



Rong-Hao Liang, PhD

Intel-NTU Research Center, National Taiwan University

Designing Physical Toys in Augmented Reality

Education

2011 - 2014, Ph.D. in Computer Science

National Taiwan University

2008 - 2010, M.S. in Electrical Engineering

National Taiwan University

Experiences

2014 - now, Assistant Research Fellow

Intel-NTU Research Center

2014 - now, Co-Founder

GaussToys



實體玩具 Physical Toys



平板遊戲 *Digital Games*



平板遊戲

Digital Games



*Ubiquitous Displays
(e.g. Tablets, Smartphones)*



平板遊戲

Digital Games



*Ubiquitous Displays
(e.g. Tablets, Smartphones)*

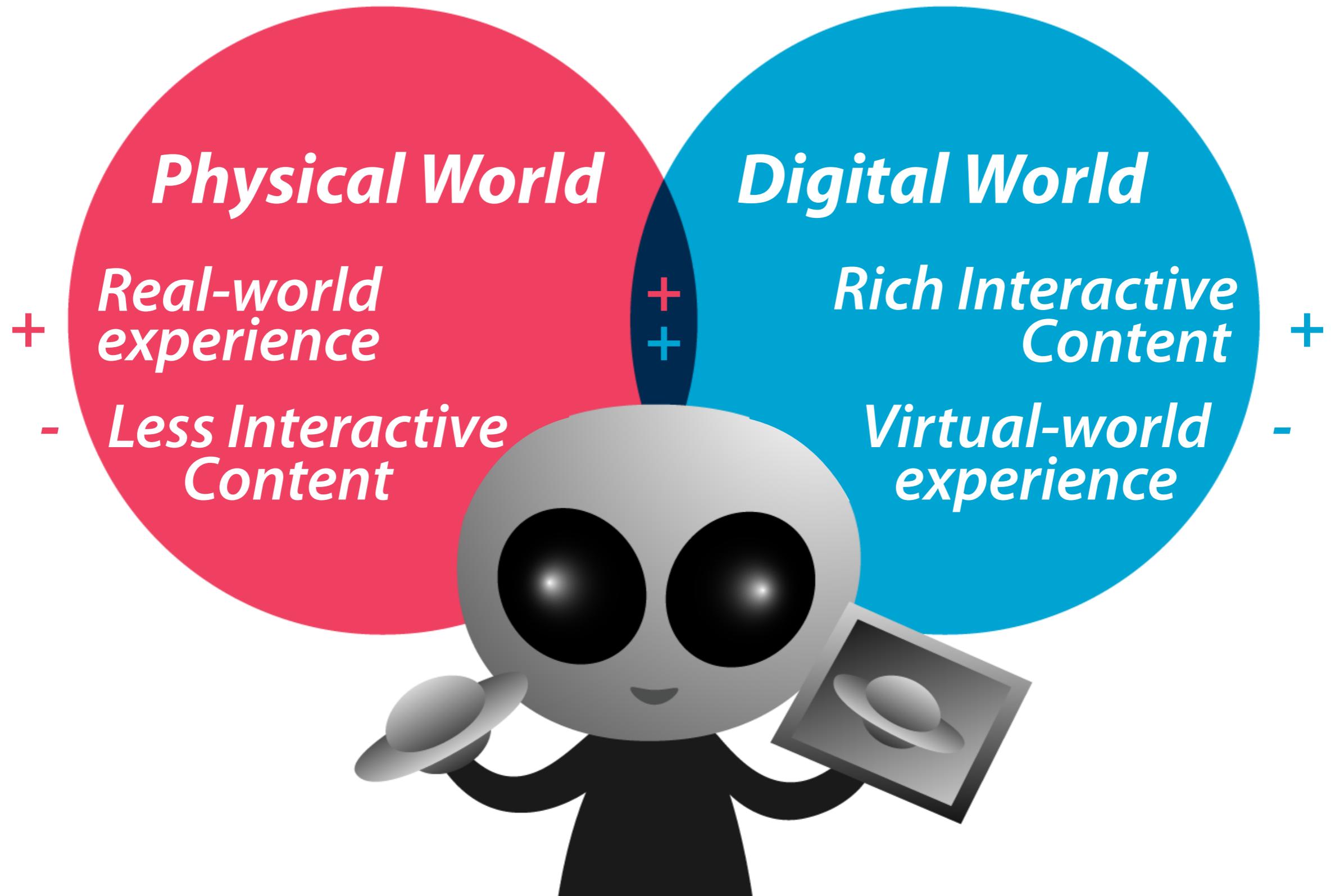




Big Challenge:
Closing the gap between virtual and physical worlds

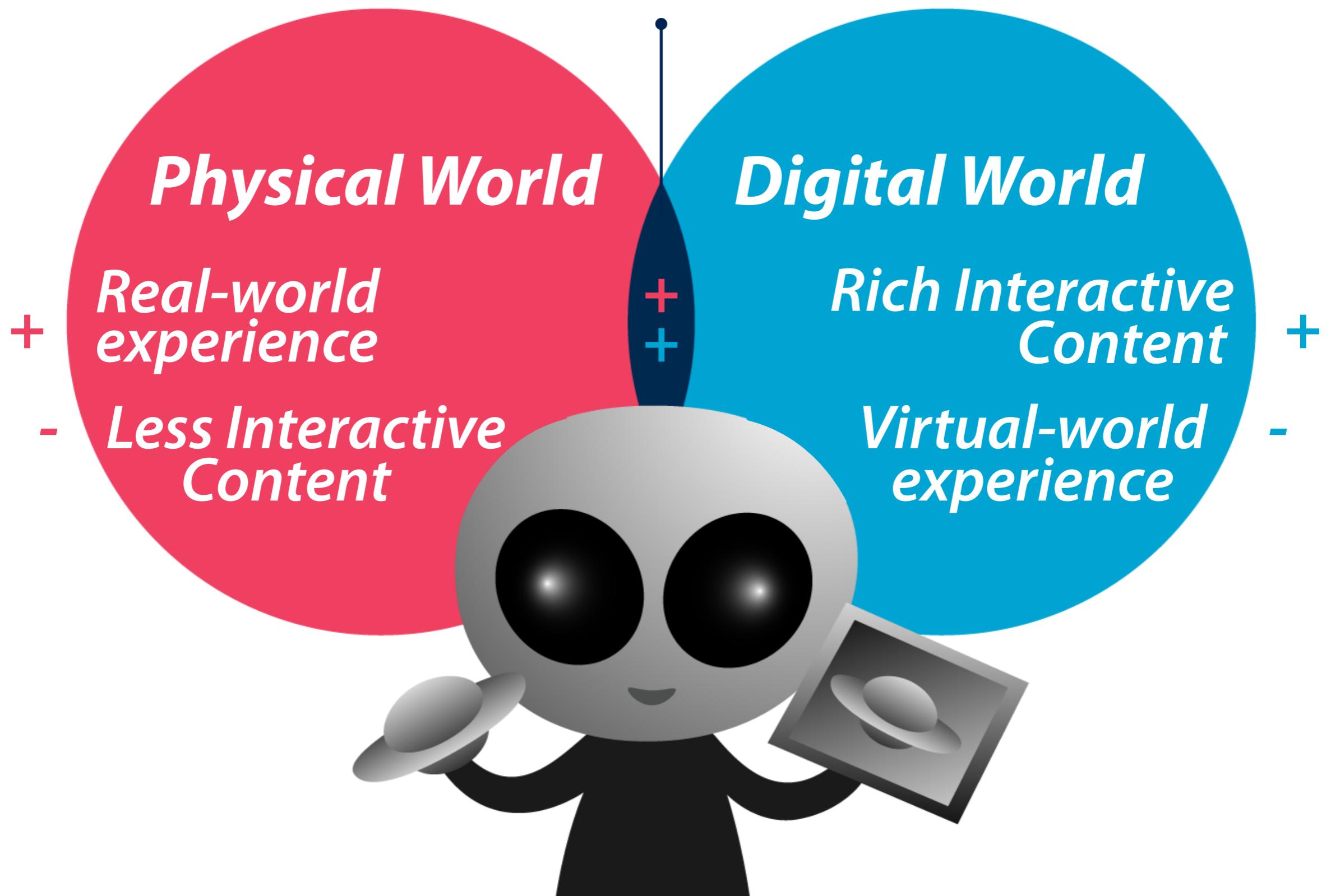
Big Challenge:

Closing the gap between virtual and physical worlds

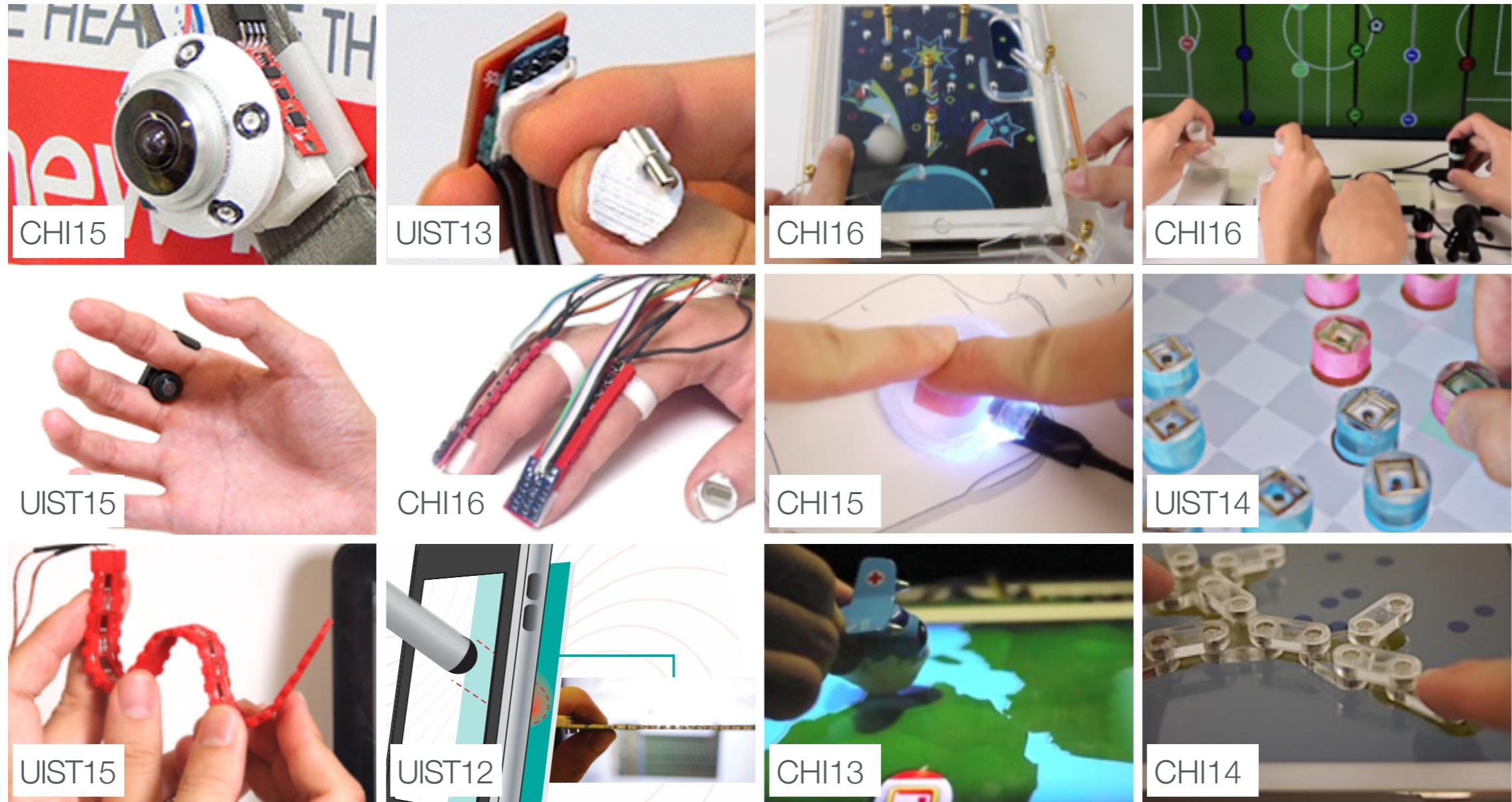


Tangible Augmented Reality

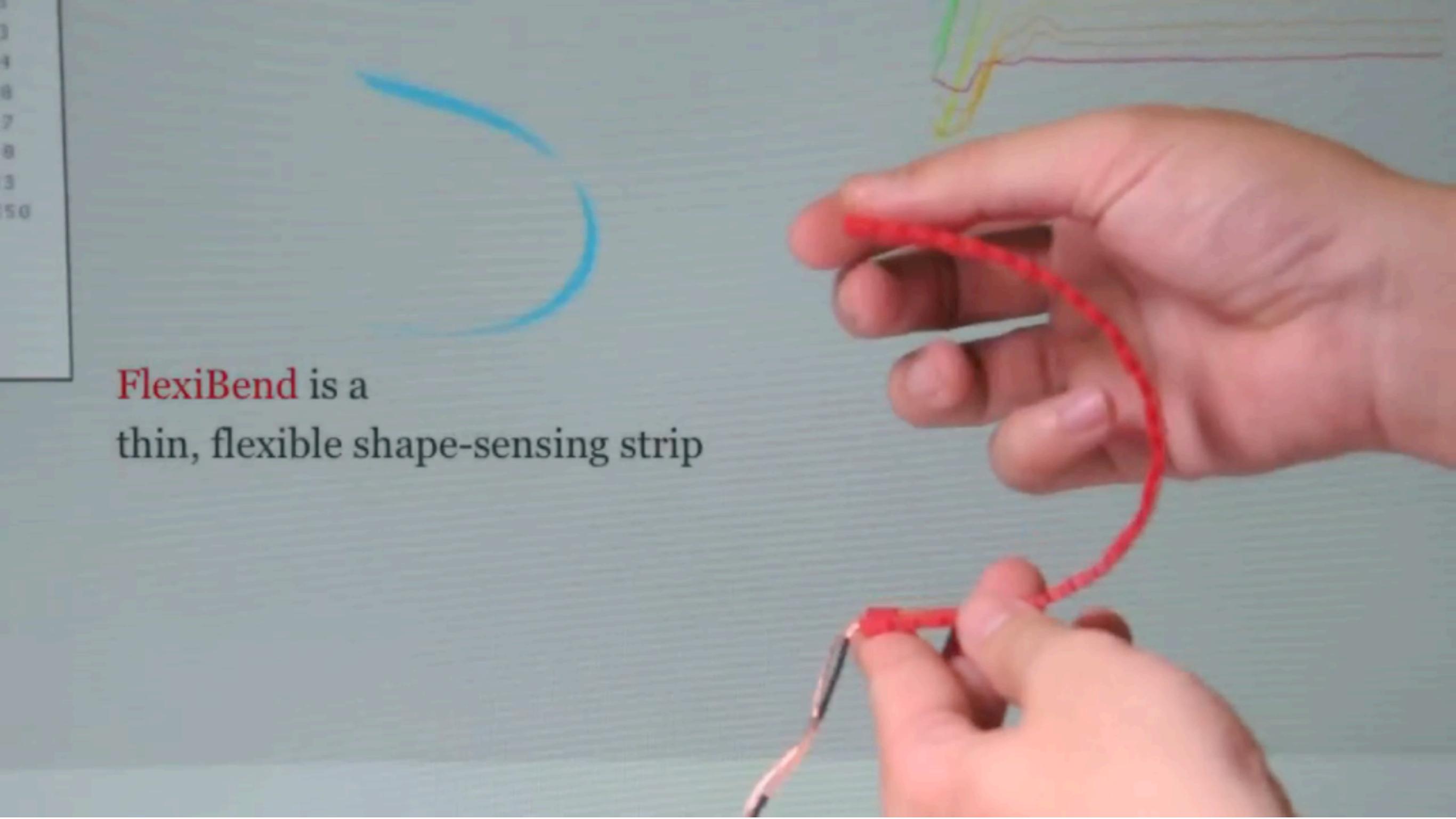
(a.k.a., **Tangible UI**)



Tangible Augmented Reality (a.k.a., *Tangible UI*)



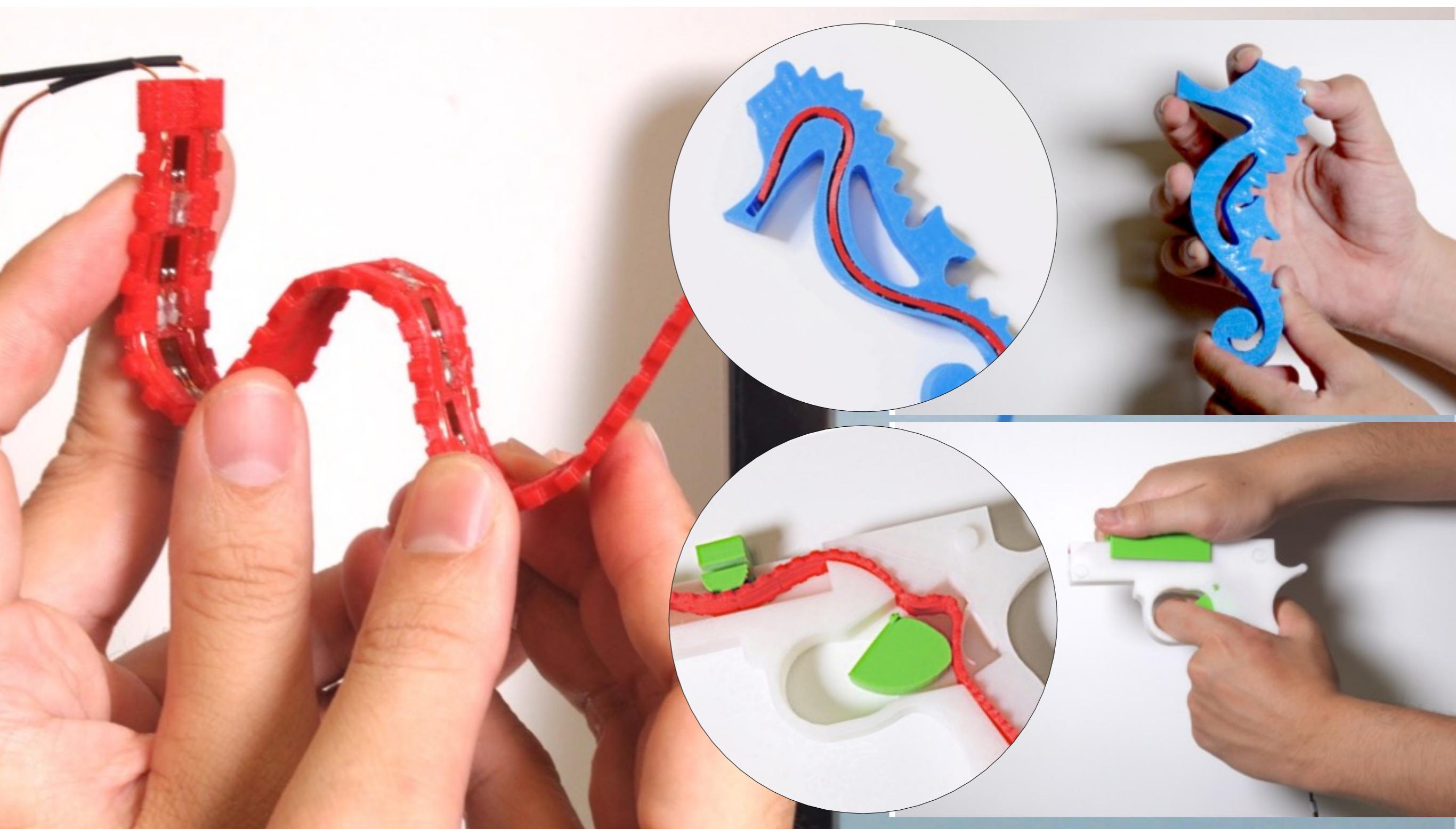
Innovative Tangible and Wearable Sensing (2012-Now)



FlexiBend is a
thin, flexible shape-sensing strip

Chin-Yu Chien, **Rong-Hao Liang**, Long-Fei Lin, Liwei Chan, Bing-Yu Chen
FlexiBend: Enabling Interactivity of Multi-Part, Deformable Fabrications Using Single Shape-Sensing Strip
ACM UIST 2015, pp.659--633, Charlotte, NC, USA. (acceptance rate = 23%)

Innovative Tangible Sensing



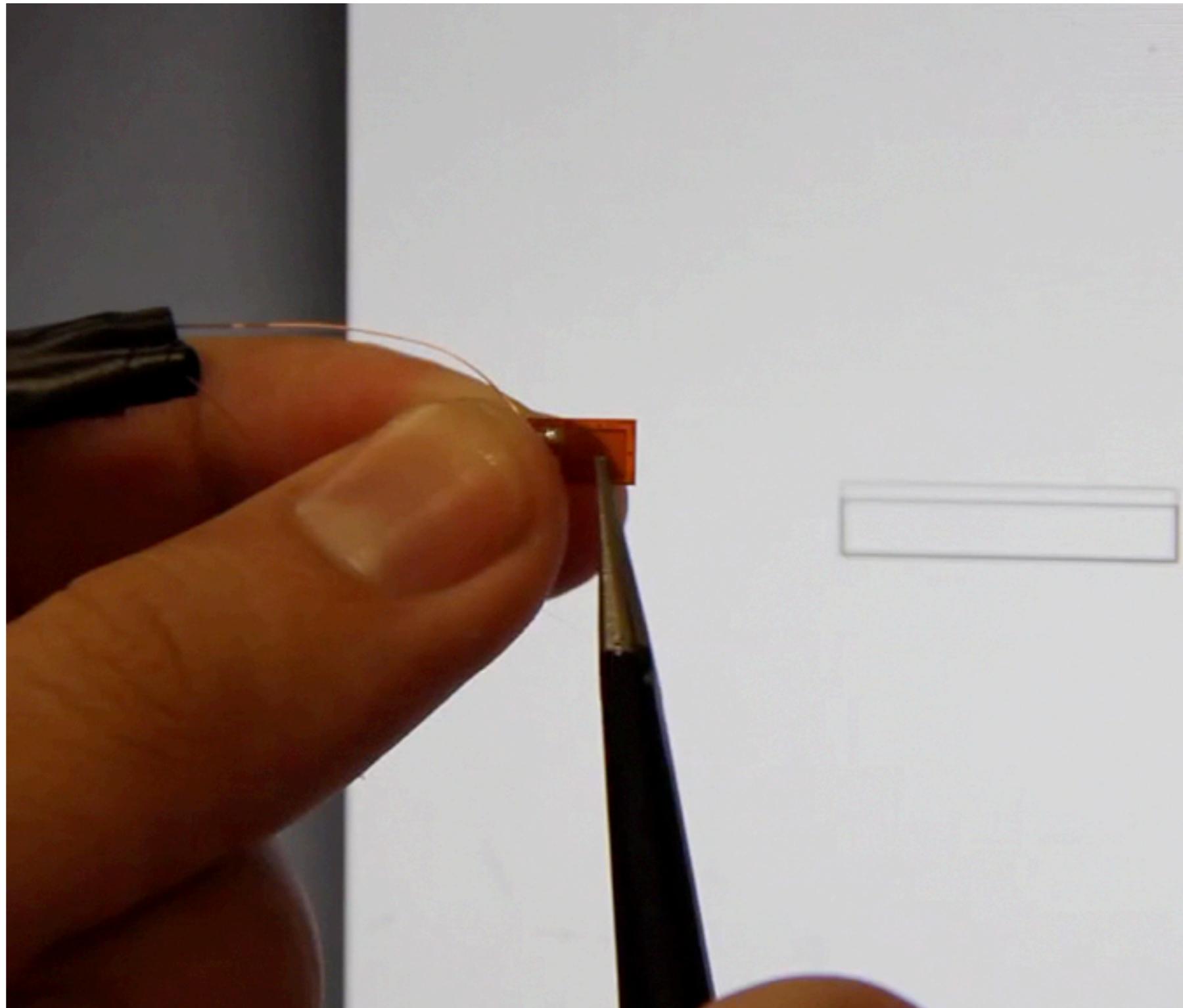
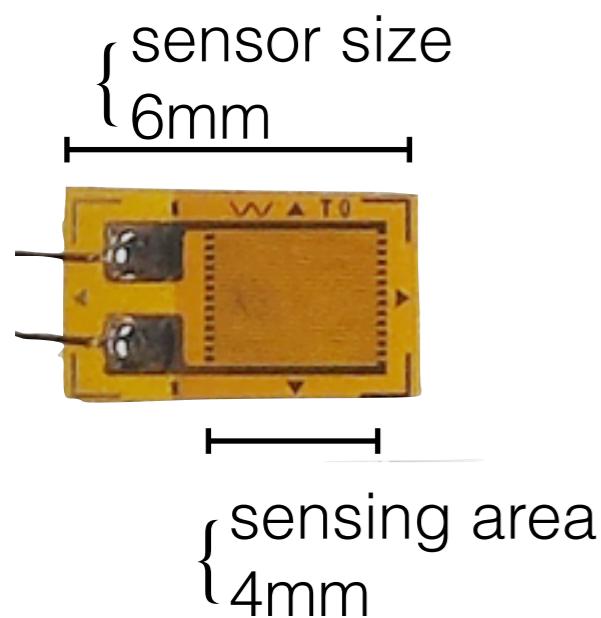
Chin-Yu Chien, Rong-Hao Liang, Long-Fei Lin, Liwei Chan, Bing-Yu Chen

FlexiBend: Enabling Interactivity of Multi-Part, Deformable Fabrications Using Single Shape-Sensing Strip

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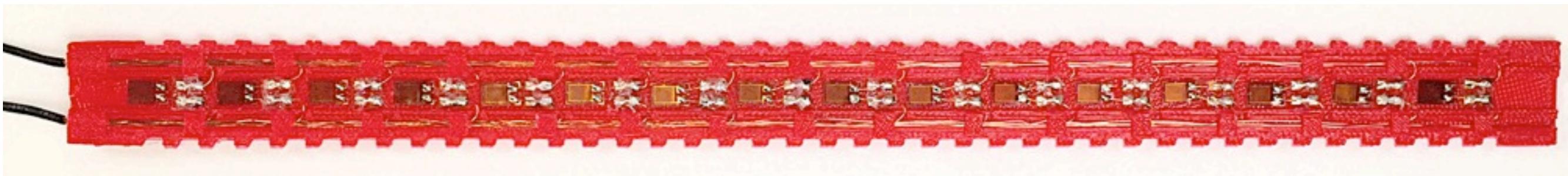
Innovative Tangible Sensing

Strain gauge



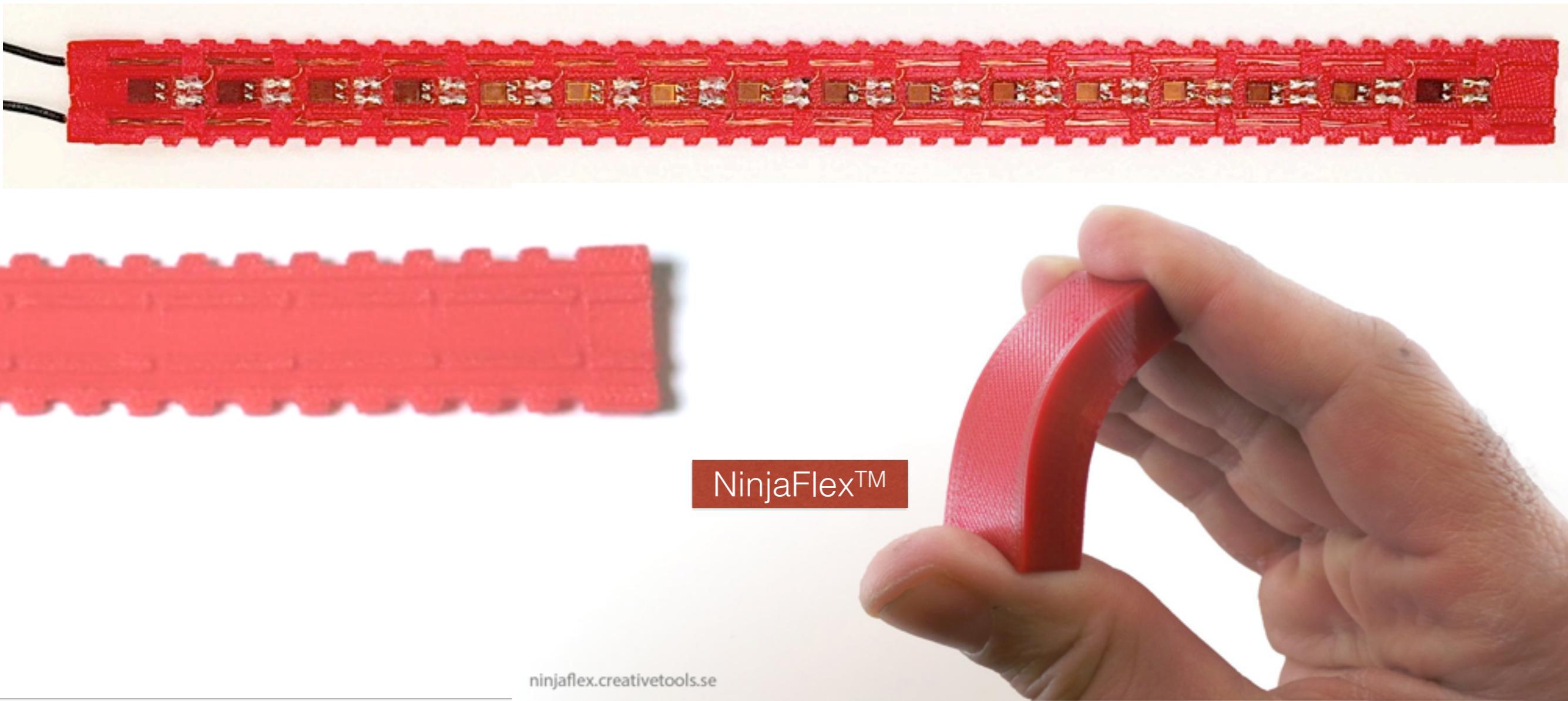
Innovative Tangible Sensing

Hardware Design



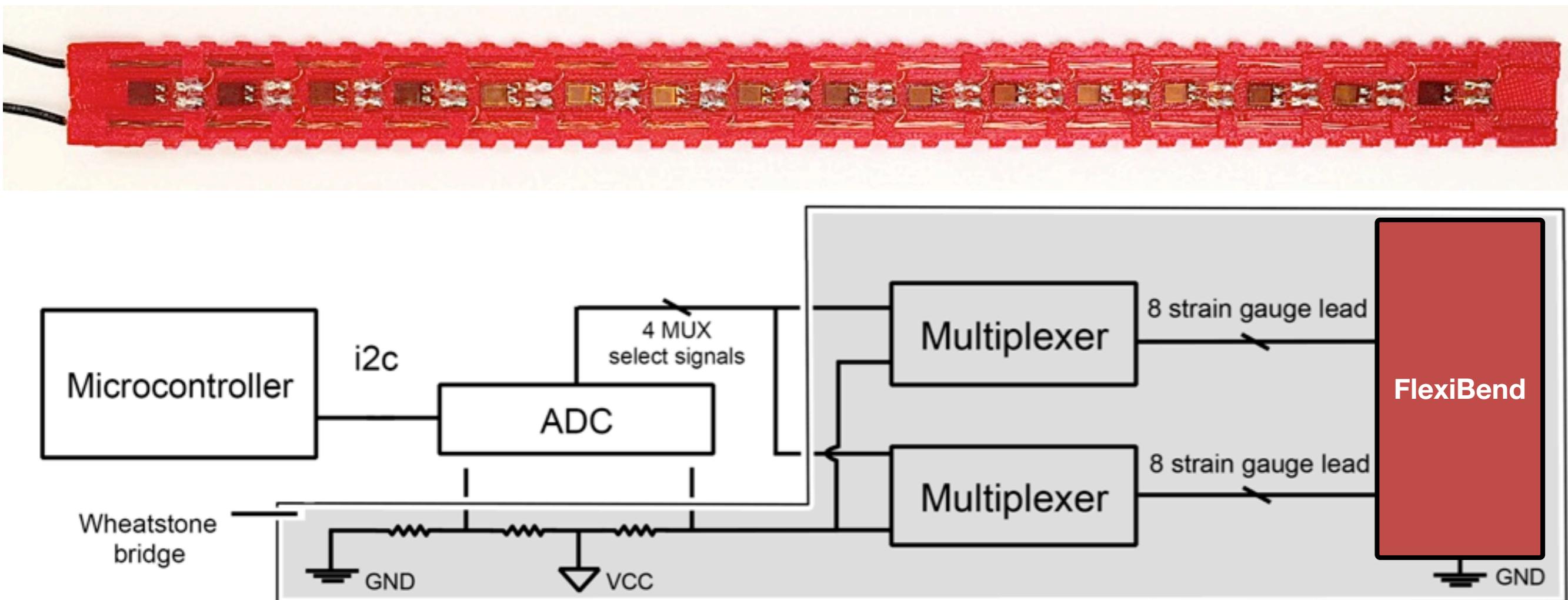
Innovative Tangible Sensing

Hardware Design



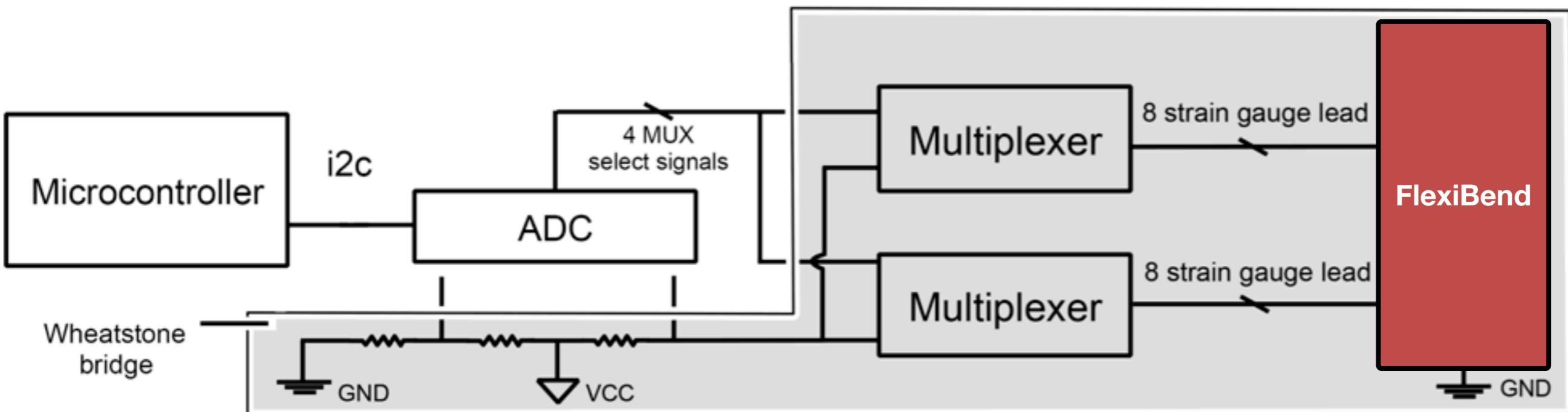
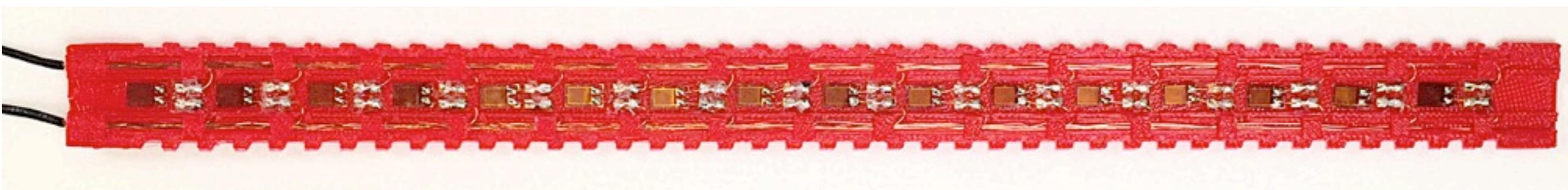
Innovative Tangible Sensing

Hardware Design

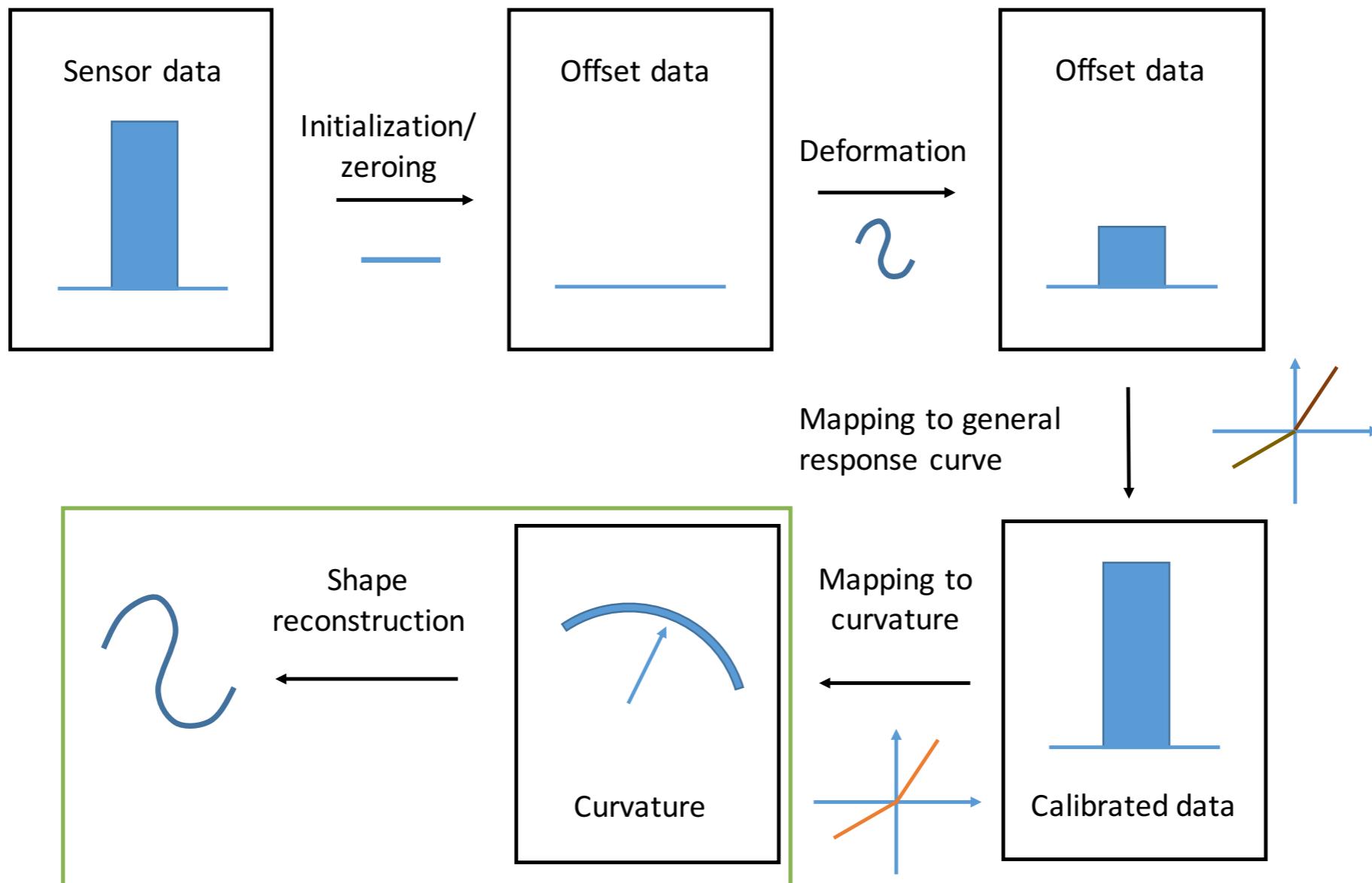


Hardware Design

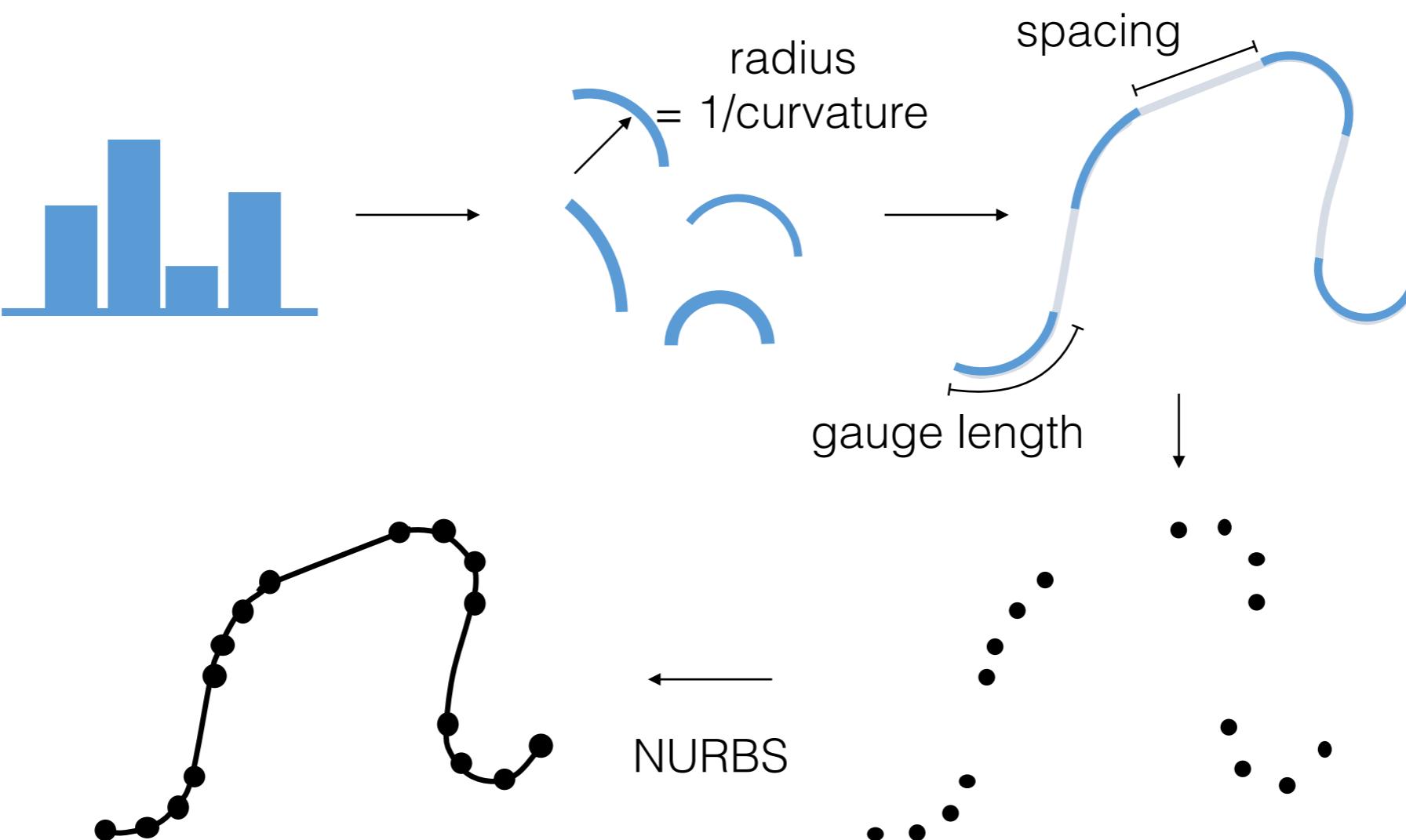
low power consumption (<3mA at 5V)



Signal Processing



Shape Reconstruction





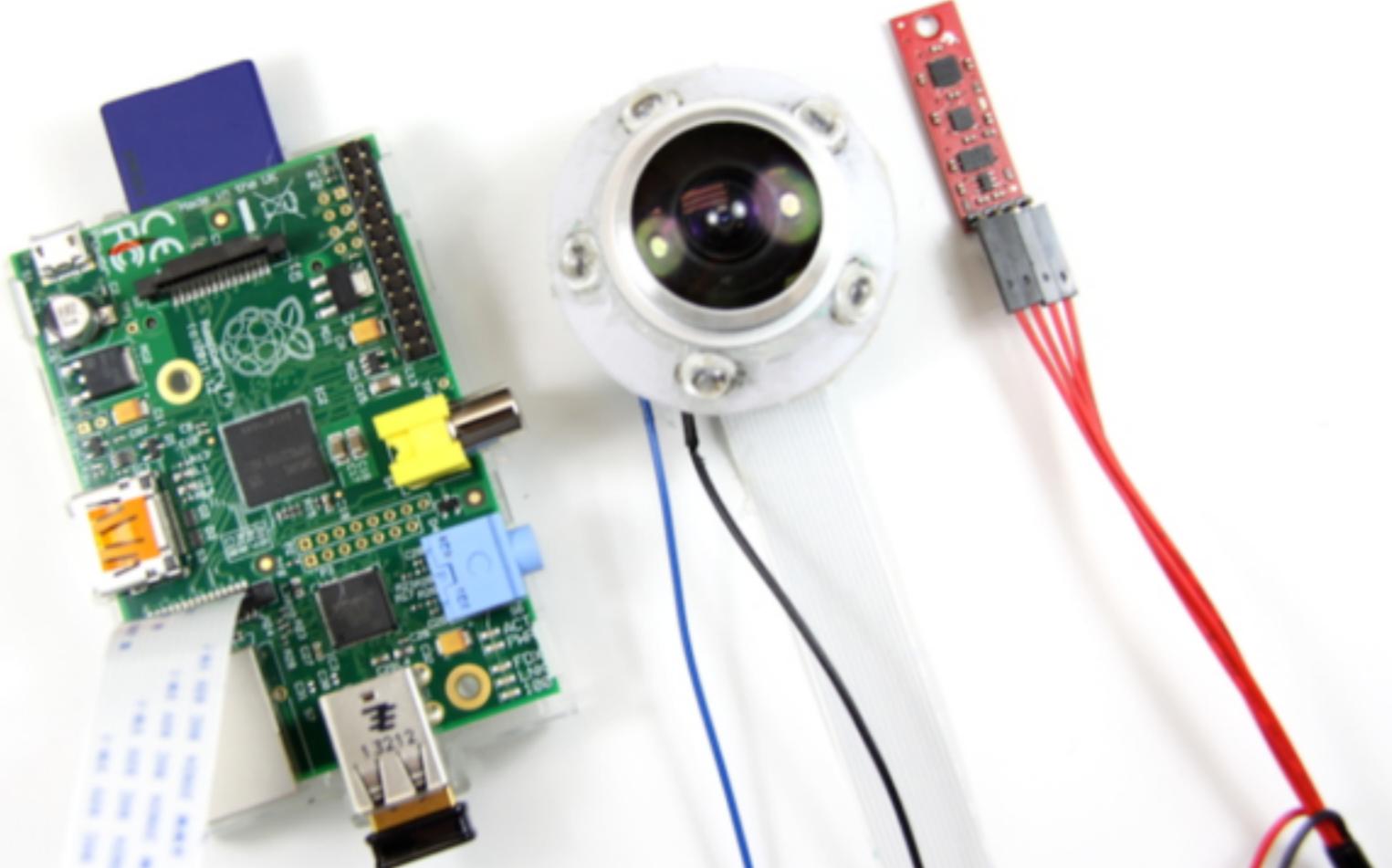
Cyclops: Wearable and Single-Piece Full-Body Gesture Input Devices

Liwei Chan, Chi-Hao Hsieh, Yi-Ling Chen, Shuo Yang,
Da-Yuan Huang, Rong-Hao Liang, Bing-Yu Chen

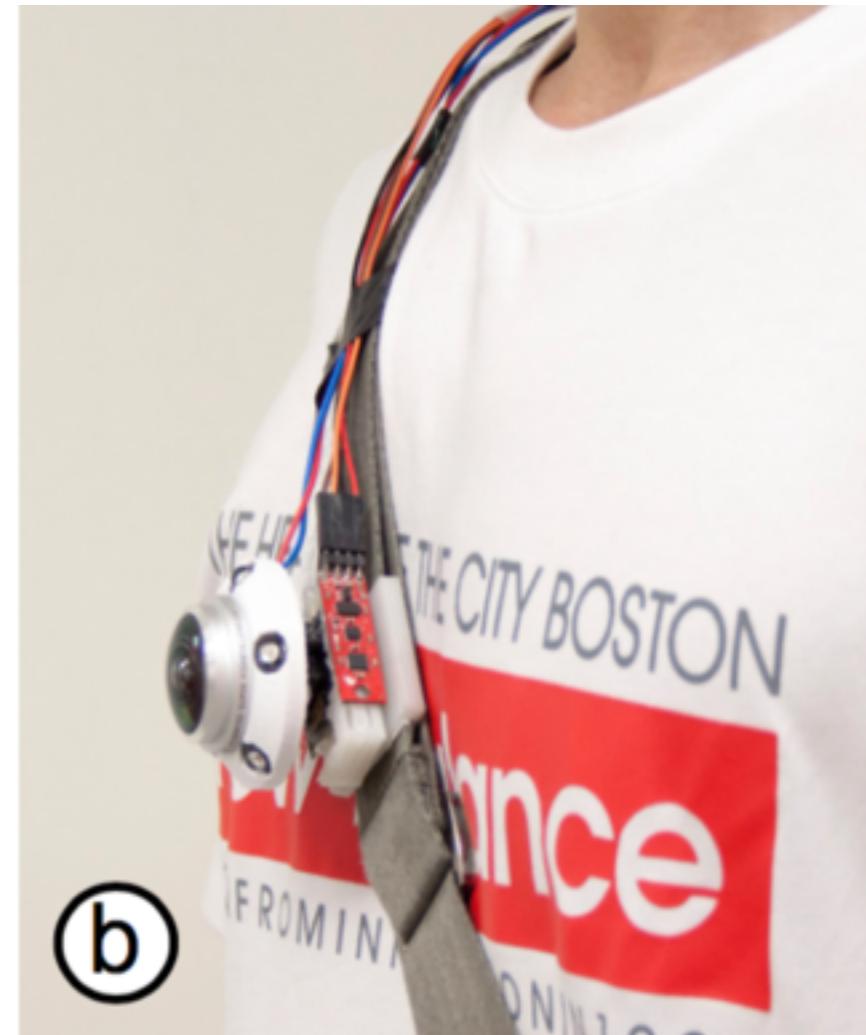
National Taiwan University

Liwei Chan, Chi-Hao Hsieh, Yi-Ling Chen, Shuo Yang, Da-Yuan Huang, **Rong-Hao Liang**, Bing-Yu Chen
Cyclops: Wearable and Single-Piece Full-Body Gesture Input Devices
ACM CHI 2015, pp.3001--3010, Seoul, Korea. (acceptance rate = 23%)

Innovative Wearable Sensing



Ⓐ



Ⓑ

Liwei Chan, Chi-Hao Hsieh, Yi-Ling Chen, Shuo Yang, Da-Yuan Huang, **Rong-Hao Liang**, Bing-Yu Chen
Cyclops: Wearable and Single-Piece Full-Body Gesture Input Devices
ACM CHI 2015, pp.3001--3010, Seoul, Korea. (acceptance rate = 23%)

Innovative Wearable Sensing

CyclopsRing

*Enabling Whole-Hand and Context-Aware Interactions
Through a Fisheye Ring*



Liwei Chan, Yi-Ling Chen, Chi-Hao Hsieh,
Rong-Hao Liang, Bing-Yu Chen

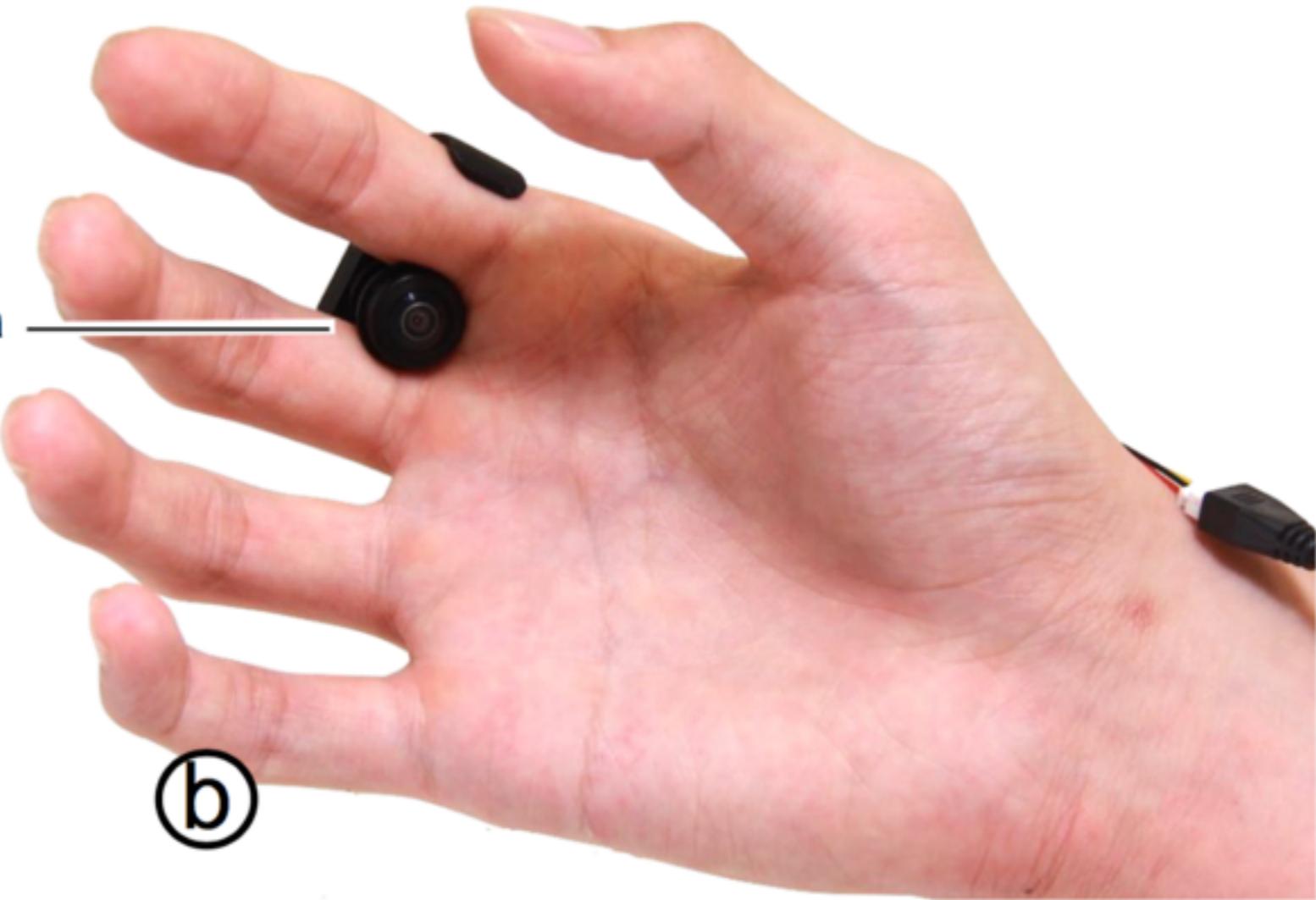
National Taiwan University
Graduate School of Media Design, Keio University

Liwei Chan, Yi-Ling Chen, Chi-Hao Hsieh, **Rong-Hao Liang**, Bing-Yu Chen
CyclopsRing: Enabling Whole-Hand and Context-Aware Interactions Through a Fisheye Ring
ACM UIST 2015, pp.549–556, Charlotte, NC, USA. (acceptance rate = 23%)

Innovative Wearable Sensing



Color camera
with 185°
fisheye lens



Liwei Chan, Yi-Ling Chen, Chi-Hao Hsieh, **Rong-Hao Liang**, Bing-Yu Chen
CyclopsRing: Enabling Whole-Hand and Context-Aware Interactions Through a Fisheye Ring
ACM UIST 2015, pp.549--556, Charlotte, NC, USA. (acceptance rate = 23%)

Innovative Wearable Sensing

Designing Portable and
Occlusion-Free Interactions

Combining Other Materials
to Enable New Features

Shaping Magnetic Fields
to Enable New Applications

DigitSpace

Wearable
Whole-Hand Input

[Huang et al. ACM CHI 2016]

GaussRFID

Magnetic Tokens
with Unlimited IDs

[Liang et al. ACM CHI 2016]

GaussMarbles

Magnetic Spheres
+ Physical Constraints

[Kuo et al. ACM CHI 2016]

FingerPad

Wearable
Private Input

[Chan et al. ACM UIST 2013]

WonderLens

TUI on
Printed Paper

[Liang et al. ACM CHI 2015]

GaussStones

Shielded
Magnetic Tangibles

[Liang et al. ACM UIST 2014]

GaussSense

Analog
Hall-Sensor Grid

[Liang et al. ACM UIST 2012]

GaussBits

Magnetic
Tangible Bits

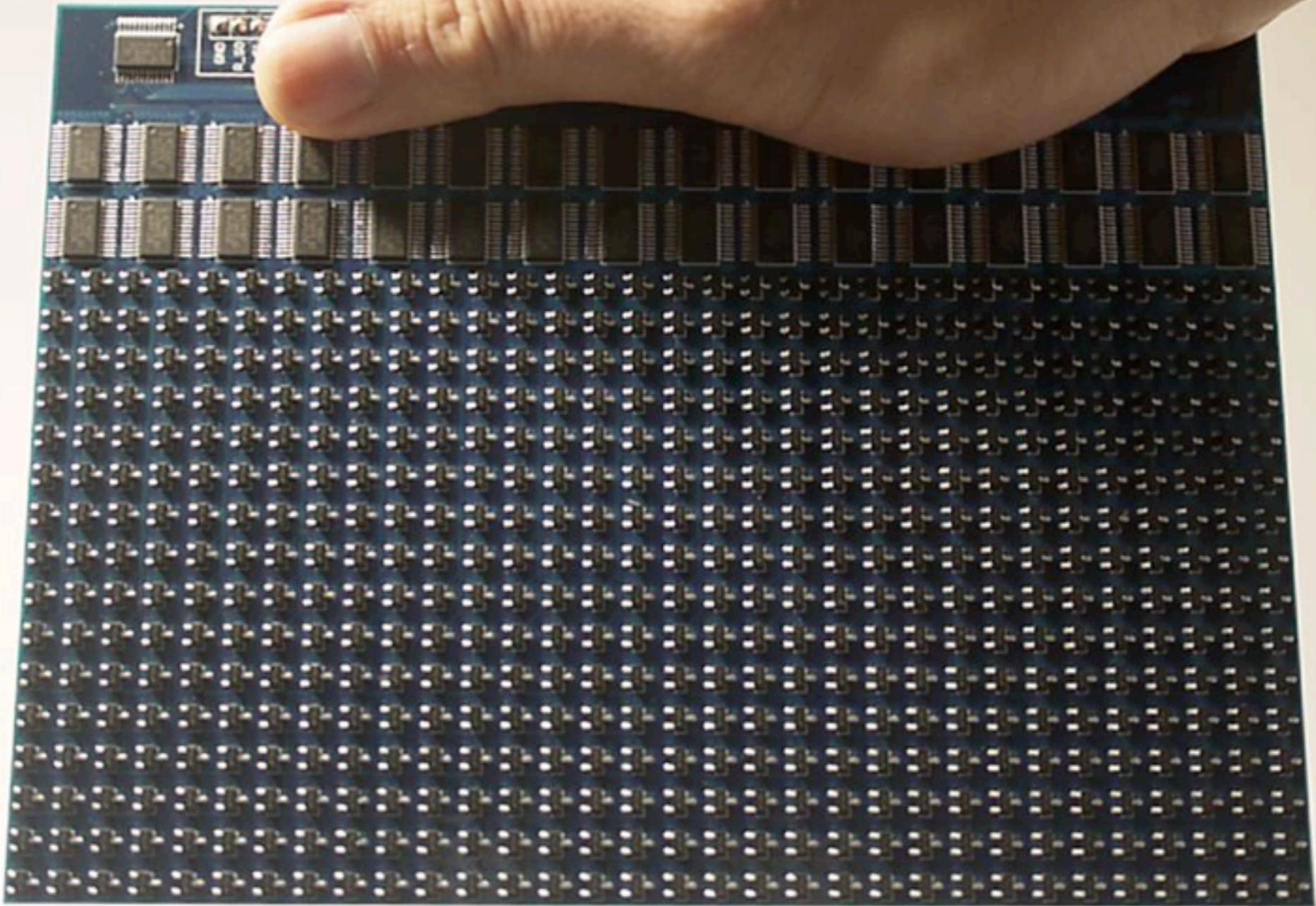
[Liang et al. ACM CHI 2013]

GaussBricks

Magnetic
Building Blocks

[Liang et al. ACM CHI 2014]

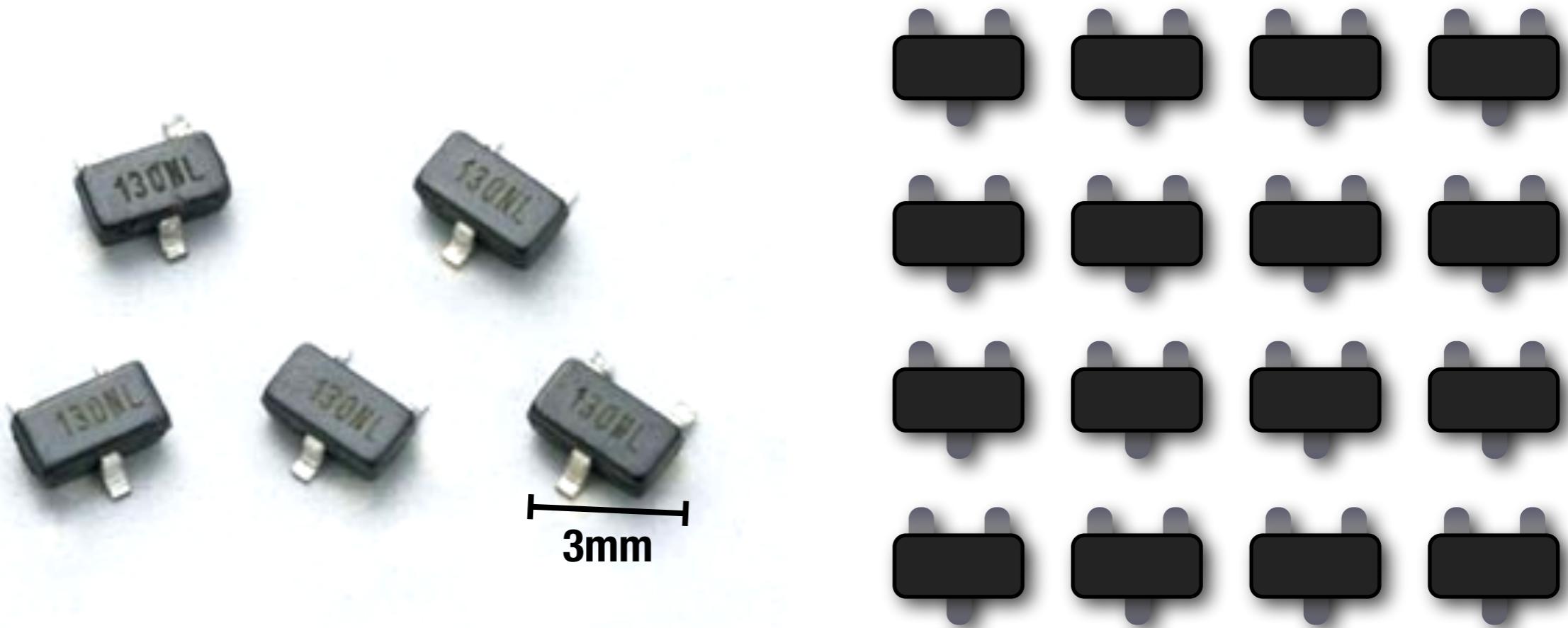
Innovative Sensing with Magnetics



Rong-Hao Liang, Kai-Yin Cheng, Chao-Huai Su, Chien-Ting Weng, Bing-Yu Chen, De-Nian Yang
GaussSense: Attachable Stylus Sensing Using Magnetic Sensor Grid
ACM UIST 2012, pp.319--326, MA, USA. (acceptance rate = 21%)
**** SIGGRAPH Asia 2012 Emerging Technologies Prize ****

Analog Hall-effect sensor

**Tiny, inexpensive, and low power-consumption (3mA/pcs)
linearly output the magnetic field intensity in high sensitivity**



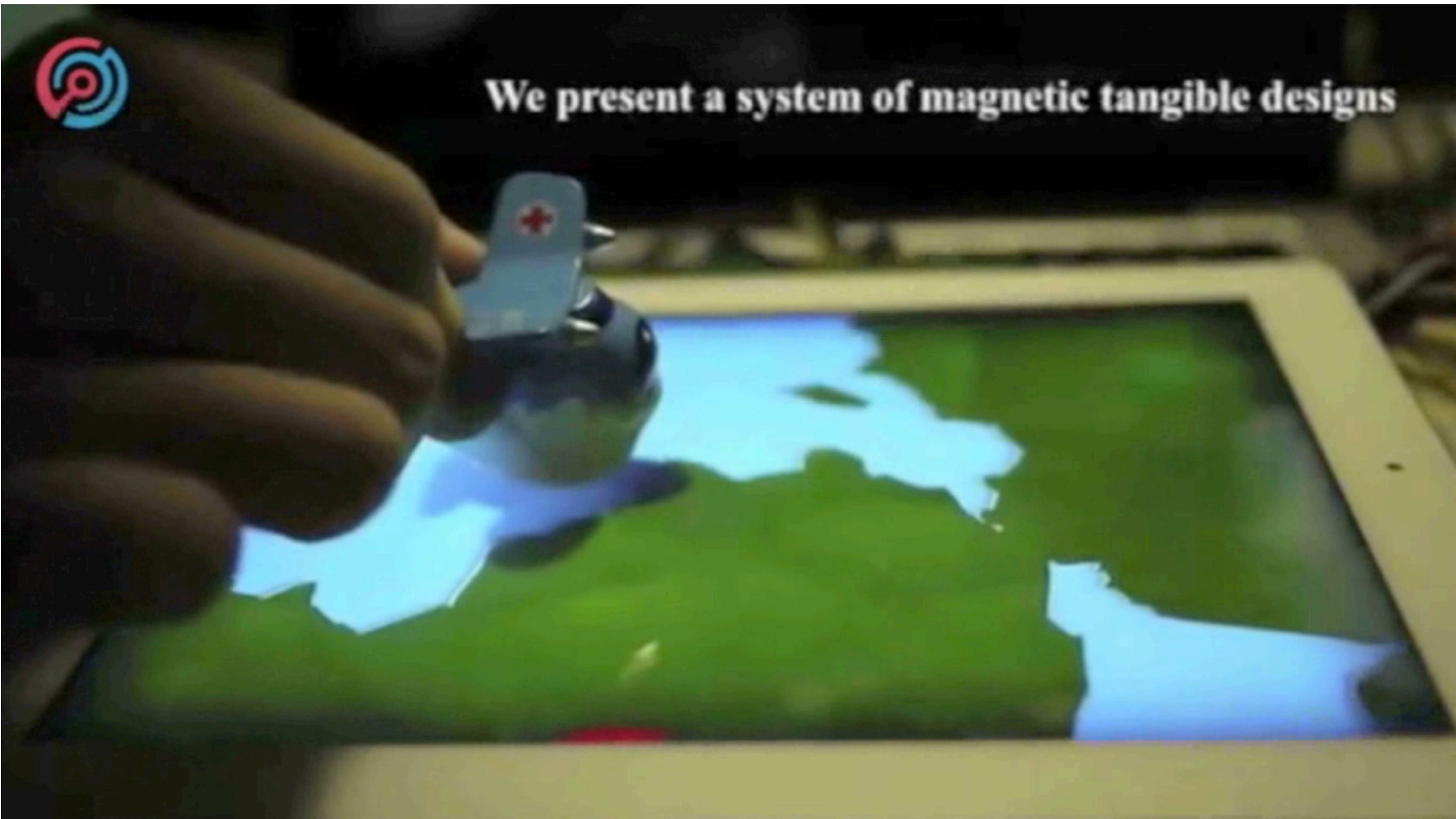
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**** SIGGRAPH Asia 2012 Emerging Technologies Prize ****



We present a system of magnetic tangible designs



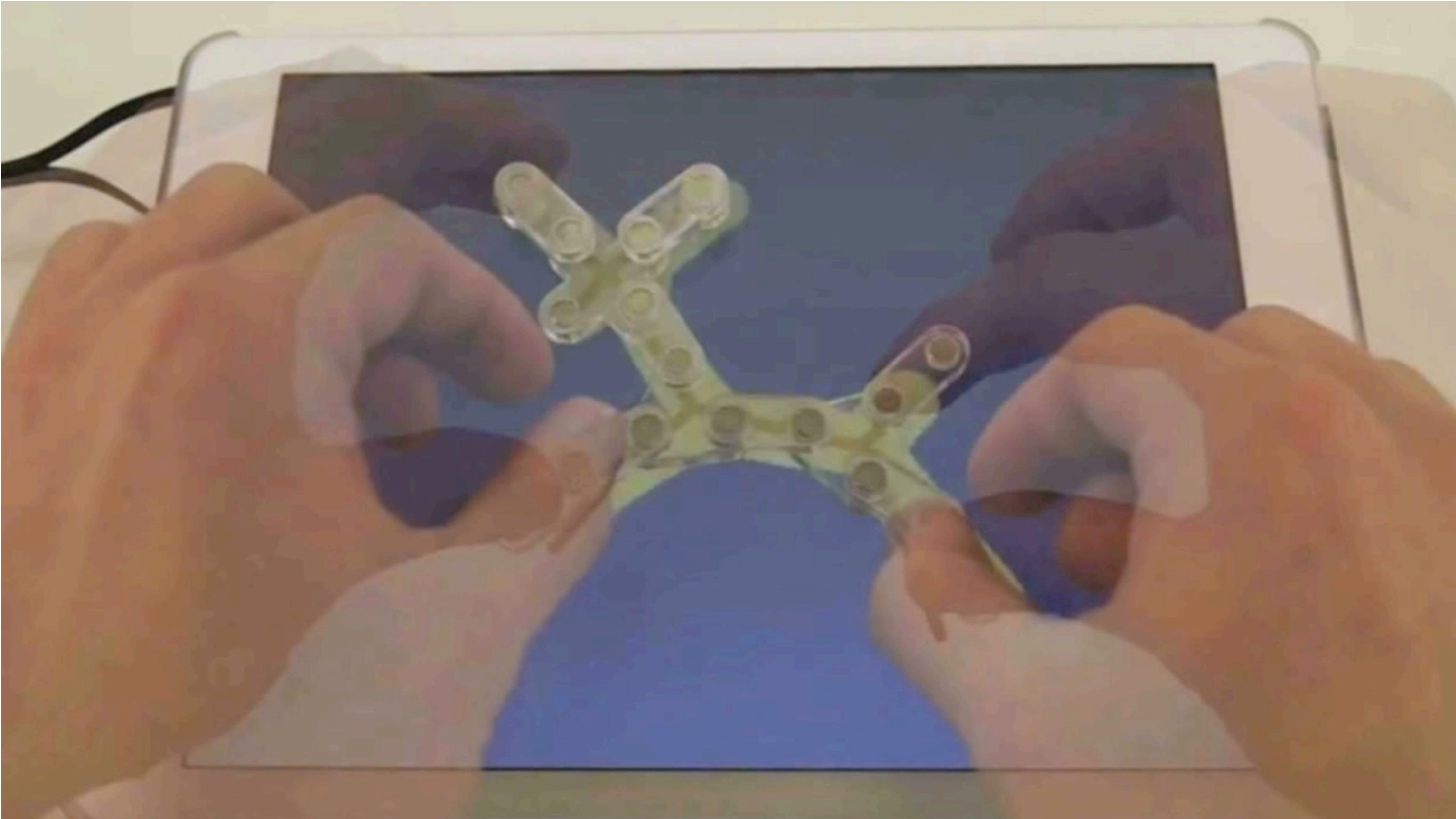
Rong-Hao Liang, Kai-Yin Cheng, Liwei Chan, Chuan-Xhyuan Peng, Mike Y. Chen, Rung-Huei Liang,
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GaussBits: Magnetic Tangible Bits for Portable and Occlusion-Free Near-Surface Interactions

ACM CHI 2013, pp.1391--1400, Paris, France. (acceptance rate = 20%)



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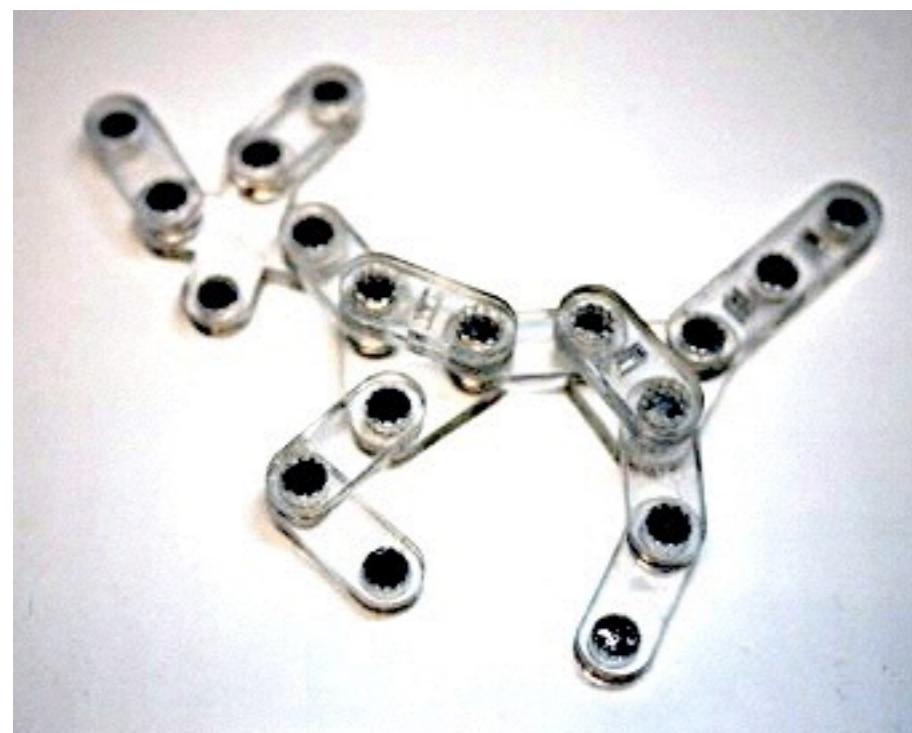
ACM CHI 2014, pp.3153--3162, Toronto, ON, Canada. (acceptance rate = 20%)

ACM Interactions Magazine, Vol. 21, No. 5, pp.6--9.

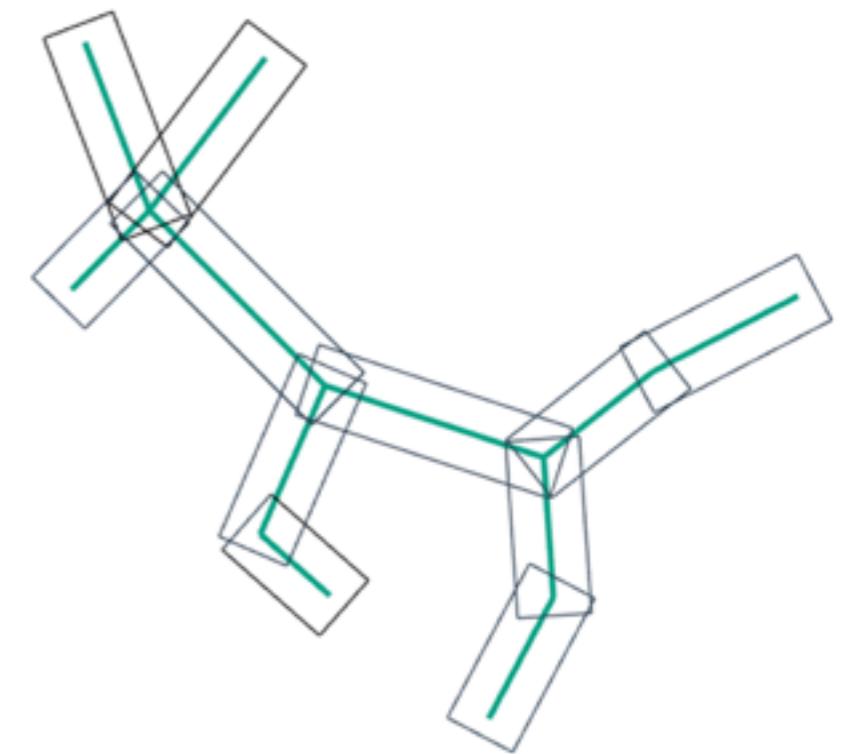
**** CHI 2014 Best Paper Honorable Mention Award ****

**** CHI 2014 People's Choice Best Talk Award ****

Geometry

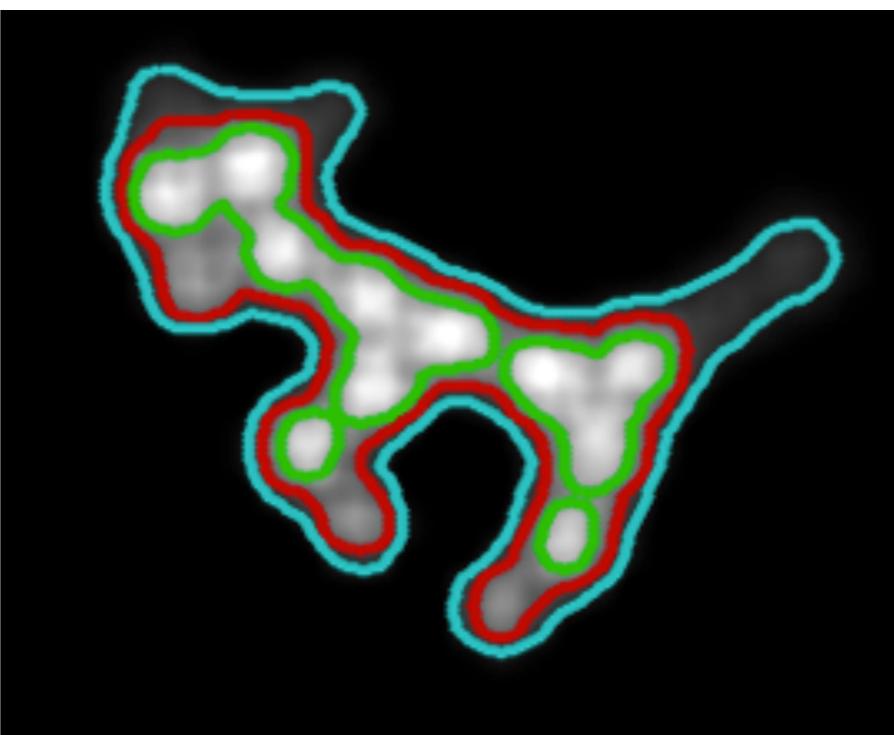
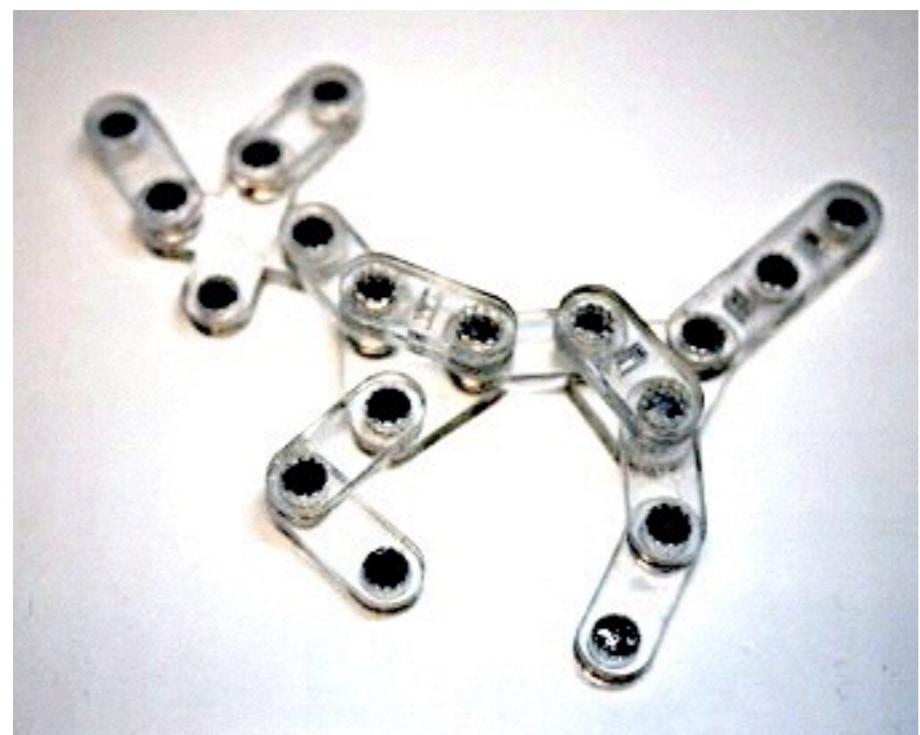


Skeleton



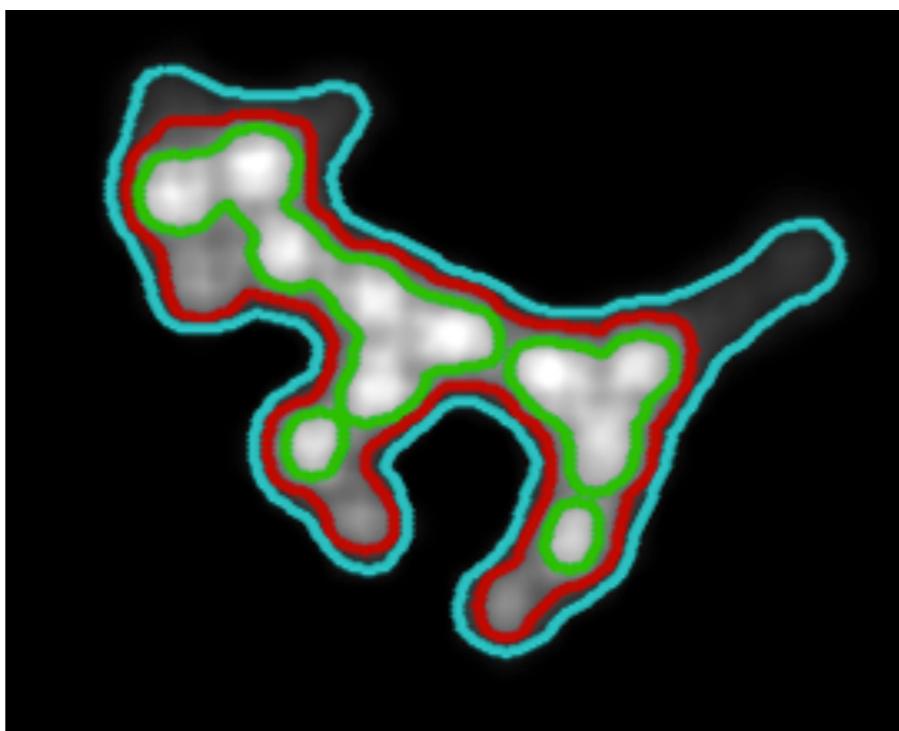
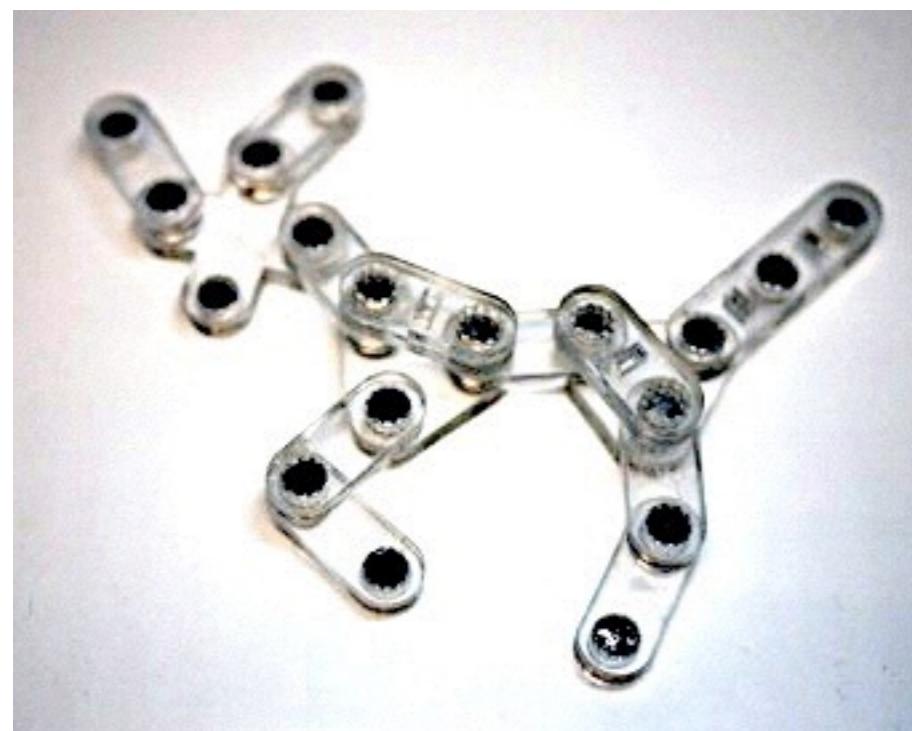
Sensing Algorithm

Geometry



1. contour extraction

Geometry



2. segmentation

not stacked

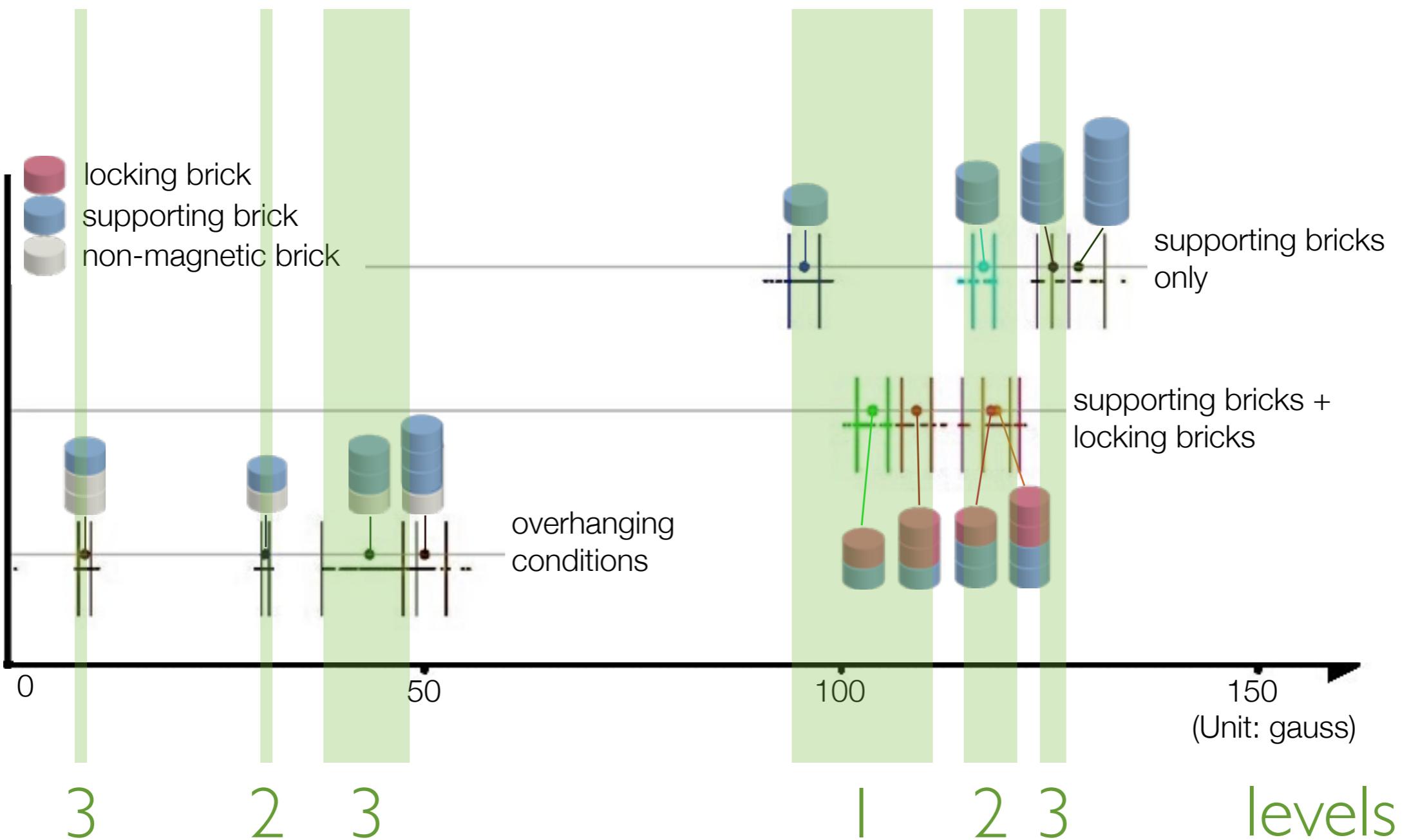
stacked

overhanging



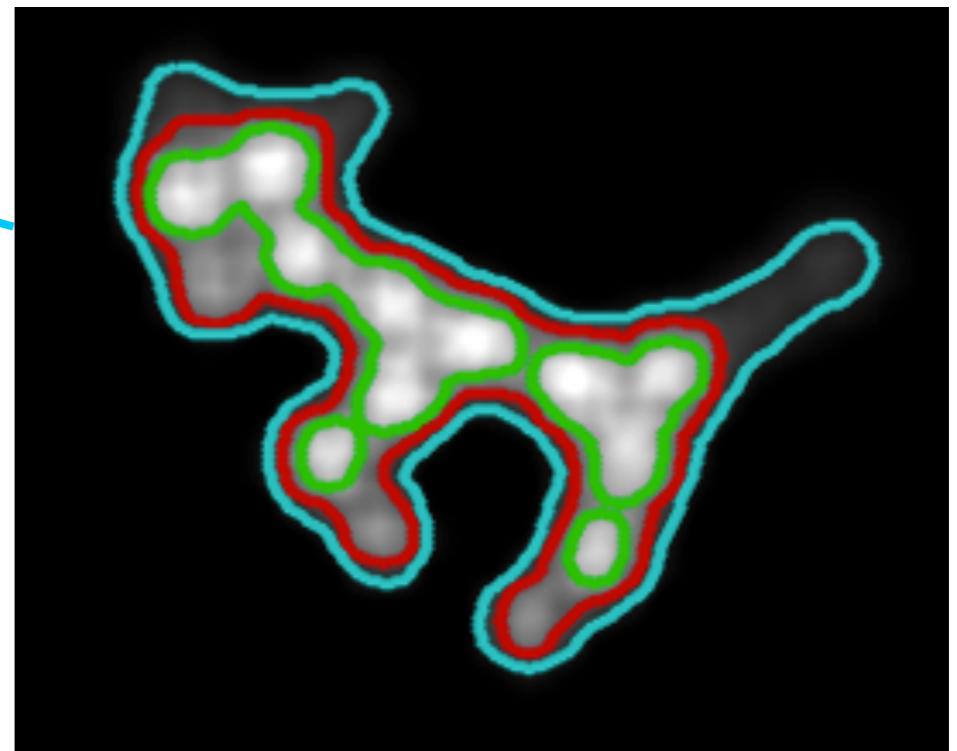
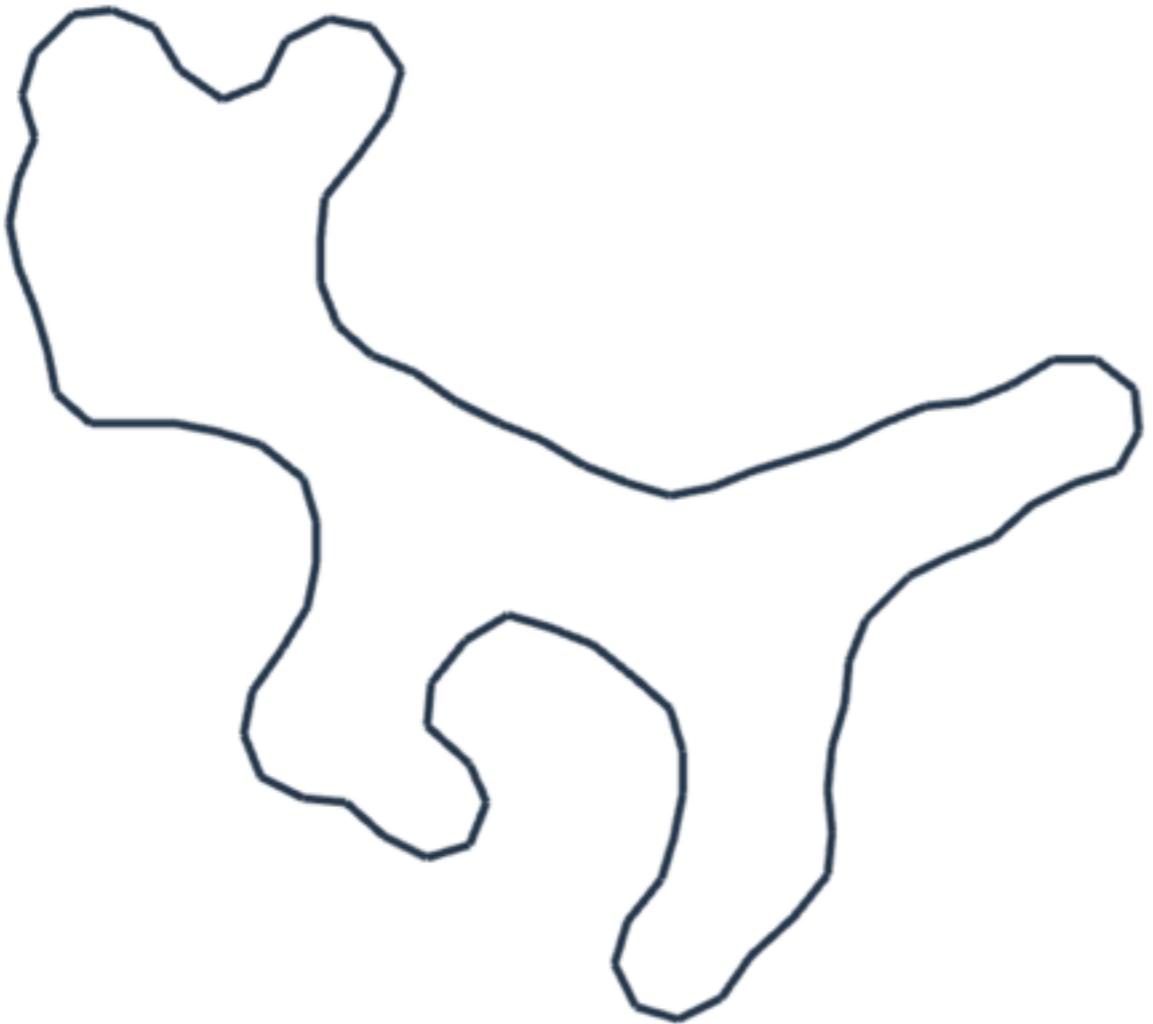
3

345

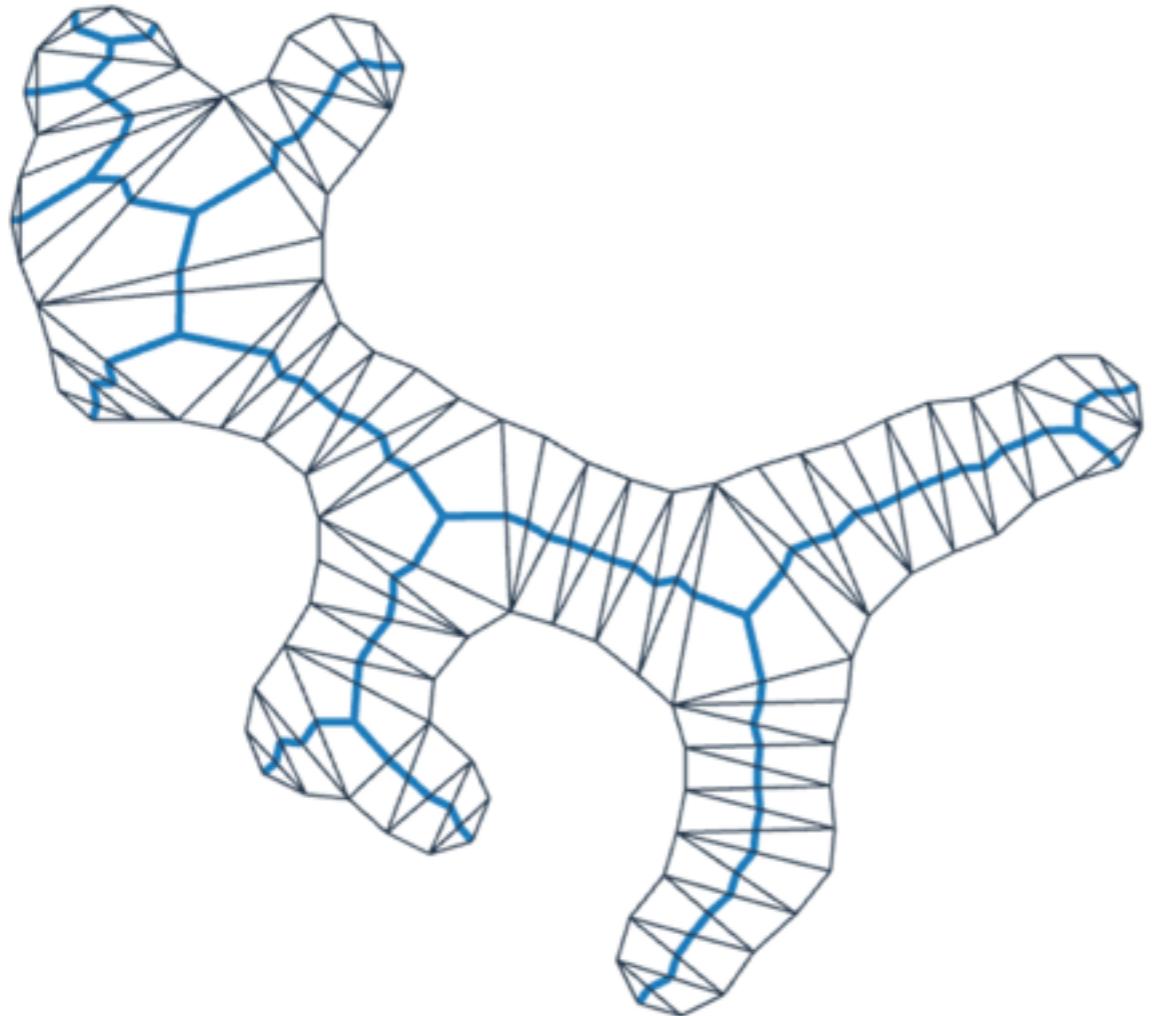


**Resolves 3D structures
in maximum 3 levels of stacking**
The uses of *locking bricks* do not affect sensing.

Skeleton



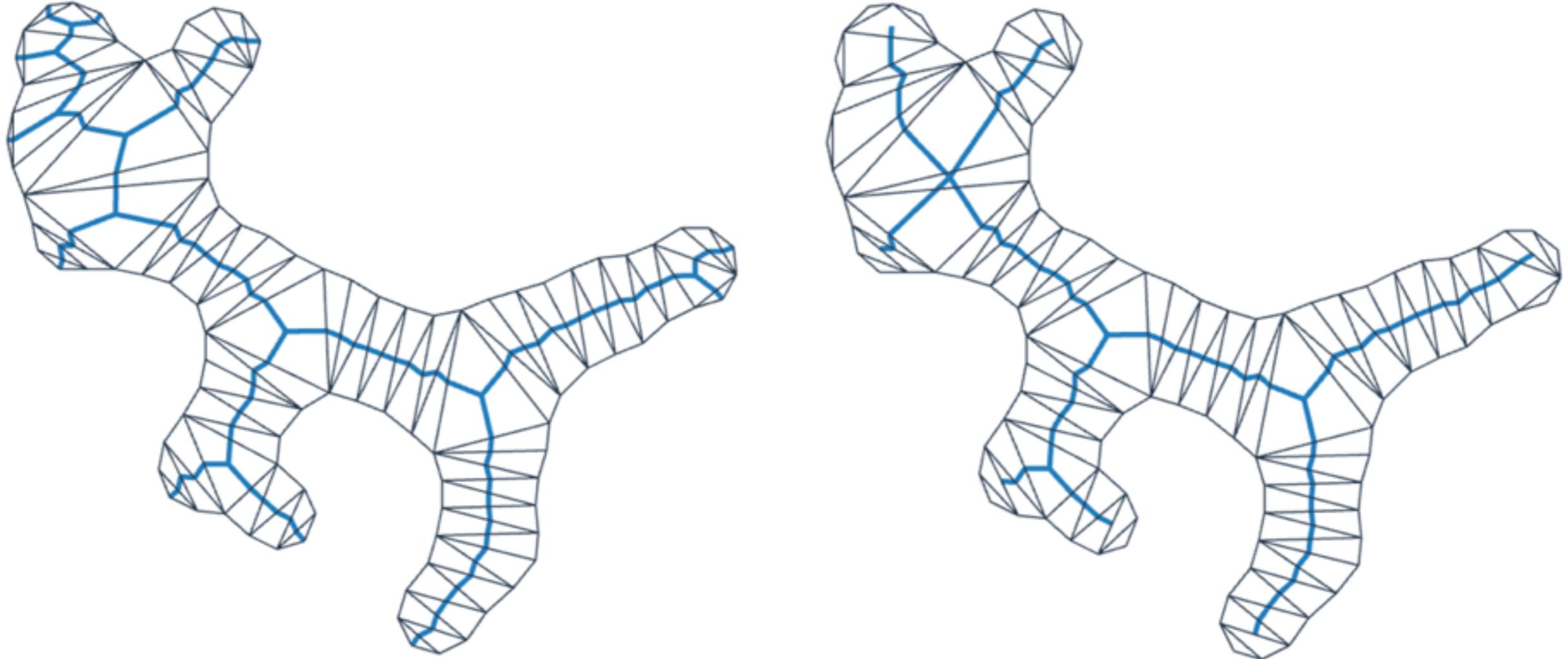
Skeleton



1. spine extraction

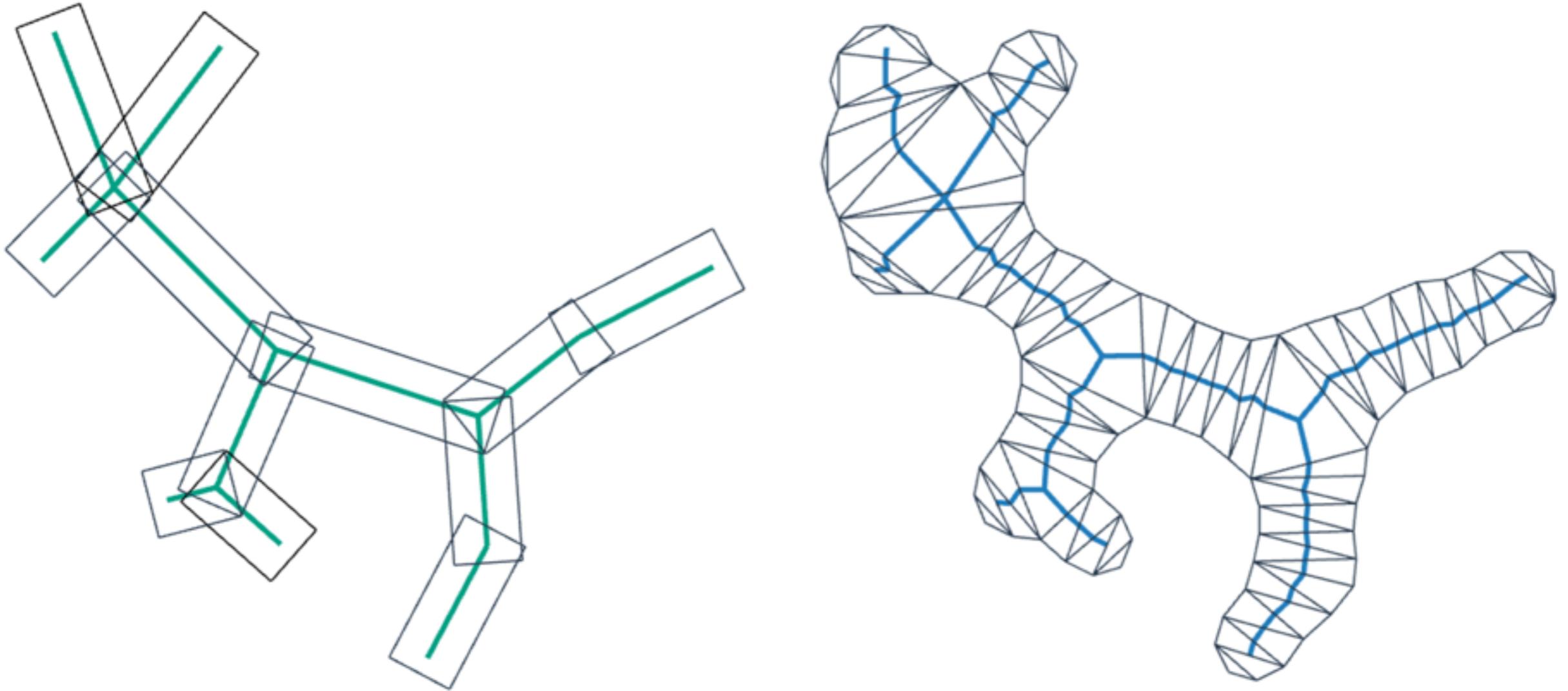
Using Constrained Delaunay Triangulation

Skeleton



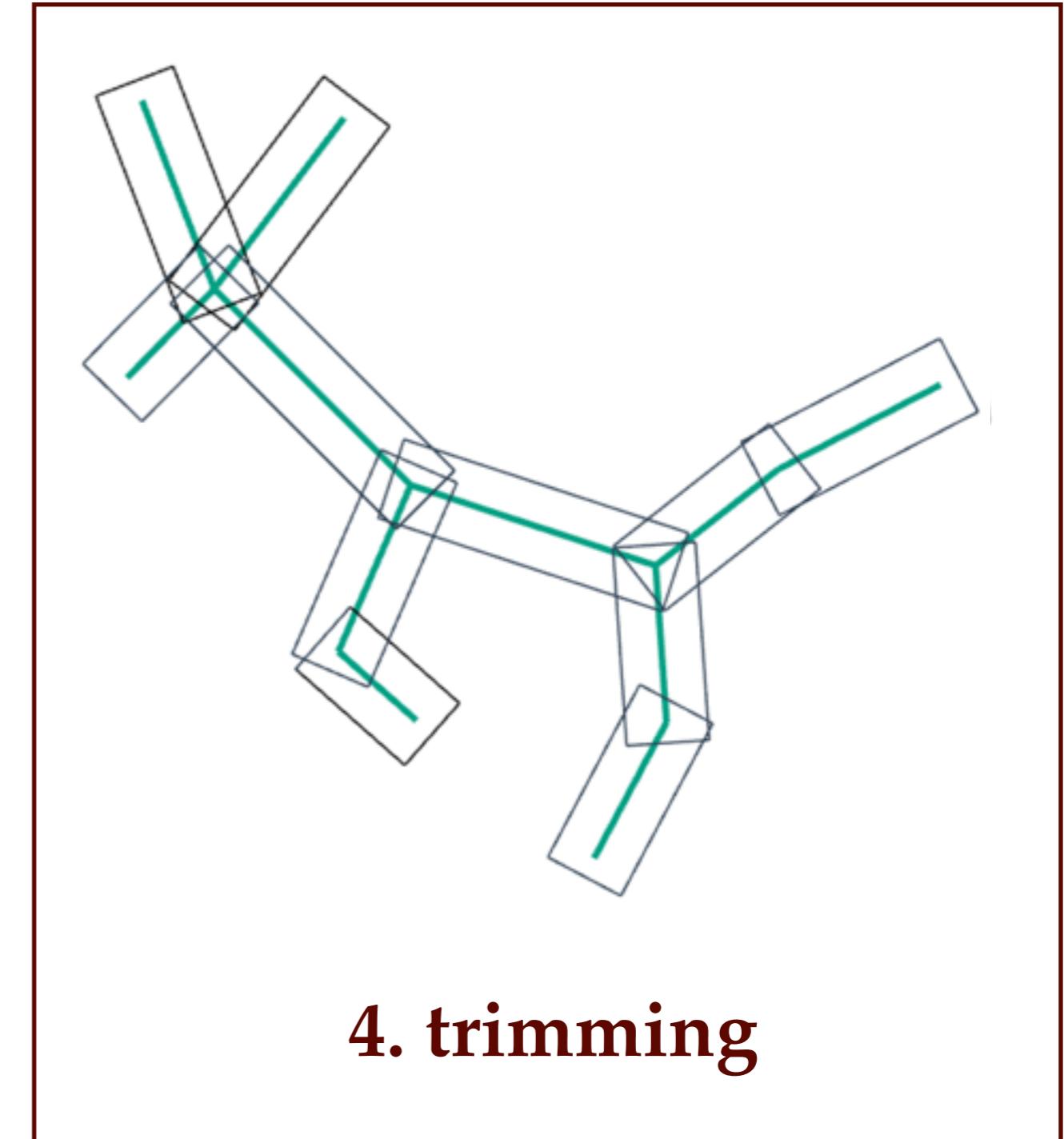
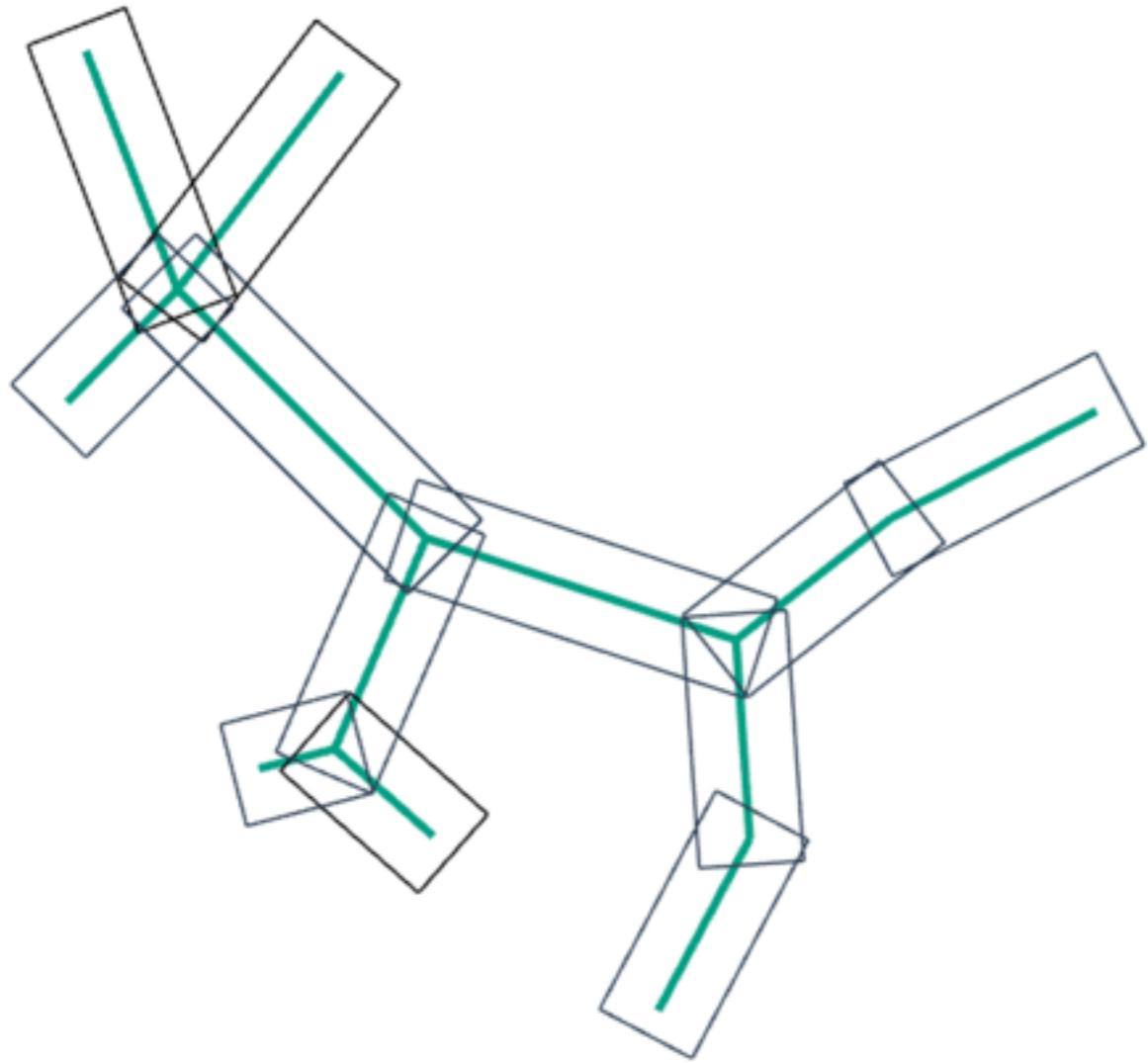
2. trimming and merging

Skeleton

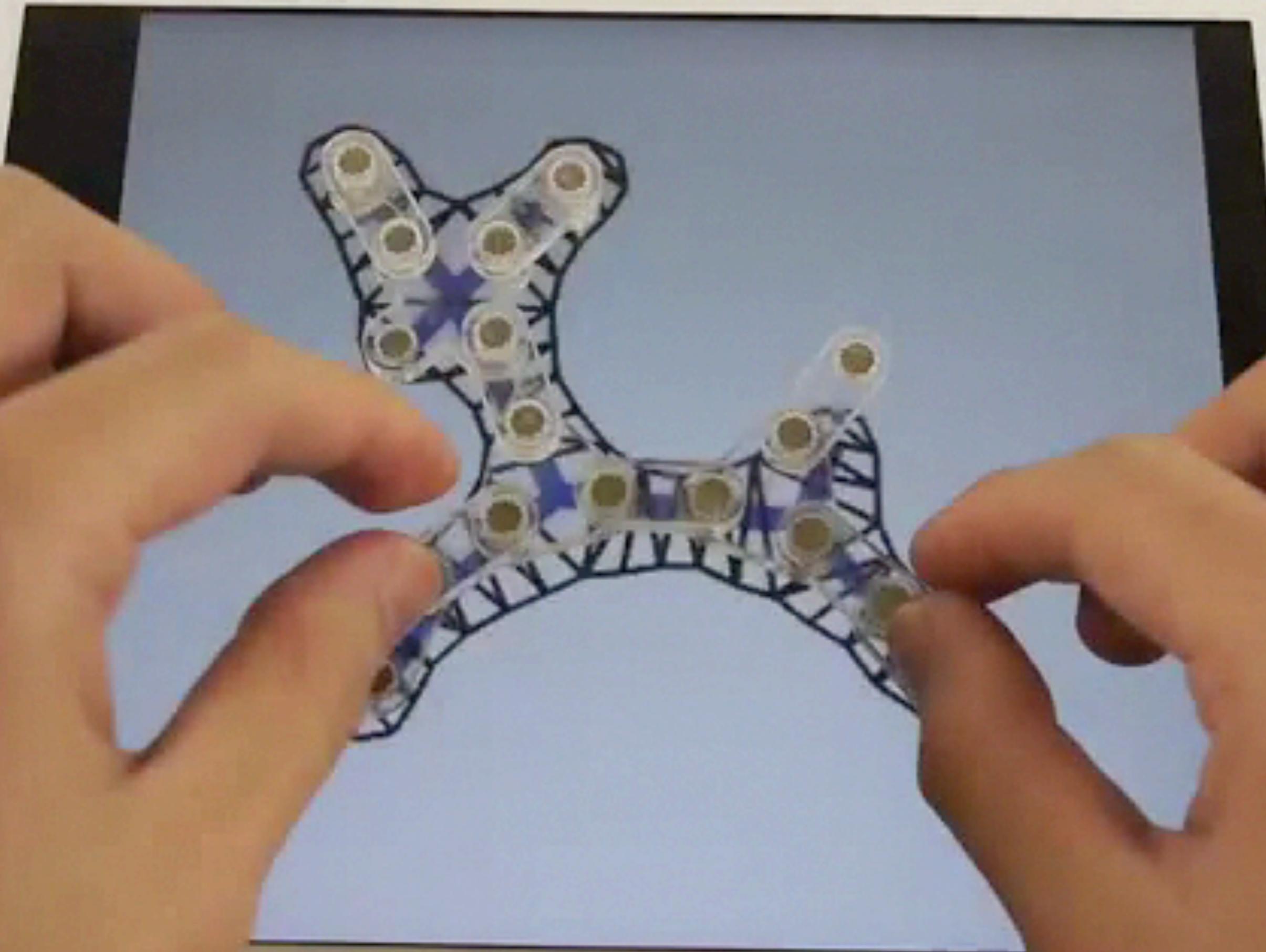


3. simplifying

Skeleton



Result





Rong-Hao Liang, Liwei Chan, Hung-Yu Tseng, Han-Chih Kuo, Da-Yuan Huang, De-Nian Yang, Bing-Yu Chen
GaussBricks: Magnetic Building Blocks for Constructive Tangible Interactions on Portable Displays

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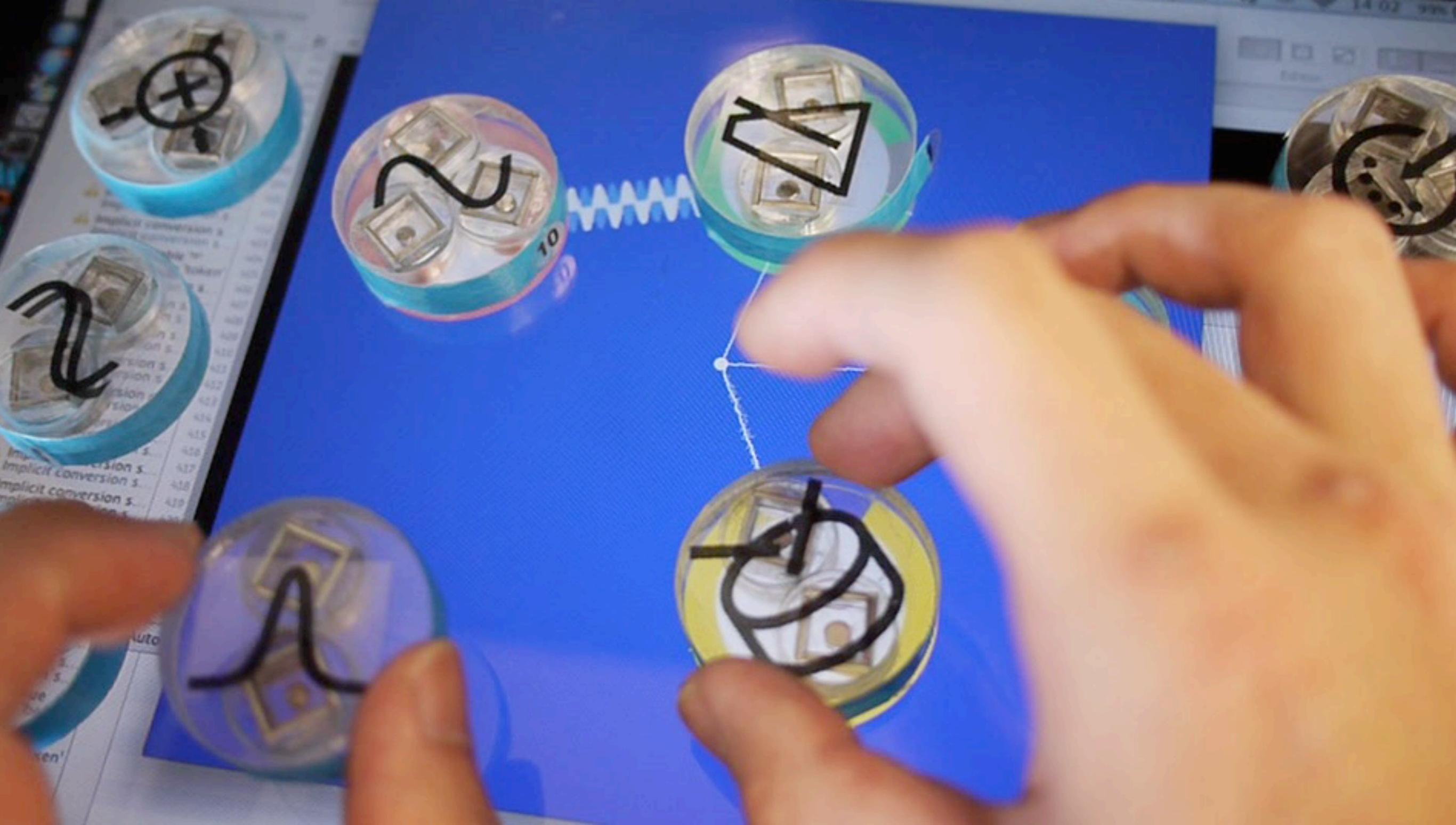
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Rong-Hao Liang, Han-Chih Kuo, Liwei Chan, De-Nian Yang, Bing-Yu Chen
GaussStones: Shielded Mangetic Tangibles for Multi-Token Interactions on Portable Displays
ACM UIST 2014, pp.365--372, Honolulu, Hawaii, USA. (acceptance rate = 22%)



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GaussStones: Shielded Mangetic Tangibles for Multi-Token Interactions on Portable Displays

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GaussMarbles: Spherical Magnetic Tangibles for Interacting with Portable Physical Constraints

Han-Chih Kuo, Rong-Hao Liang, Long-Fei Lin, Bing-Yu Chen

National Taiwan University

ACM CHI 2016

Han-Chih Kuo, **Rong-Hao Liang**, Long-Fei Lin, Bing-Yu Chen.

GaussMarbles: Spherical Magnetic Tangibles for Interacting with Portable Physical Constraints.

ACM CHI 2016, 5 pages (to appear), San Jose, CA, USA. (acceptance rate = 23%)

WonderLens

Optical Lenses and Mirrors for Tangible Interactions on Printed Paper

Rong-Hao Liang¹, Chao Shen¹, Yu-Chien Chan¹, Guan-Ting Chou¹,
Liwei Chan¹, Mike Y. Chen¹, De-Nian Yang², Bing-Yu Chen¹

¹National Taiwan University ²Academia Sinica

ACM CHI 2015

Rong-Hao Liang, Chao Shen, Yu-Chien Chan, Guan-Ting Chou, Liwei Chan, De-Nian Yang, Mike Y. Chen, Bing-Yu Chen

WonderLens: Optical Lenses and Mirrors for Tangible Interactions on Printed Paper
ACM CHI 2015, pp.1281--1284, Seoul, Korea. (acceptance rate = 23%)

Tangible Interactions on Paper

GaussRFID:
*Reinventing Physical Toys Using
Magnetic RFID Development Kits*

Rong-Hao Liang, Han-Chih Kuo, Bing-Yu Chen
National Taiwan University
ACM CHI 2016

MacBook Air



Rong-Hao Liang, Han-Chih Kuo, Bing-Yu Chen.

GaussRFID: Reinventing Physical Toys Using Magnetic RFID Development Kits

ACM CHI 2016, 5 pages (to appear), San Jose, CA, USA. (acceptance rate = 23%)

Tangible Interactions with Rich ID



A 2-day toy-hacking workshop is conducted to study the applications and the experiences of users.

Rong-Hao Liang, Han-Chih Kuo, Bing-Yu Chen.

GaussRFID: Reinventing Physical Toys Using Magnetic RFID Development Kits

ACM CHI 2016, 5 pages (to appear), San Jose, CA, USA. (acceptance rate = 23%)

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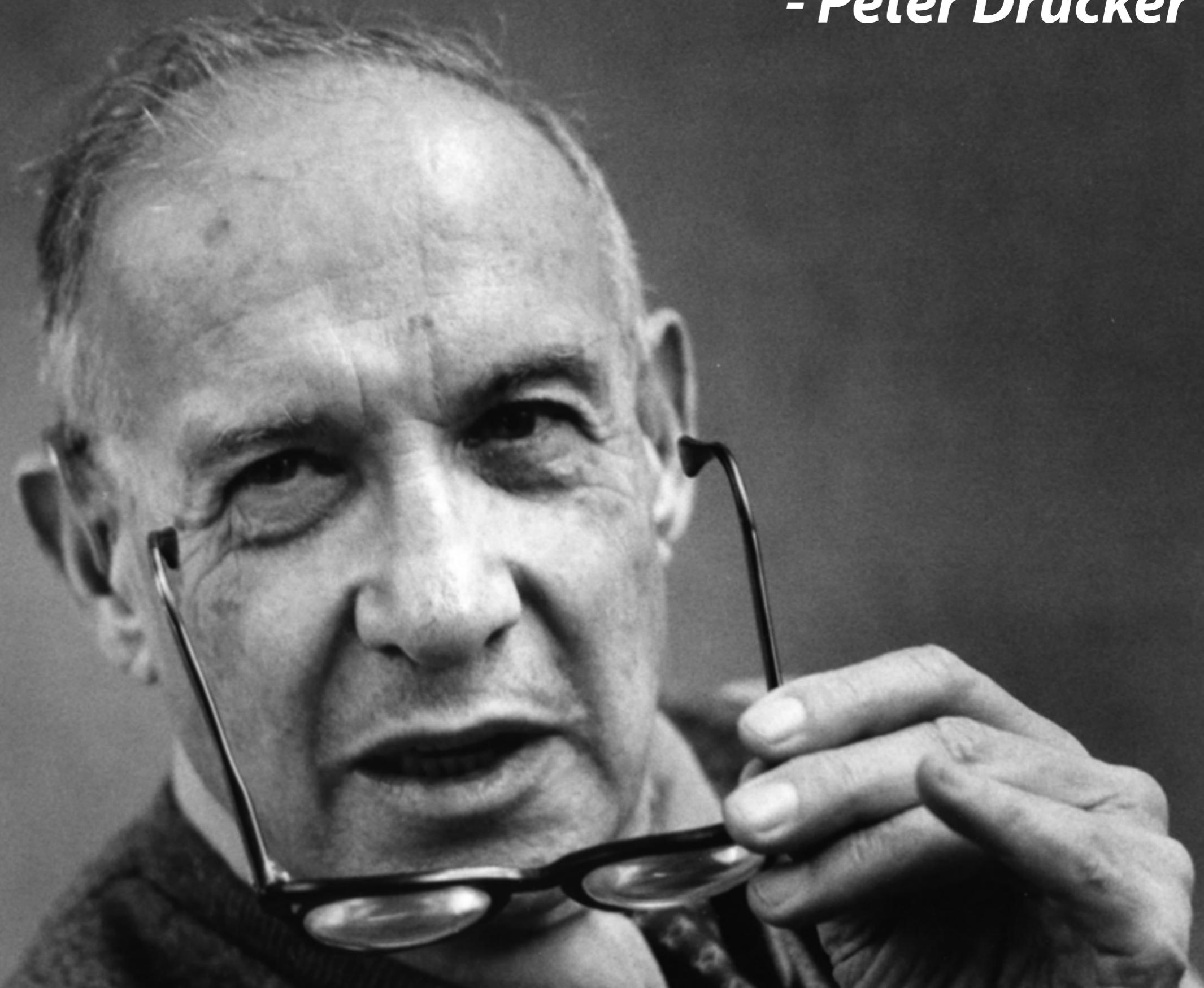
Tangible Interactions with Rich ID



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GaussRFID: Reinventing Physical Toys Using Magnetic RFID Development Kits
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Tangible Interactions with Rich ID

Impact = Innovation * Entrepreneurship
- Peter Drucker



Mini GaussSense

以一打十的自造工具箱
盡在方寸之間

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Designing Tools for Makers



Physical Prototyping

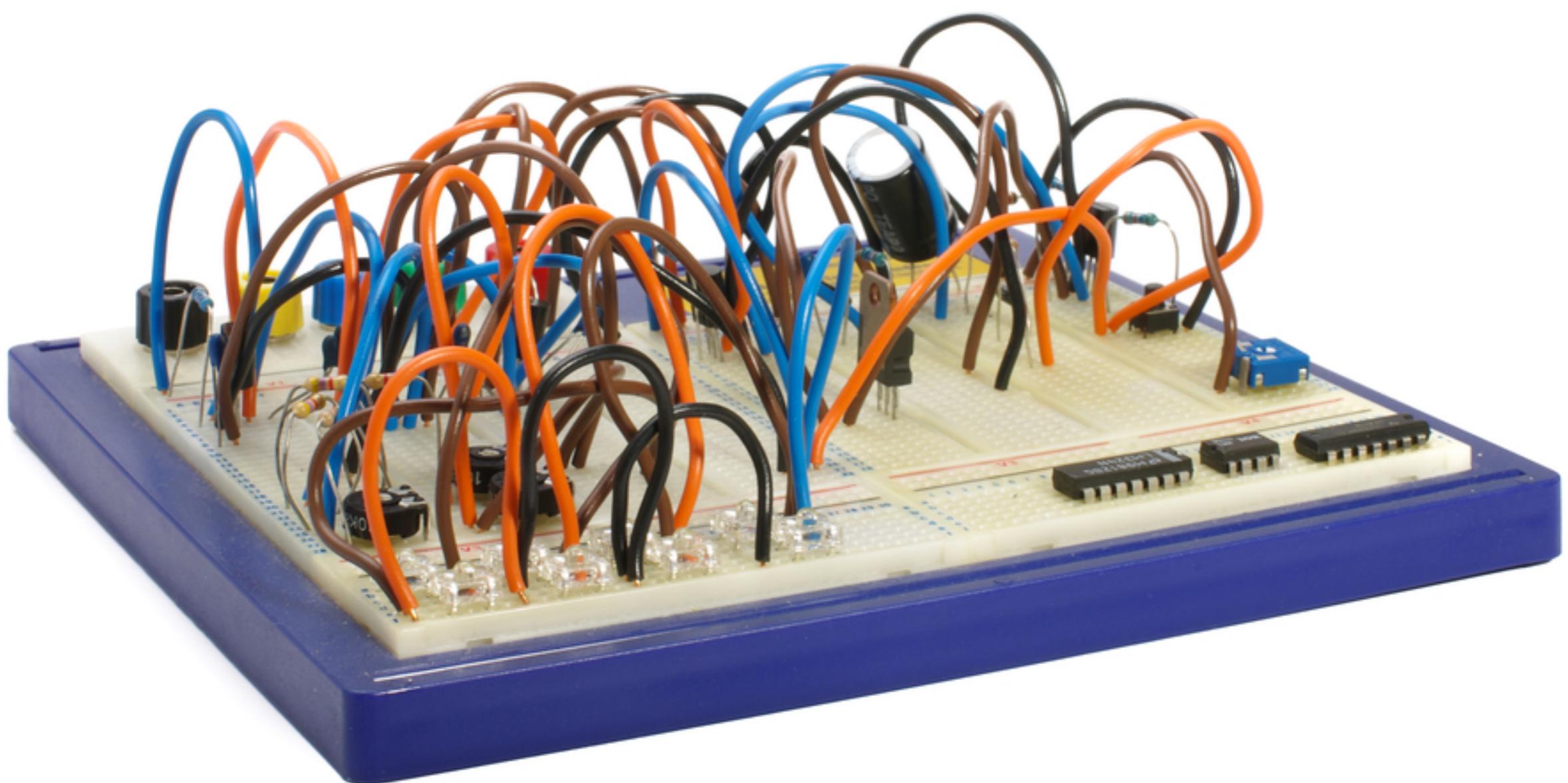


Design Tools for Makers

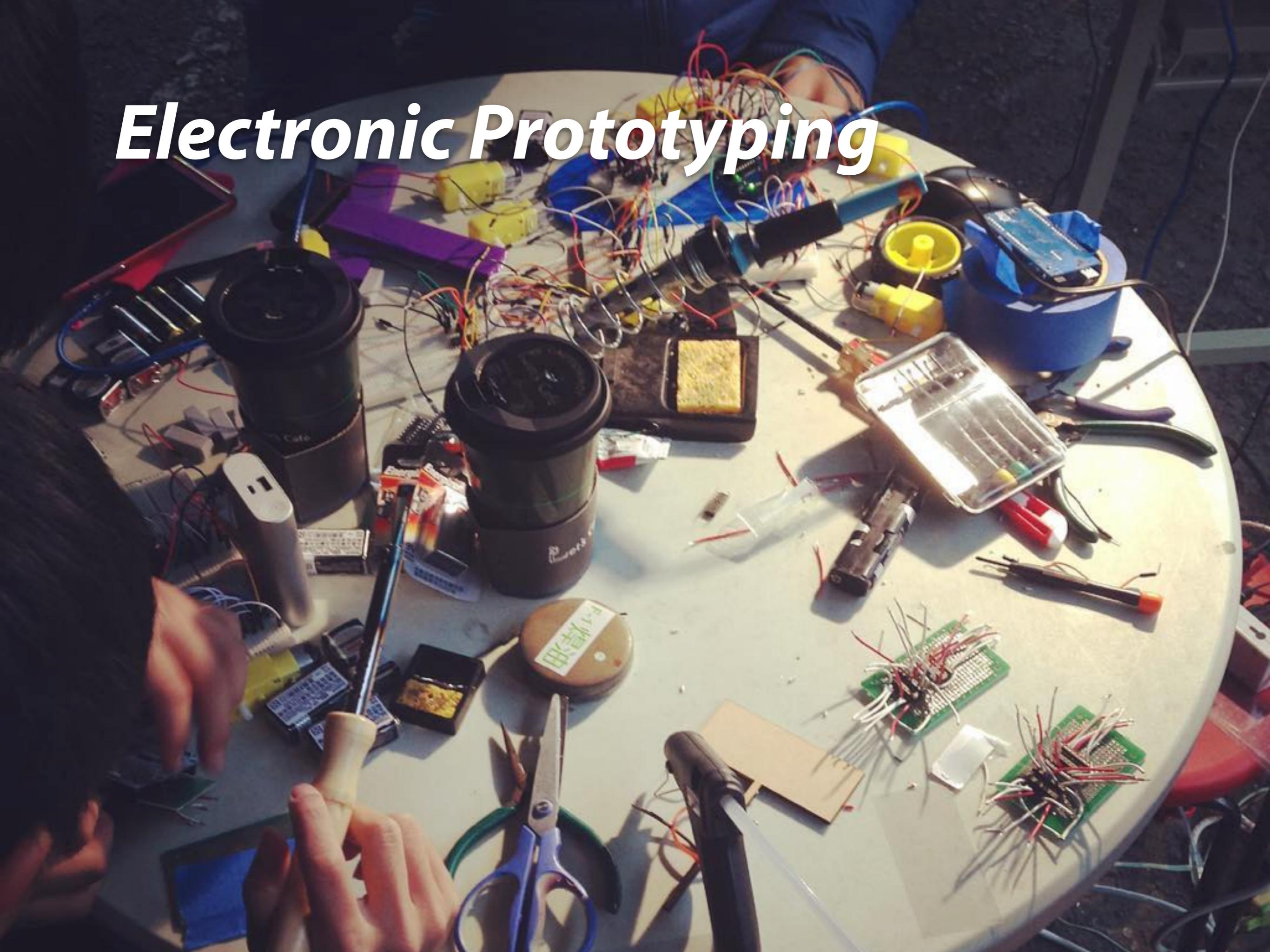
Motivation —————→ *Goal*
Tools
(with explicit mechanisms)



Electronic Prototyping



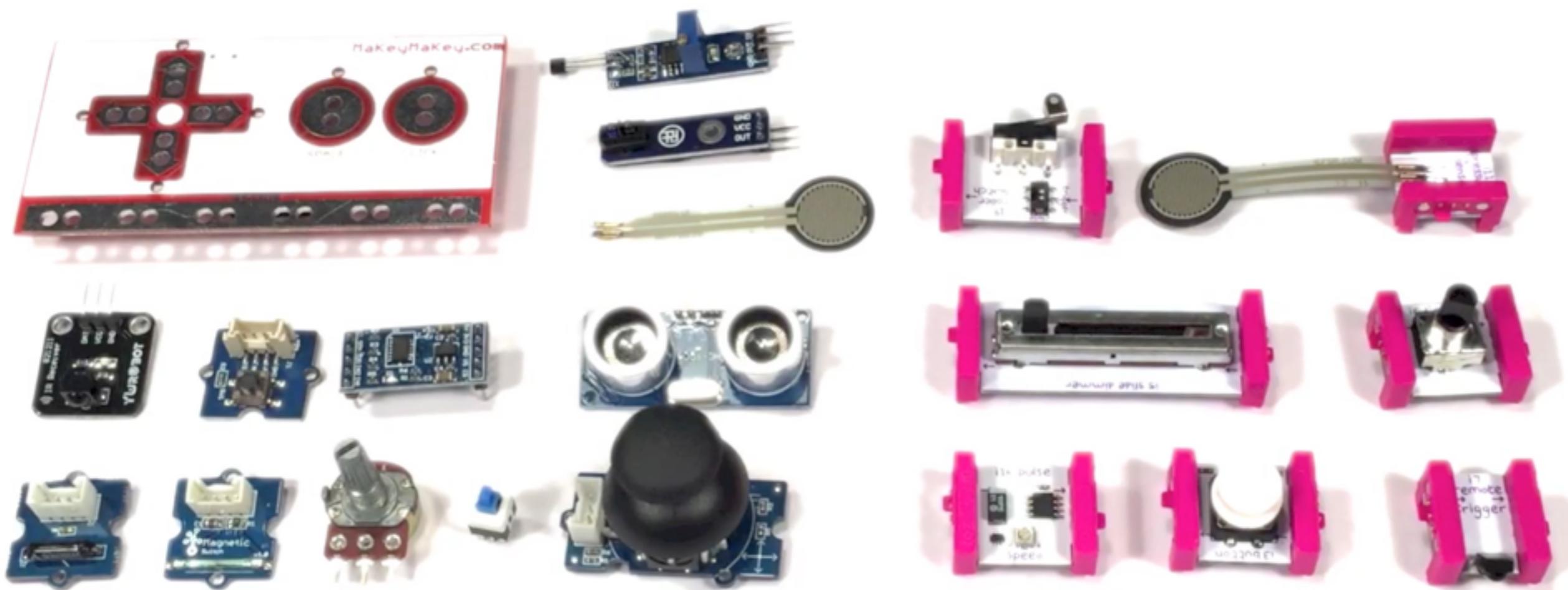
Electronic Prototyping



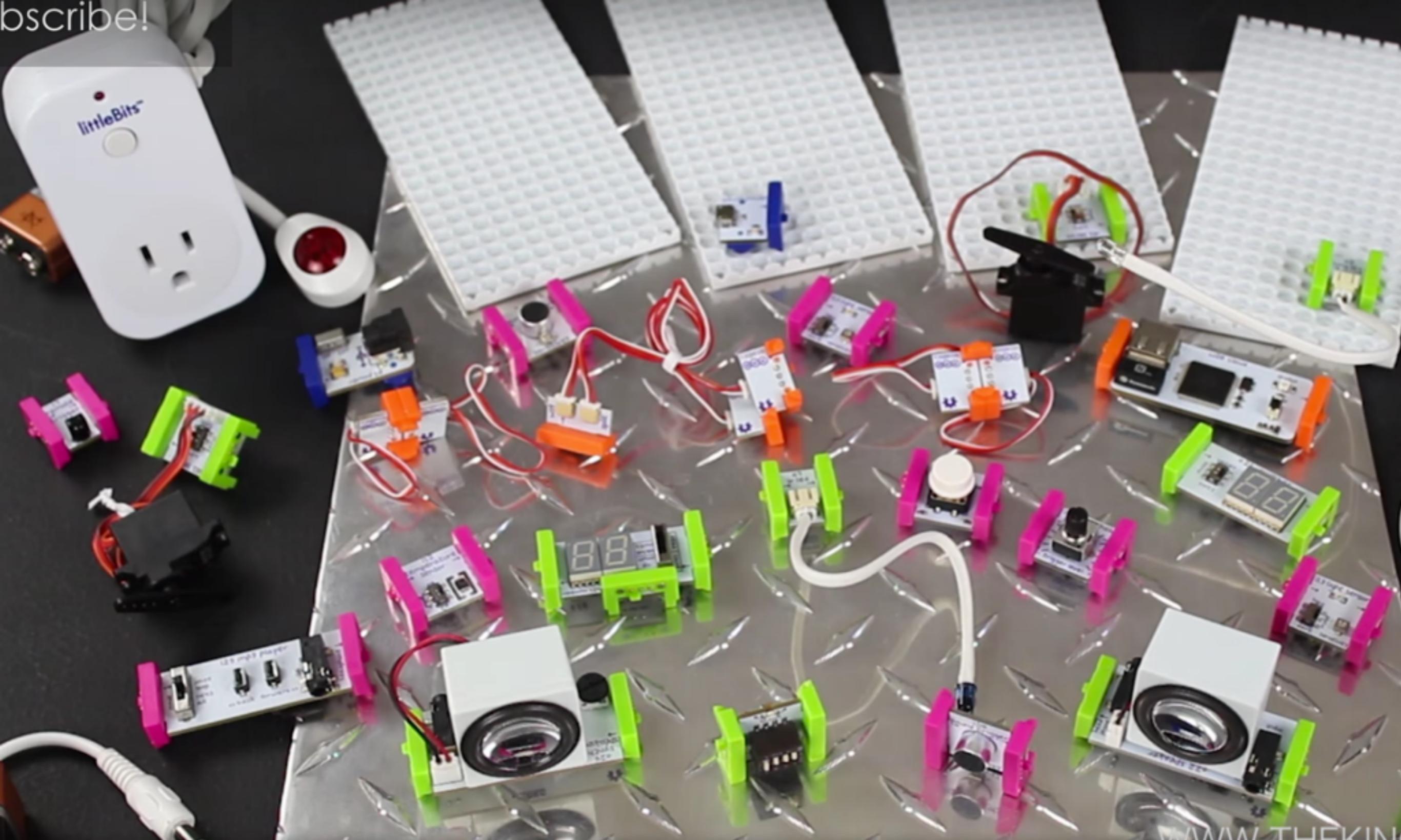
Electronic Prototyping Tools for Makers

*Motivation -----> Goal
Tools
(with implicit mechanisms)*

Electronic Building Blocks



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每件都是獨當一面的

*Make It
Simpler*

Mini GaussSense

The Simplest Maker's Toolkit



9 Basic Utilities



1. *Sensing Flipping*



2. *Sensing Rotation*



3. *Sensing Tilt*



4. *Sensing Sliding*



5. *Sensing 2D Movement*



6. *Sensing 3D Movement*



7. *Sensing Pressure*

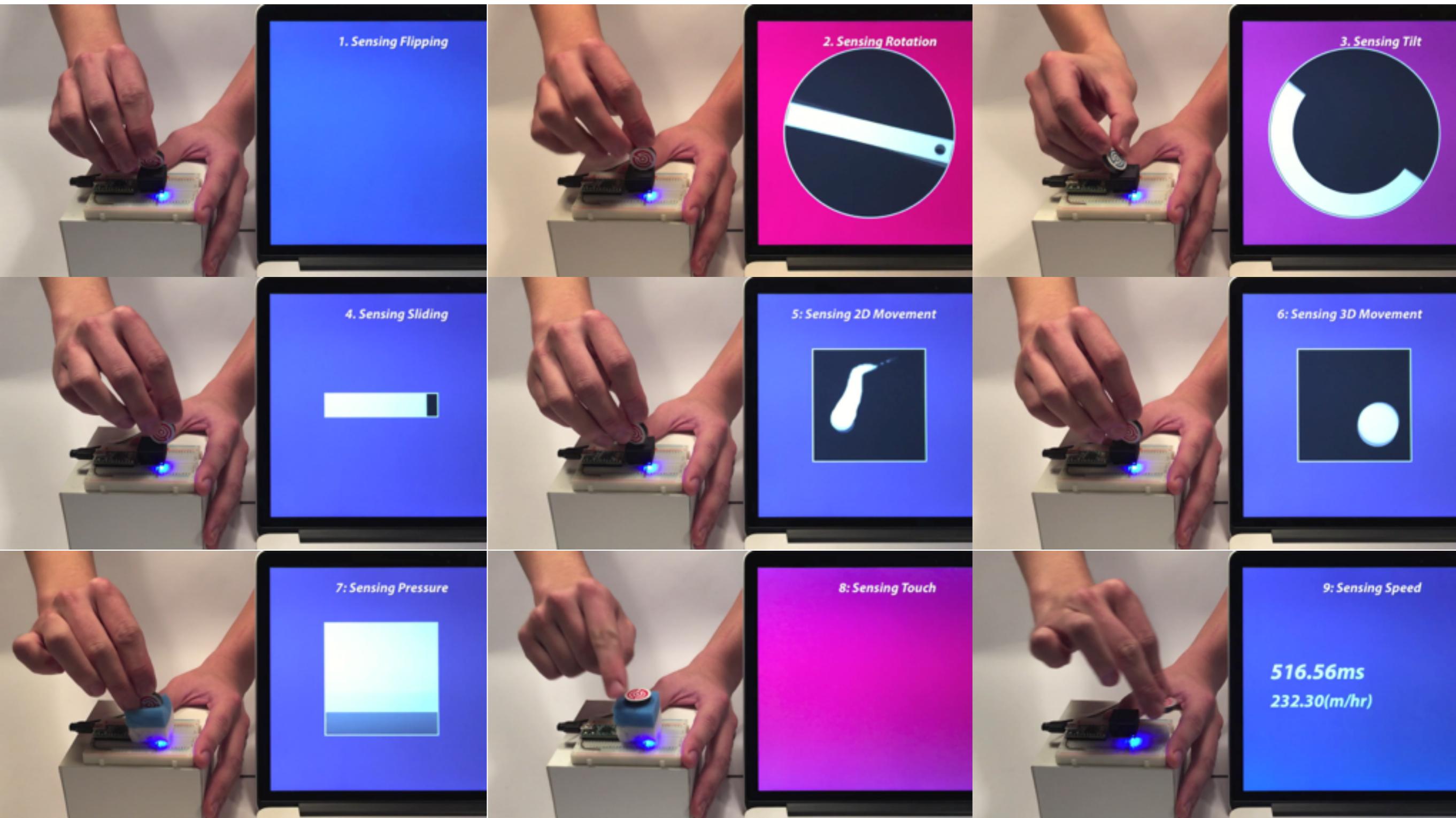


8. *Sensing Touch*



9. *Sensing Speed*

Enabling 9 Basic Utilities Using Just 1 Magnet



Hacking Toys





YouTube Channel (<http://tinyurl.com/j4axawa>)



Mini GaussSense

由GaussToys建立 · 7 部

加上說明

全部播放

分享



1 **已觀看** Mini GaussSense - Intro

上傳者 : GaussToys



2 **已觀看** Mini GaussSense - Part 2: Domino Playback

上傳者 : GaussToys



3 **已觀看** Mini GaussSense - Part 3: Compact Disc Jockey

上傳者 : GaussToys



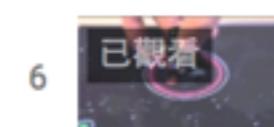
4 **已觀看** Mini GaussSense - Part 4: Zombie, Beat It!

上傳者 : GaussToys



5 **已觀看** Mini GaussSense - Part 5: Merry-'Oh!' Xmas

上傳者 : GaussToys



6 **已觀看** Mini GaussSense - Part 6: Darth Vader's Defense

上傳者 : GaussToys



7 **已觀看** Mini GaussSense - Part 7: Go-Go-Roll!

上傳者 : GaussToys

