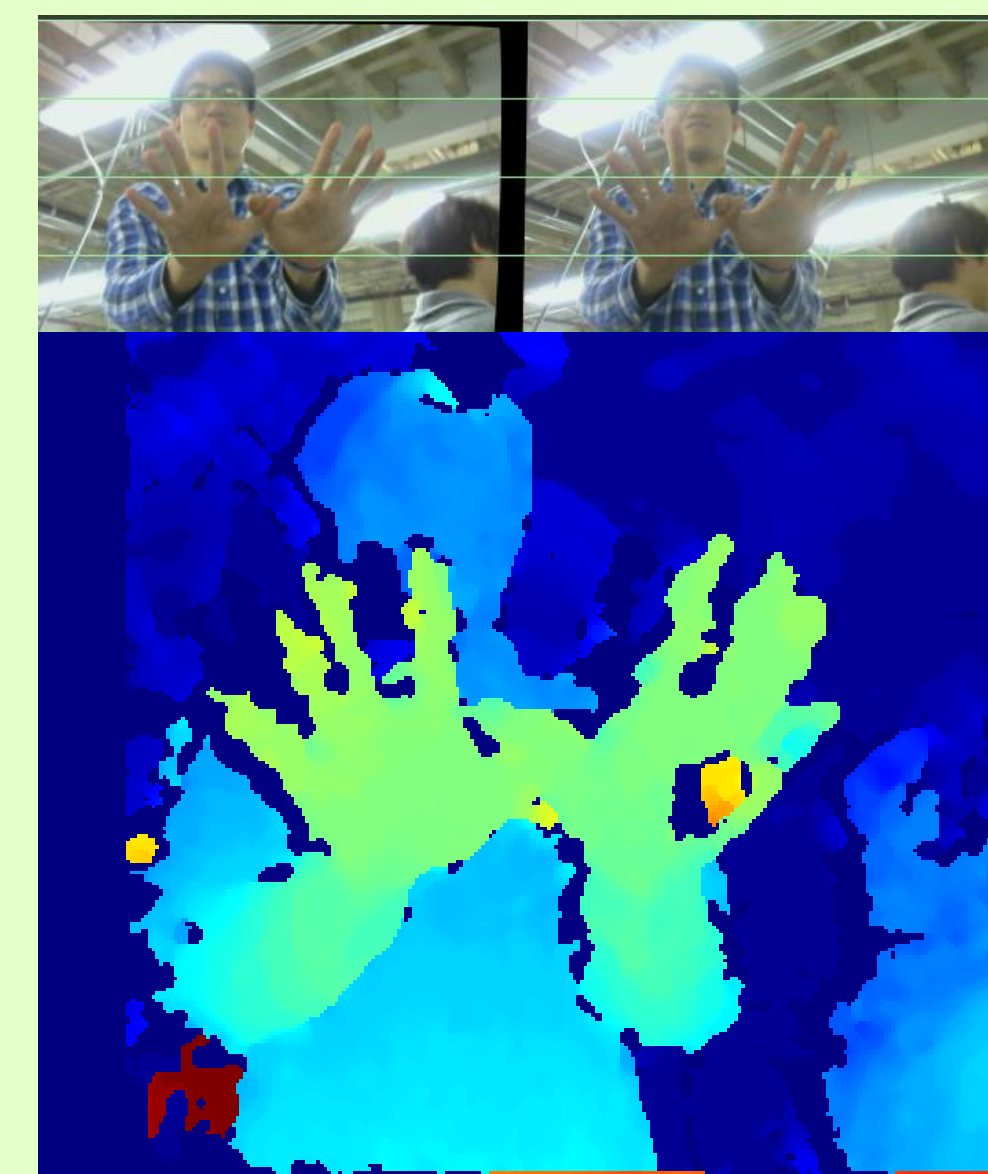
## The ARCANE Seamlessly Portrays your Surroundings

### 1 Stereo Cameras



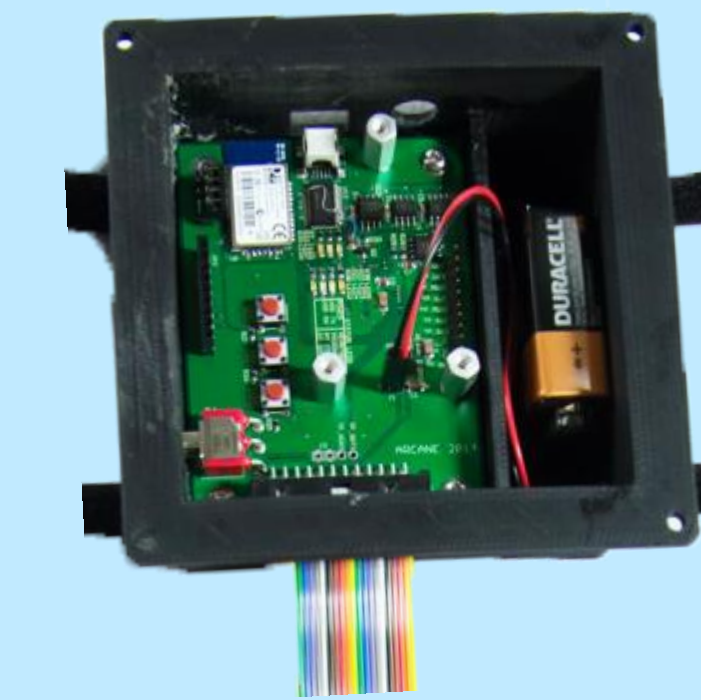
- Two RGB cameras aligned horizontally in a weather sealed case
- Placed on head for control & minimal blurring

### 2 Image Processing



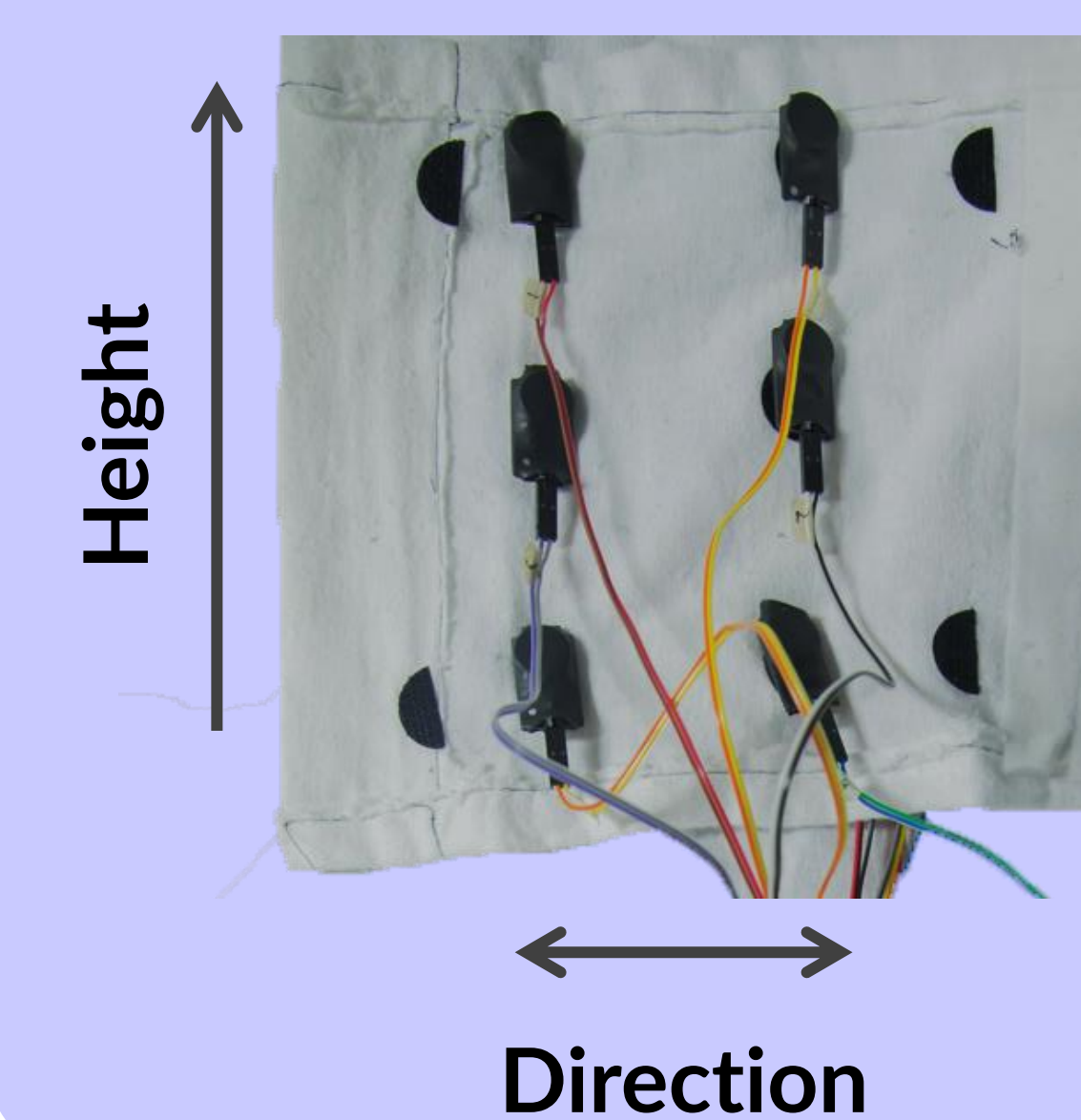
- Generates depth map through semi-global block-matching algorithm
- Extracts 6 depth areas
- Transmits to the haptic controller via Bluetooth 10 times per second

### 3 Haptic Controller

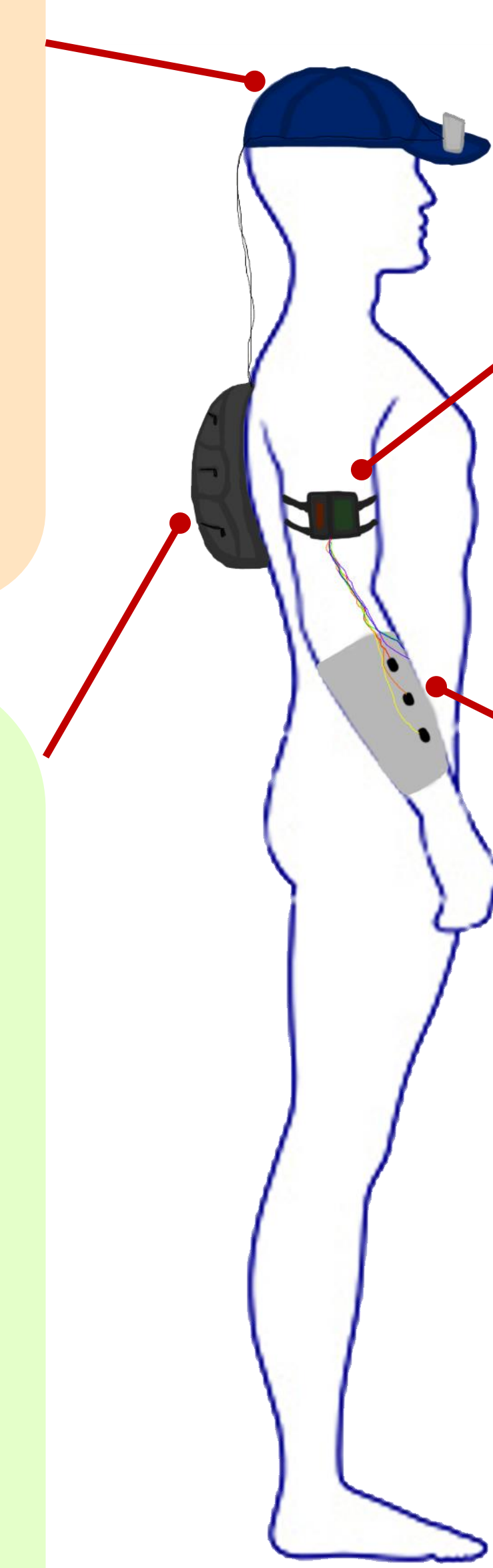


- Drives motors on sleeve
- Adds tilt compensated compass functionality

### 4 Tactile Feedback



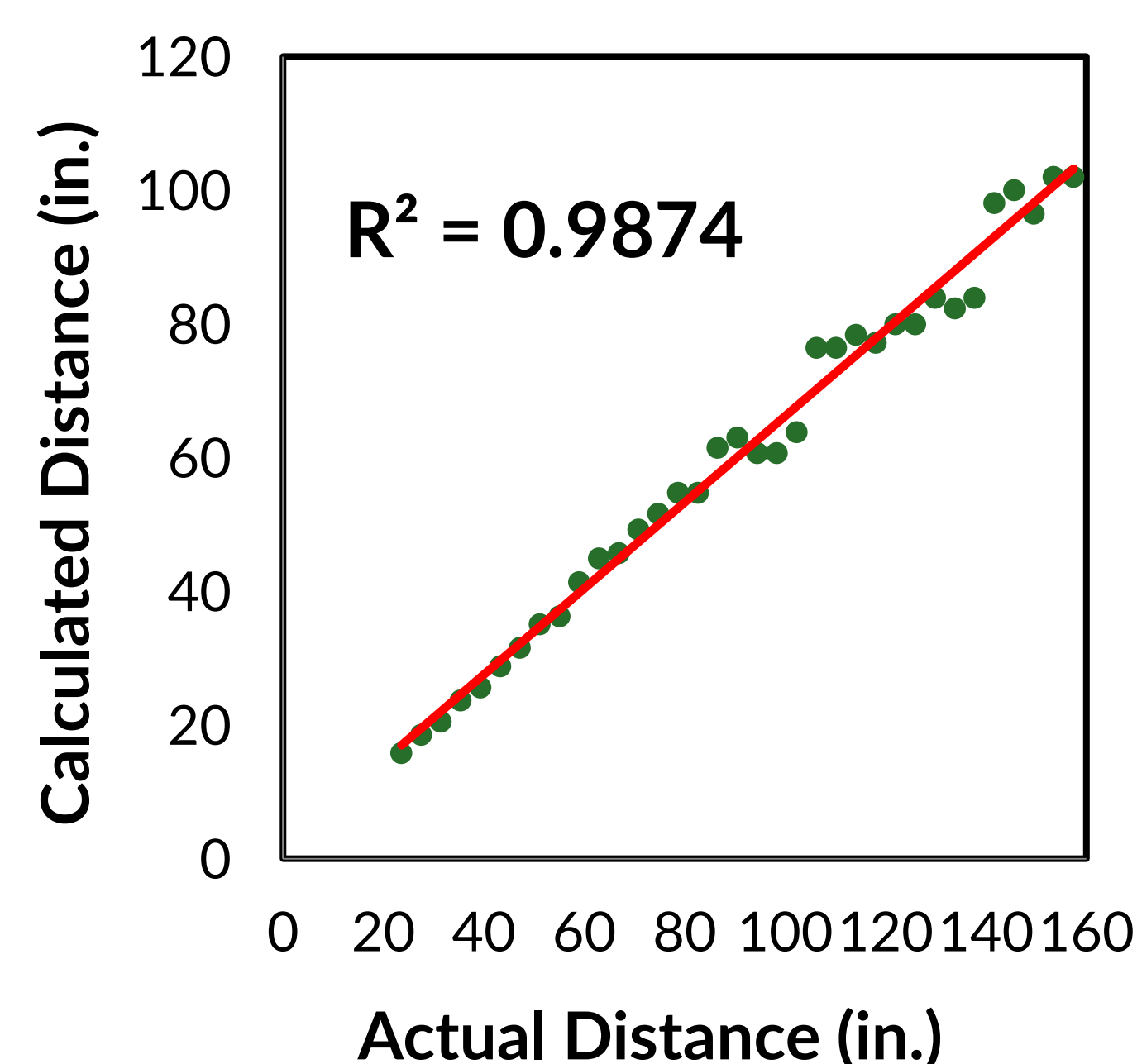
- Grid of motors vibrate with varying intensities to indicate obstacle location and proximity
- Optimal layout determined after testing



## Benefits of Portable Stereovision

- **Stereovision** presents major advantages:
  - Works in outdoor settings vs. structured light
  - Provides higher resolution vs. ultrasonic sensors

### Stereovision Accuracy



### Stereovision Resolution

Distance from cameras	Smallest identifiable object
9 feet	CREDIT CARD
6 feet	DURACELL
3 feet	Quarter coin

## Testing Results

### % Accuracy Map of Vibration Layout

93% (26/28)	83% (25/30)
86% (25/29)	57% (16/28)
66% (19/29)	79% (23/29)

- Conducted tests on 7 blind-folded individuals
  - 2 minutes of training
  - Vibrated individual motors
  - User identified location of vibration
- 78% success rate of identifying object location
- Users gained confidence and accuracy over time

## ARCANE: The Future of Visual Aids

The ARCANE enables users to:

- Detect obstacles that they might not be able to identify (e.g. overhead obstacles)
- Gain additional time to react to surroundings
- Overcome the shortcomings of the white cane and guide dog

Team ARCANE looks forward to making this design more compact and portable for everyday use.

## References & Acknowledgements

A. Mandal, "What is visual impairment?" [Online]. Available: <http://www.news-medical.net/health/What-is-visual-impairment.aspx>  
 Danielsen, Chris. "What It Means to Walk with a White Cane." National Federation for the Blind. N.p., n.d. Web. 20 Feb. 2014. [Online]. Available: <https://nfb.org/images/nfb/publications/bm/bm07/bm0702/bm070205.htm>.  
 Mathworks. "Stereo Vision." Mathworks. N.p., n.d. Web. 20 Feb. 2014. [Online]. Available: <http://www.mathworks.com/discovery/stereo-vision.html>.

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