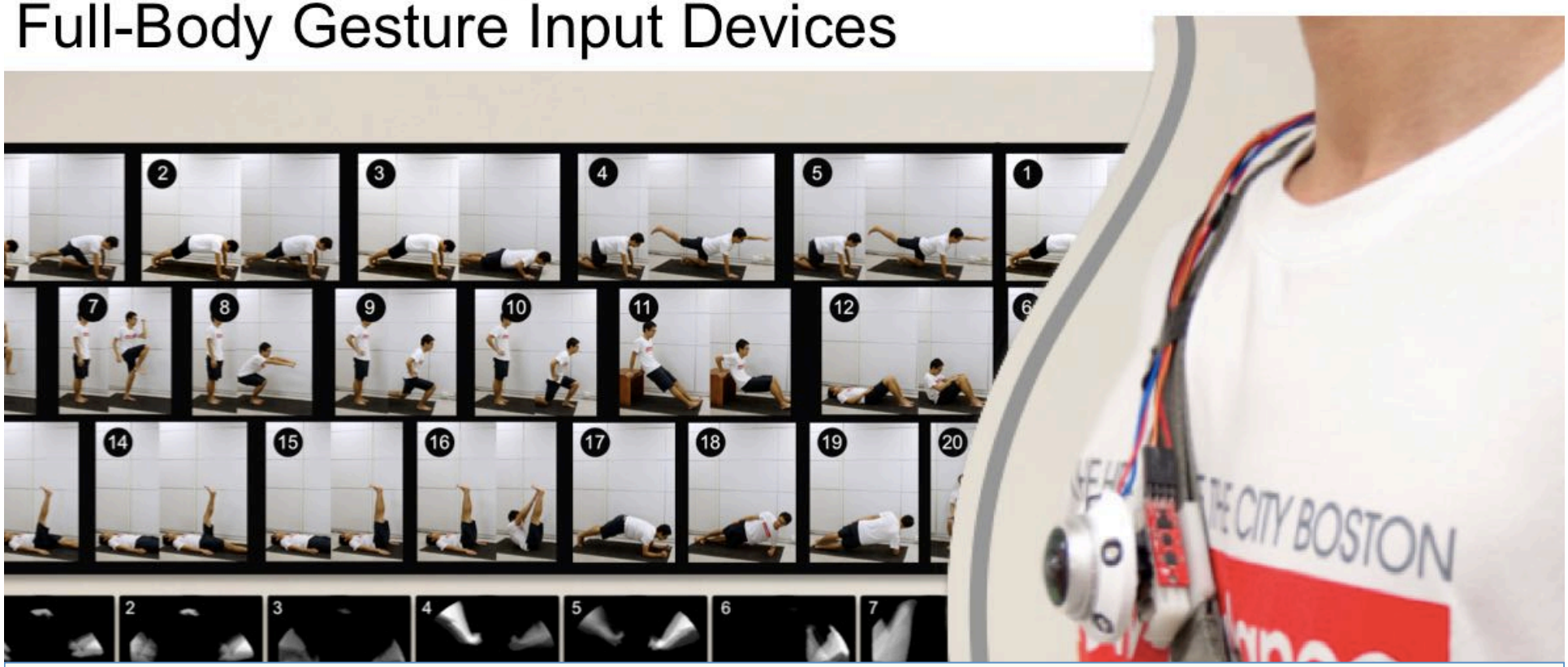
Cyclops

CHI 2015

Wearable and Single-Piece Full-Body Gesture Input Devices



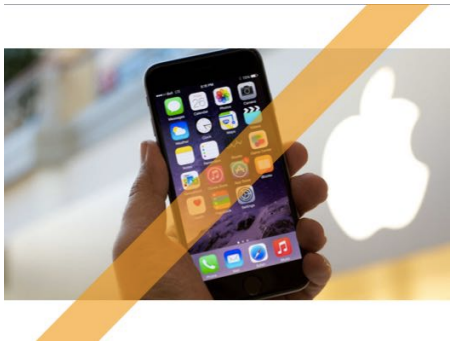
Liwei Chan
Chi-Hao Hsieh
Da-Yuan Huang
Yi-Ling Chen
Rong-Hao Liang
Shuo Yang
Bing-Yu Chen

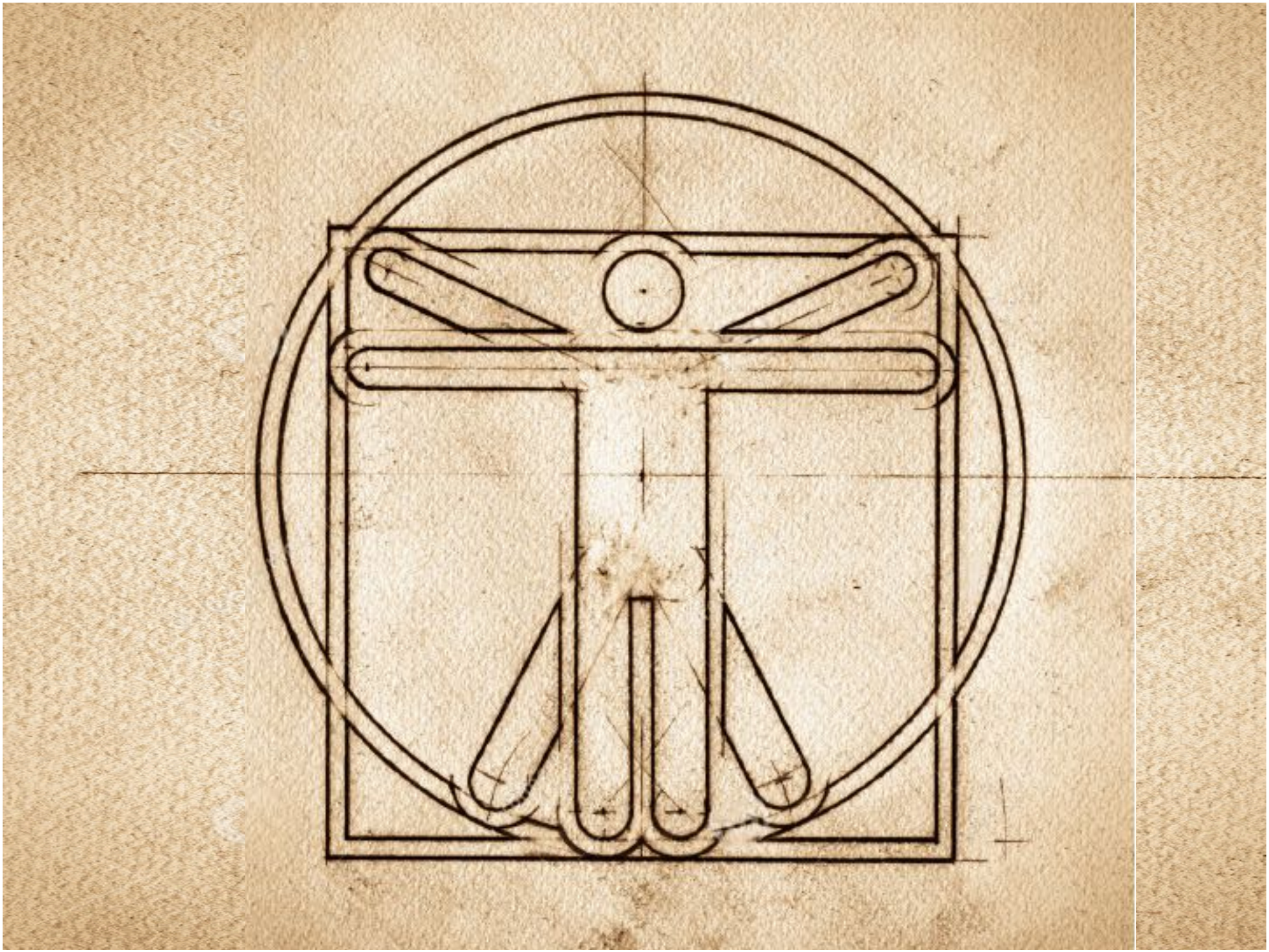
National Taiwan University

most effective interface:

most effective interface:

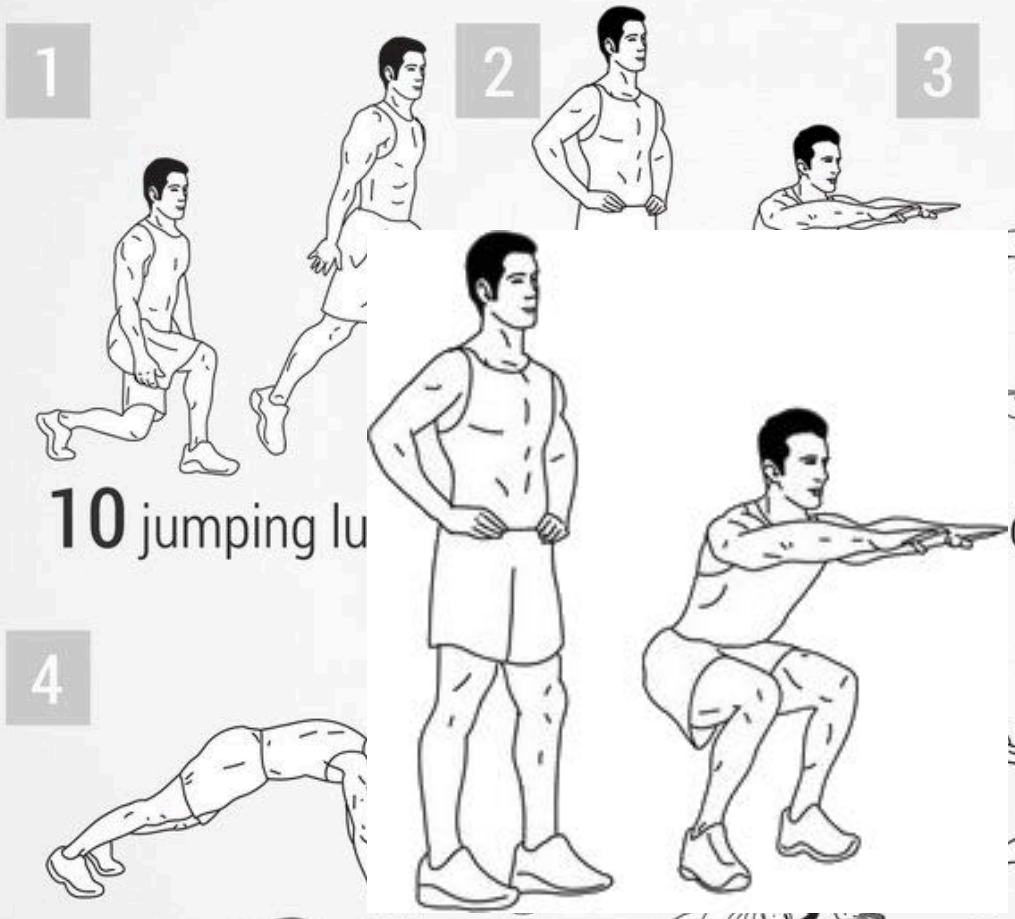
interface that we are trained to use at the longest



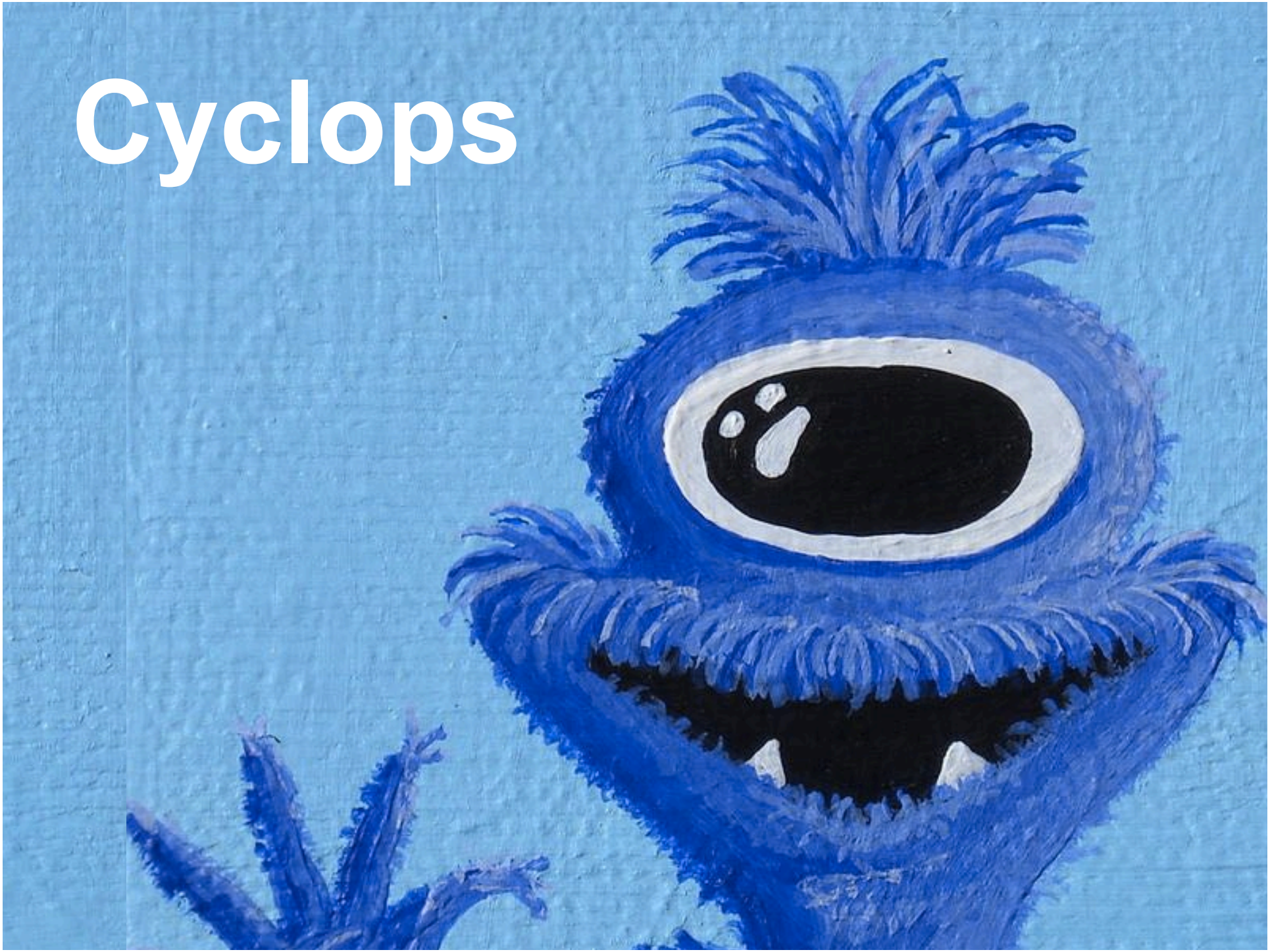


NEILA REY WORKOUT

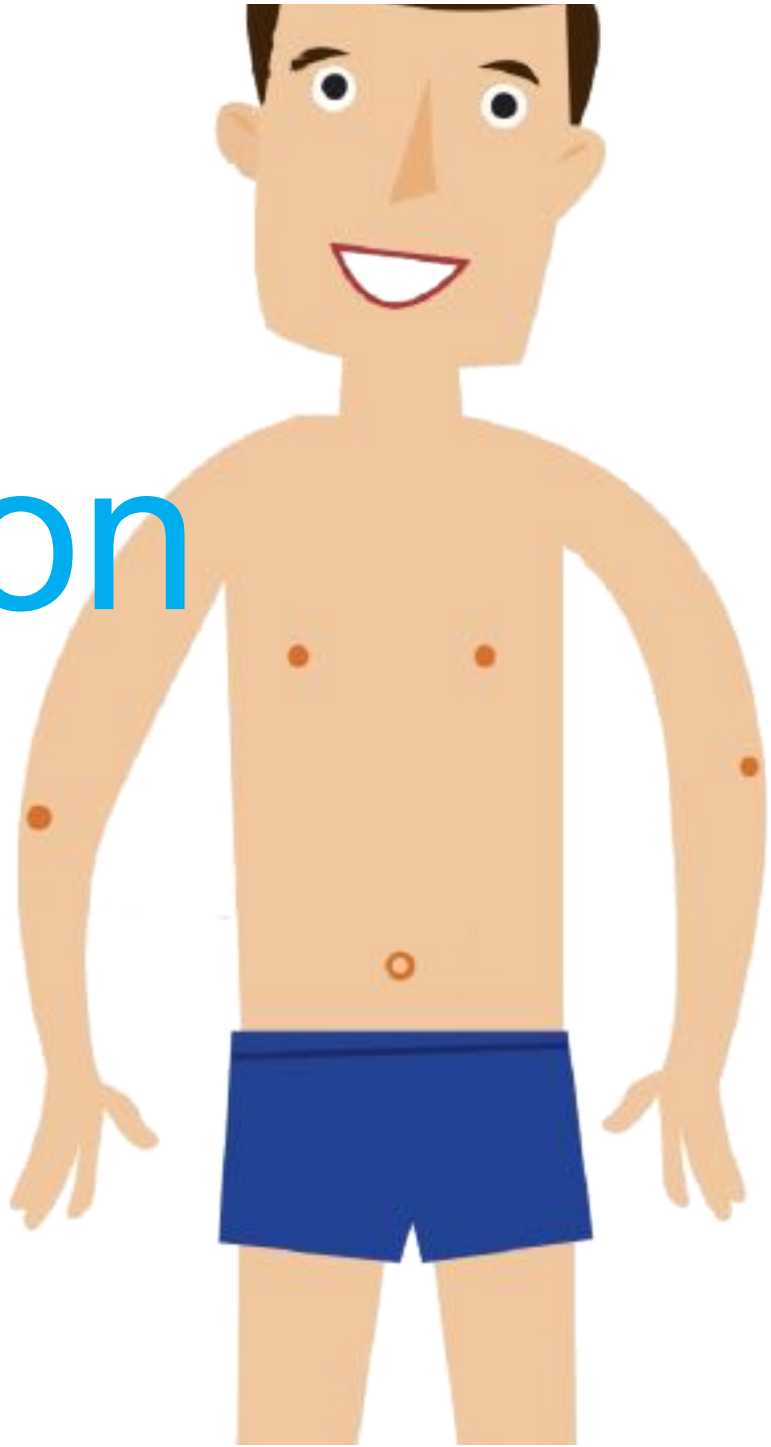
neilarey.com



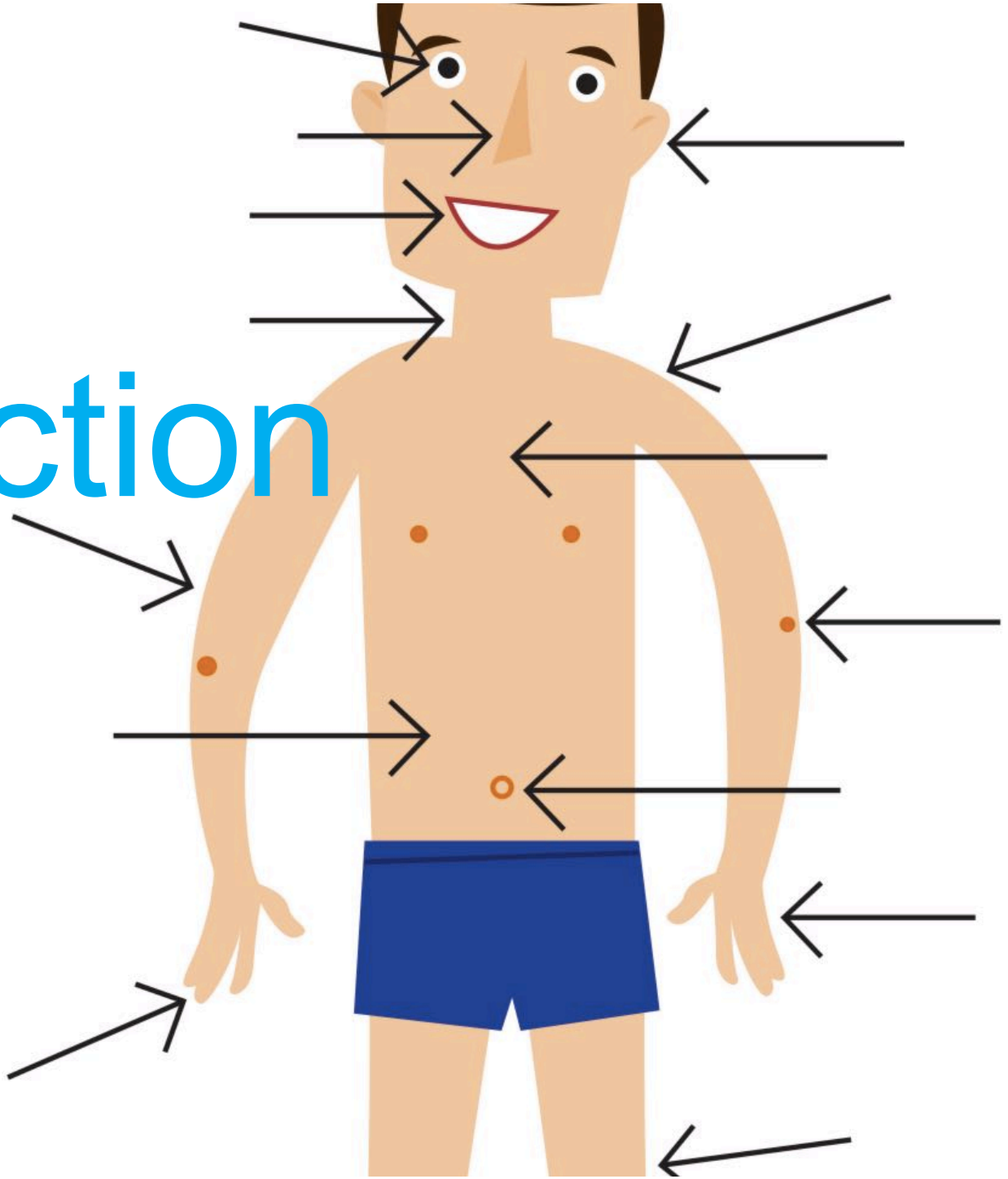
Cyclops



Full Body Interaction



Full Body Interaction

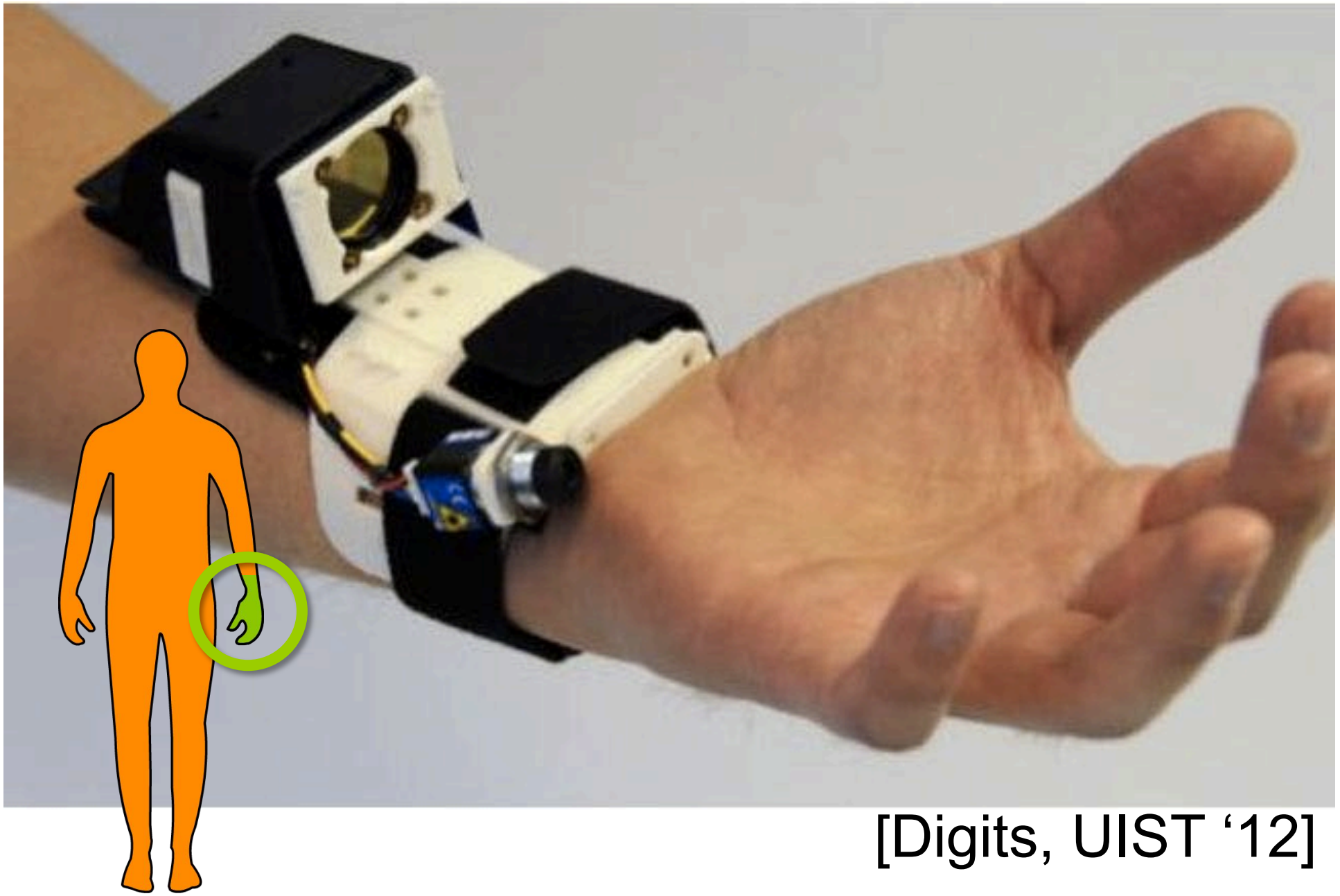


Related Work

Kinect


Kinect
Interaction zone


On-body camera
wearable interaction zone



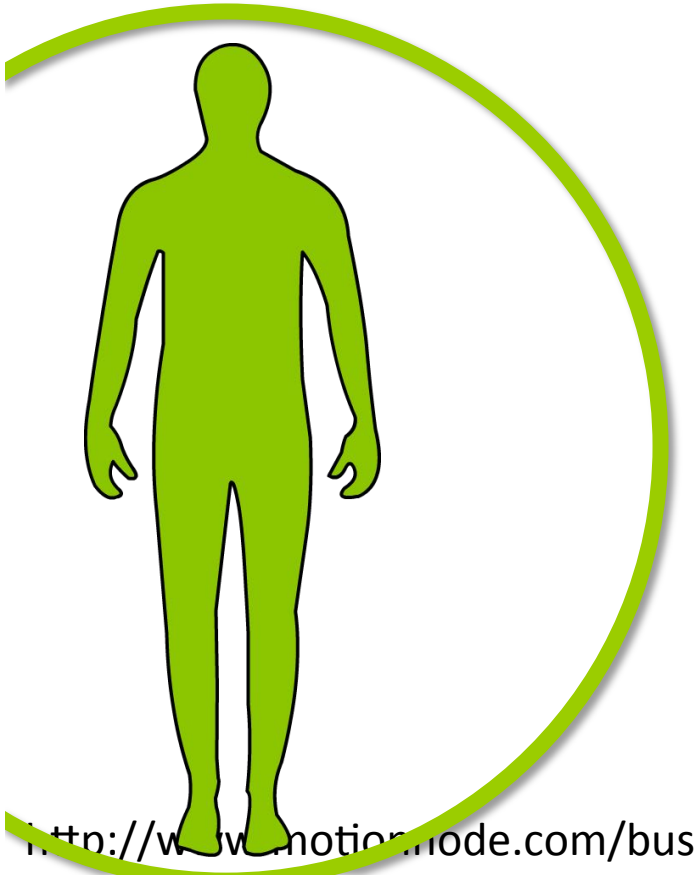
[Digits, UIST ‘12]


[OmniTouch, UIST ‘11

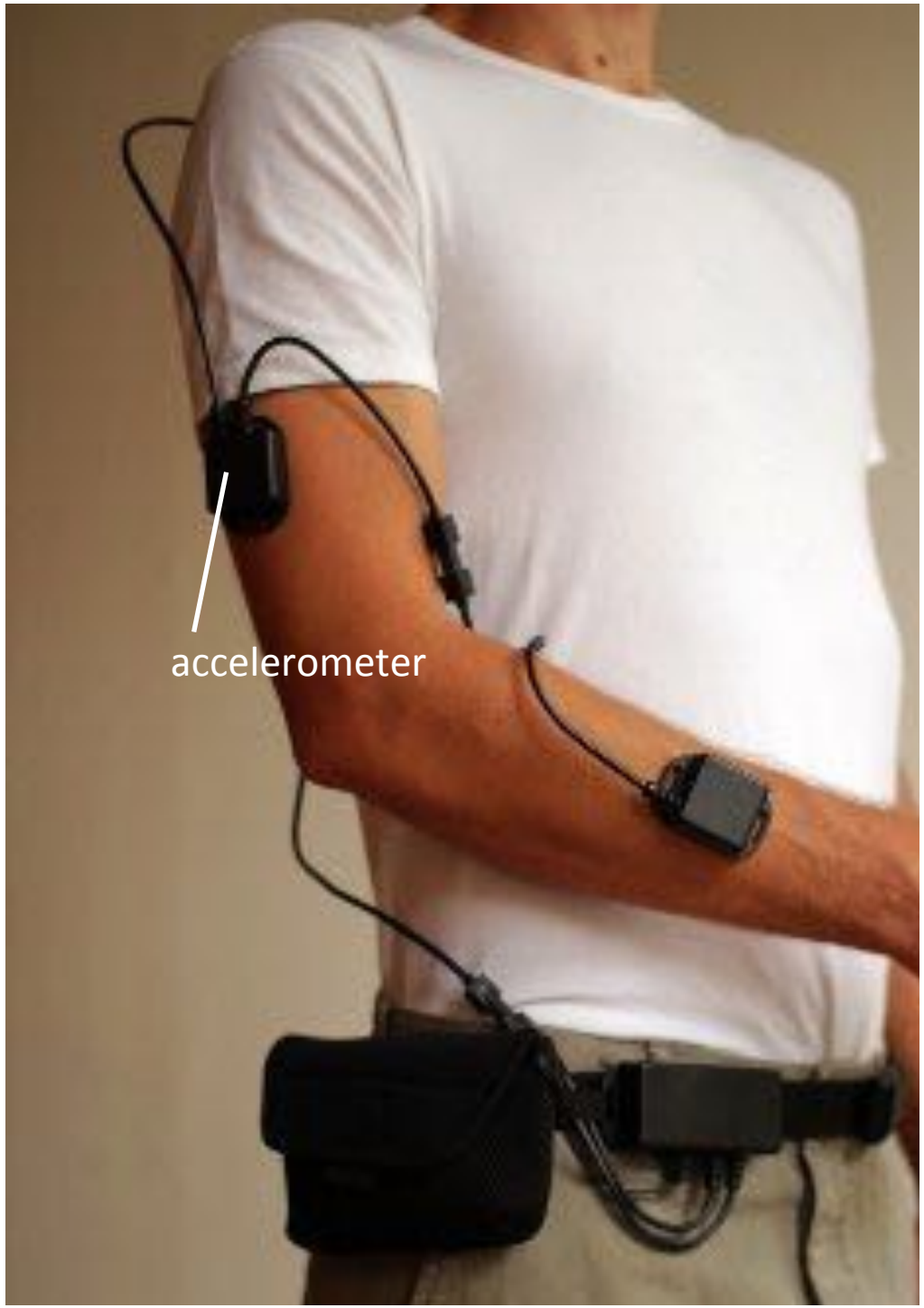
[ShoeSense, CHI‘12]

MotionNode

a wearable network of 3-DOF inertial measurement units (**IMU**) for use in motion capture applications

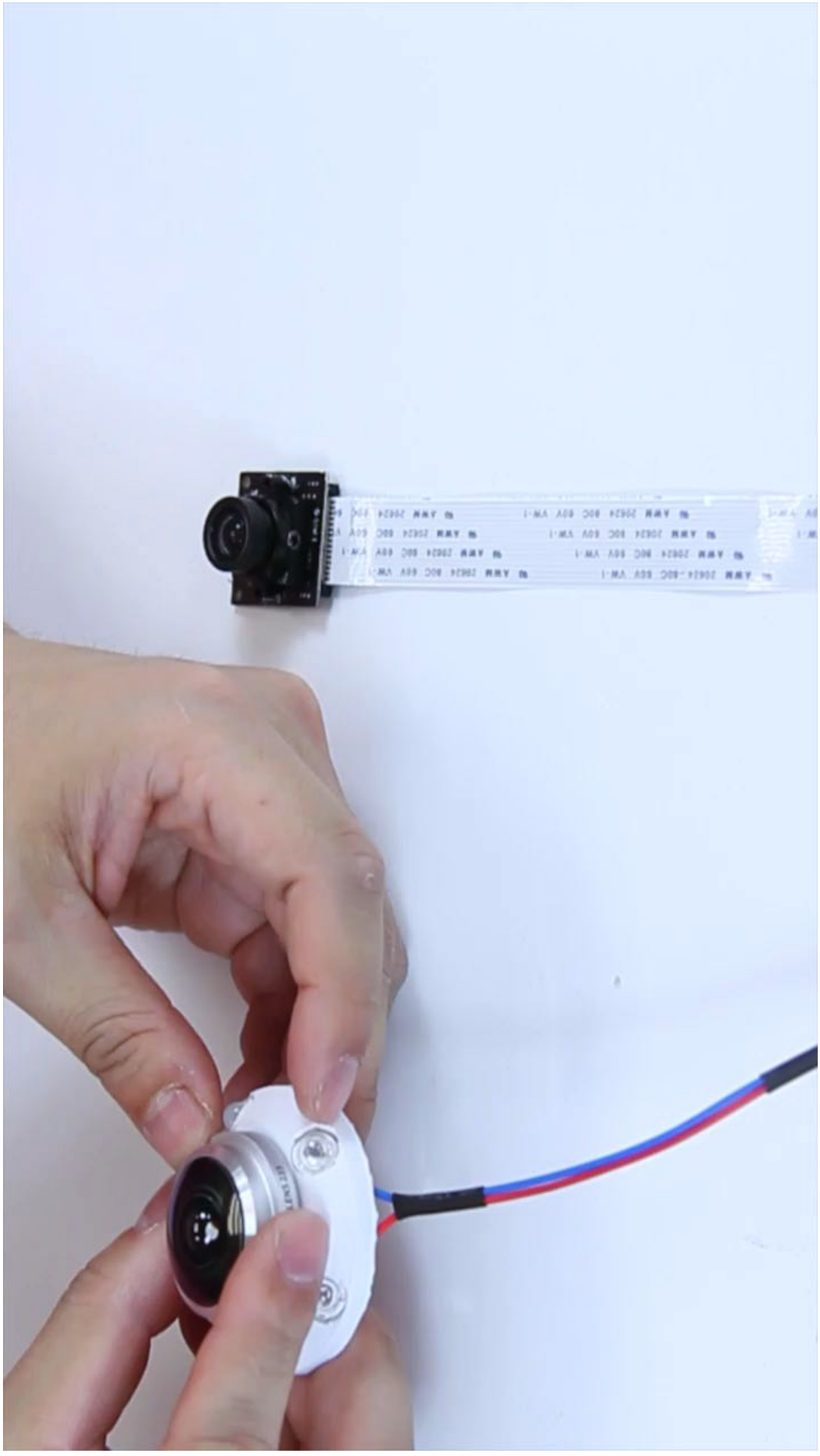


http://www.motionnode.com/bus.html




Motion
Capture
Suit


Motion
Capture
Suit

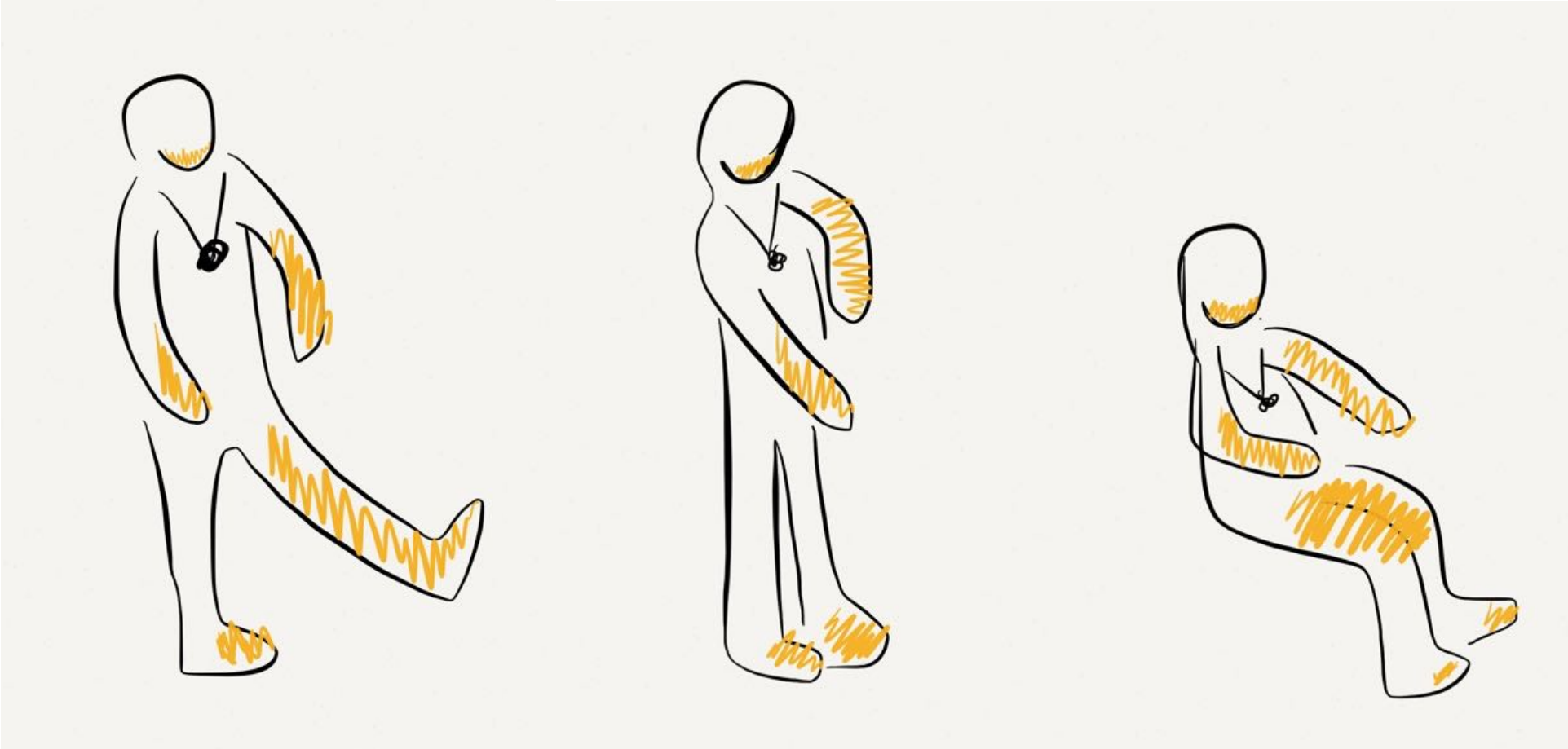


Cyclops

:: a single-piece wearable device that sees all.

Cyclops

:: a single-piece wearable device that sees all.

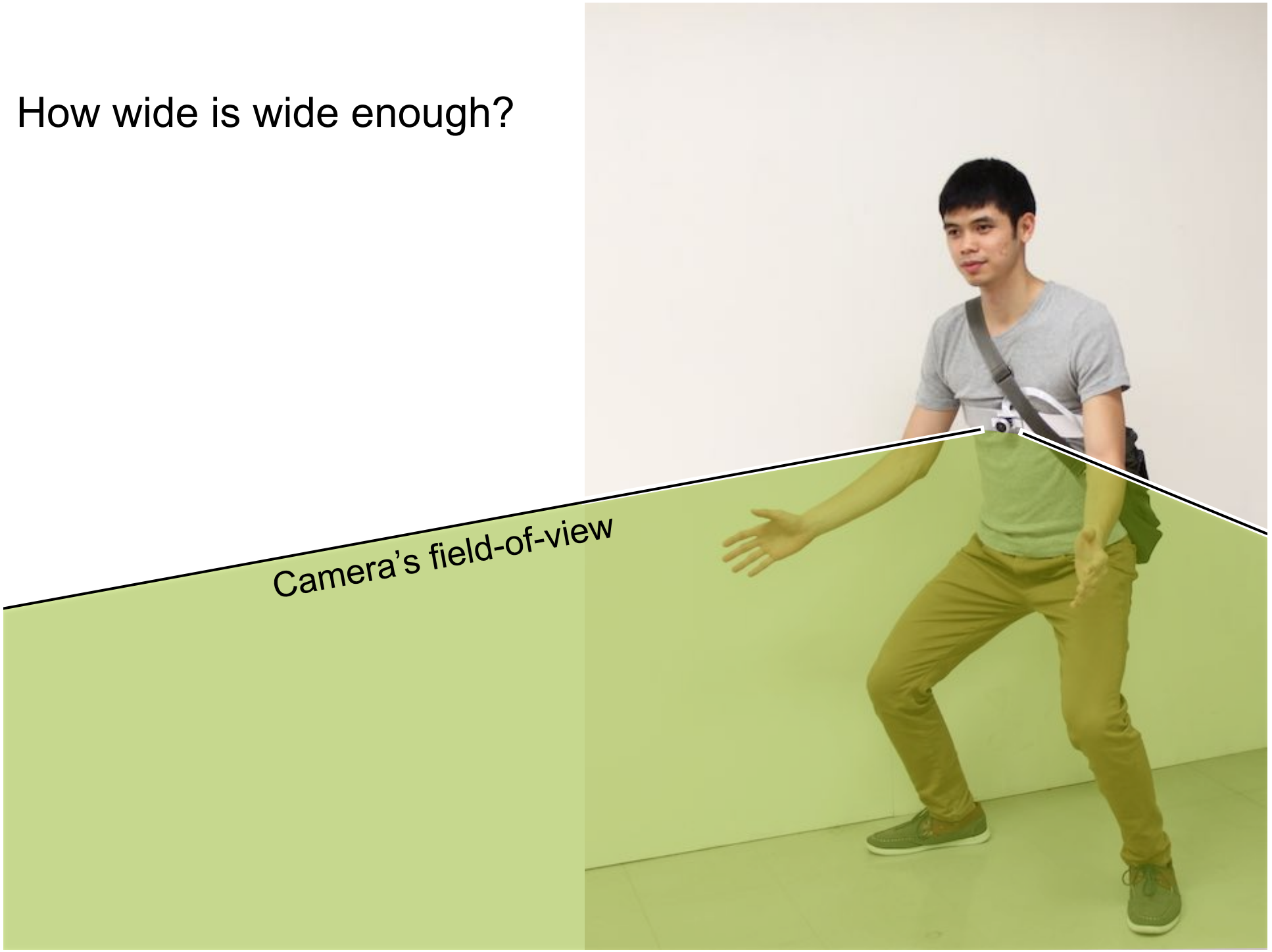


How wide the field-of-view
of the lens is required to see
the full body from users' chest?

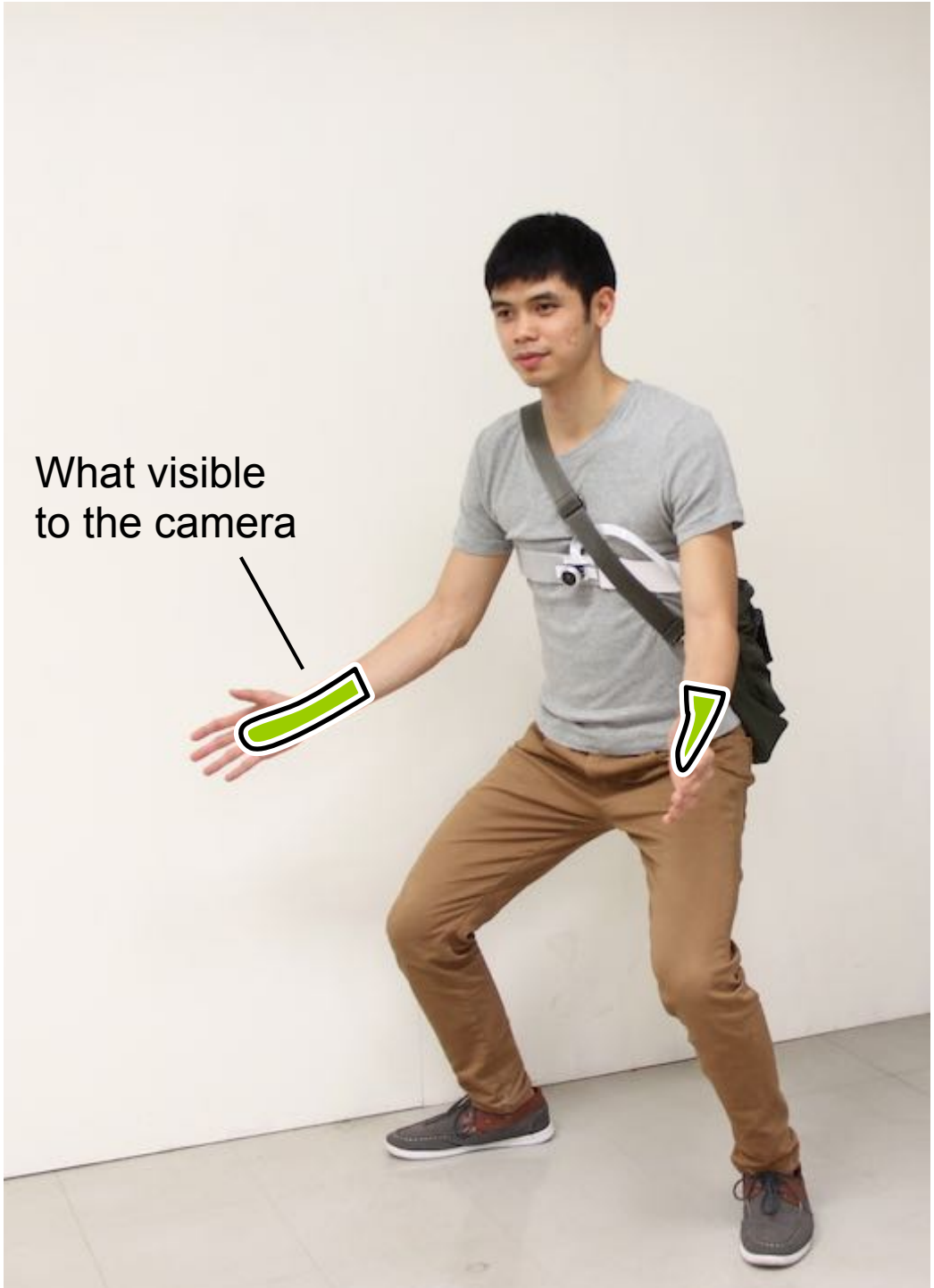

GOPRO


GOPRO
Feet?

How wide is wide enough?



How wide is wide enough?

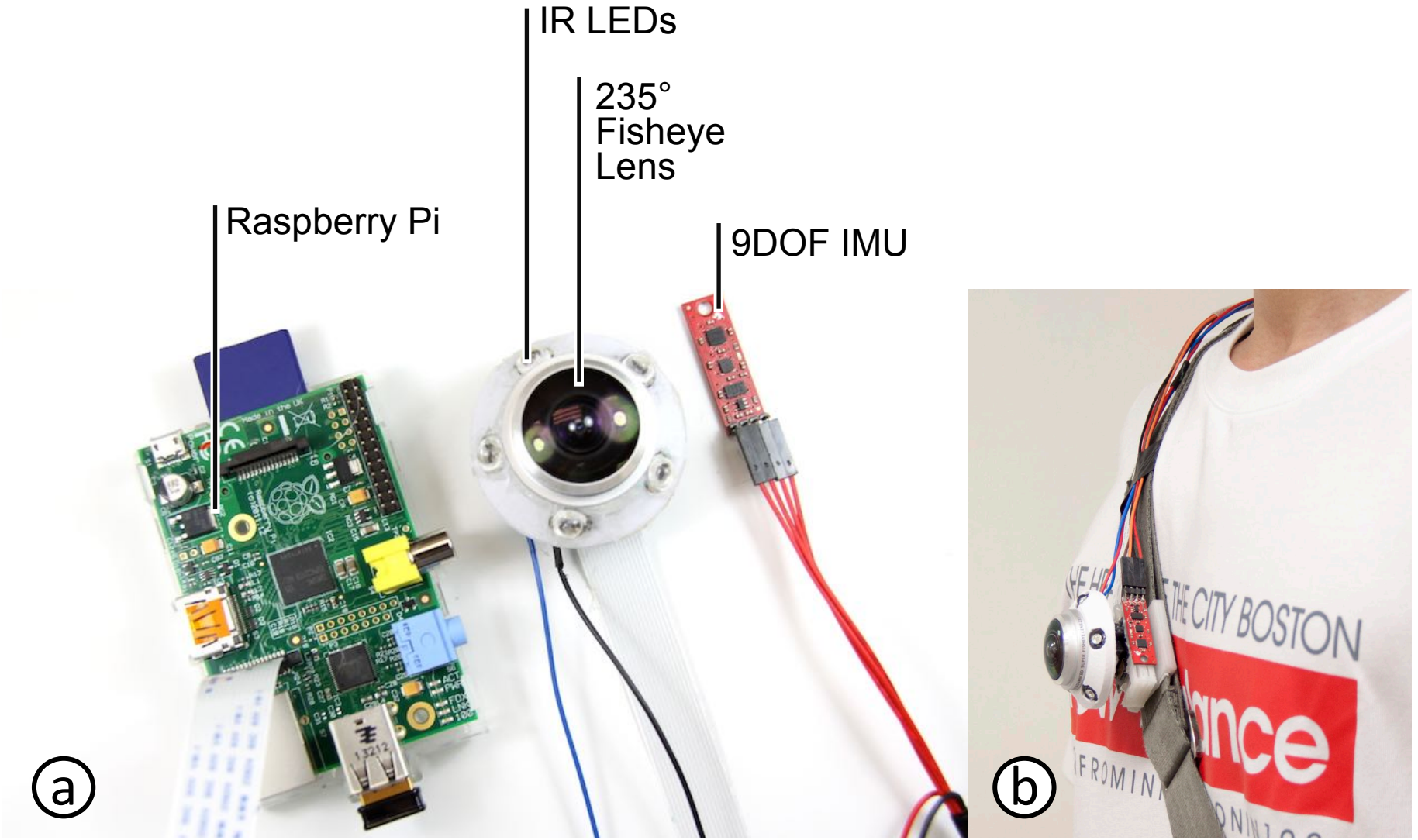


How wide is wide enough
to see the body like this?

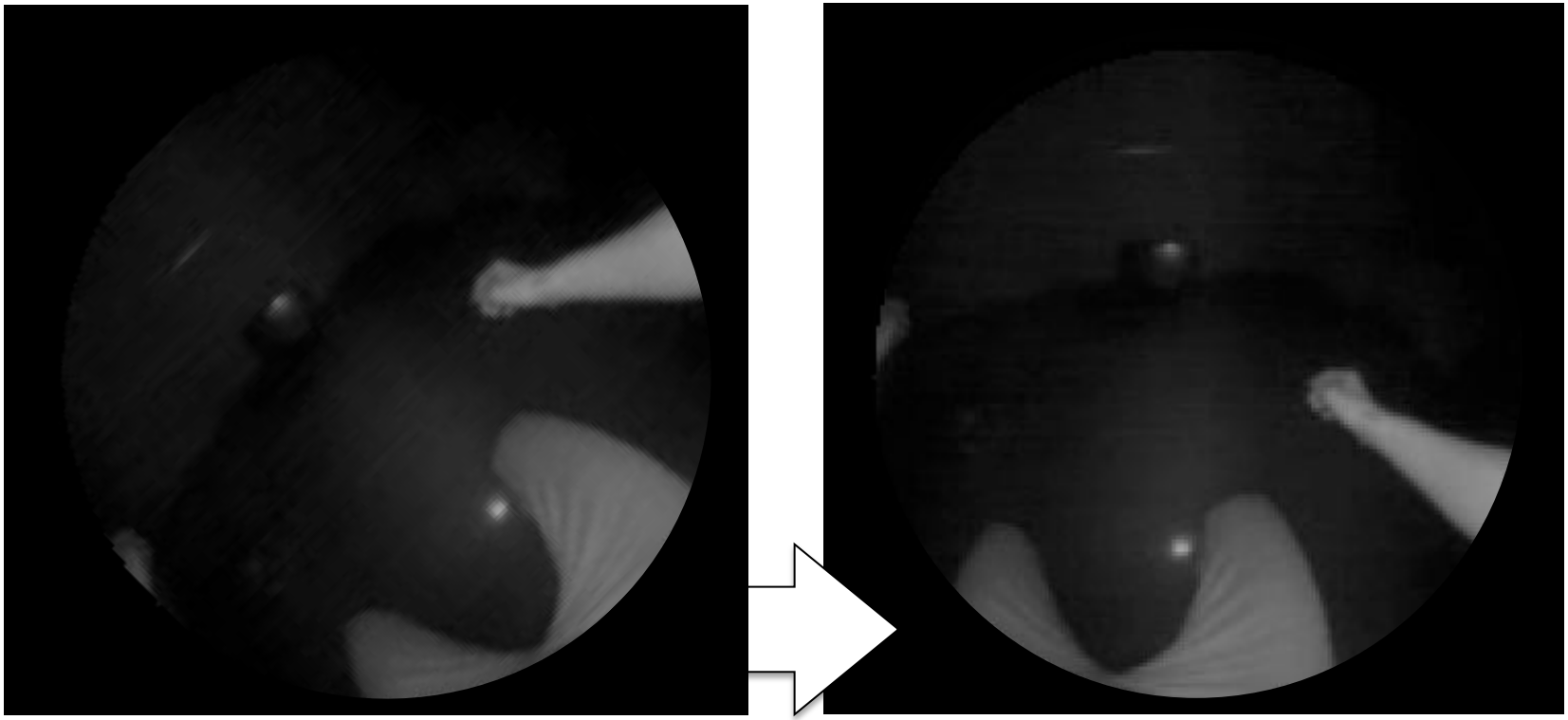

Safari
HERO


235°

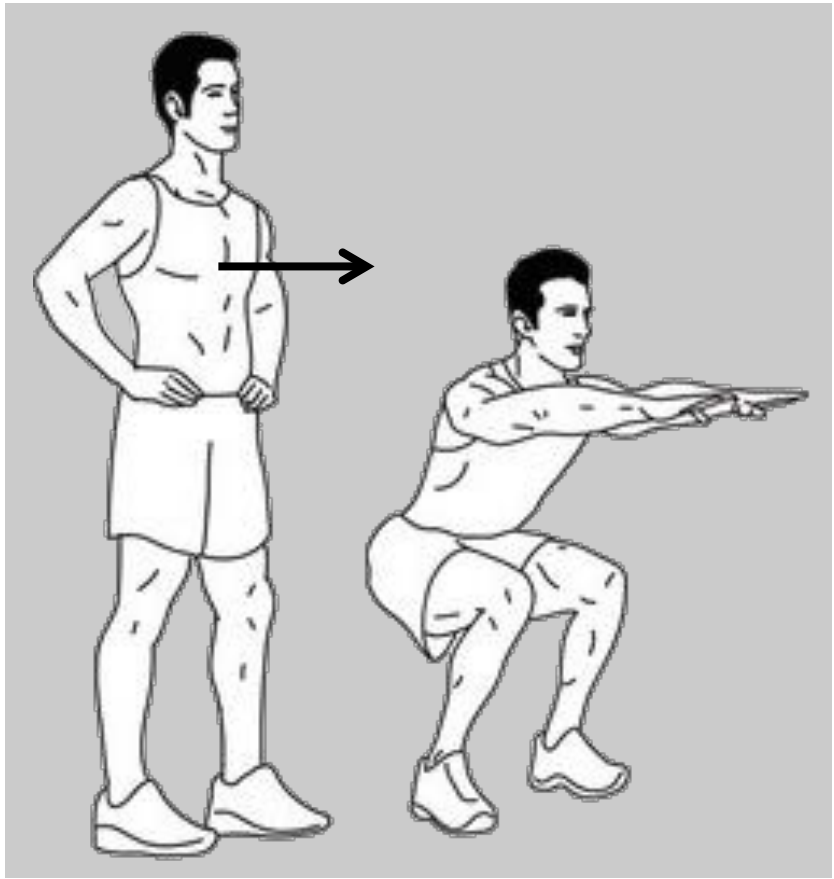
Proof-of-concept Prototype

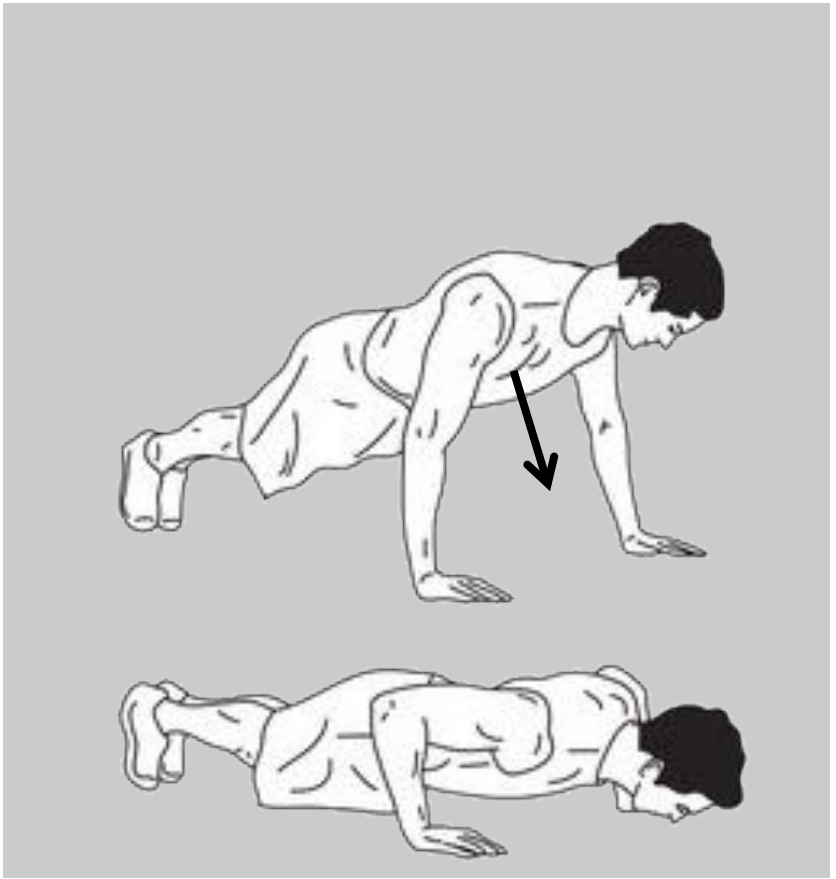


1. Reorient the image to up right

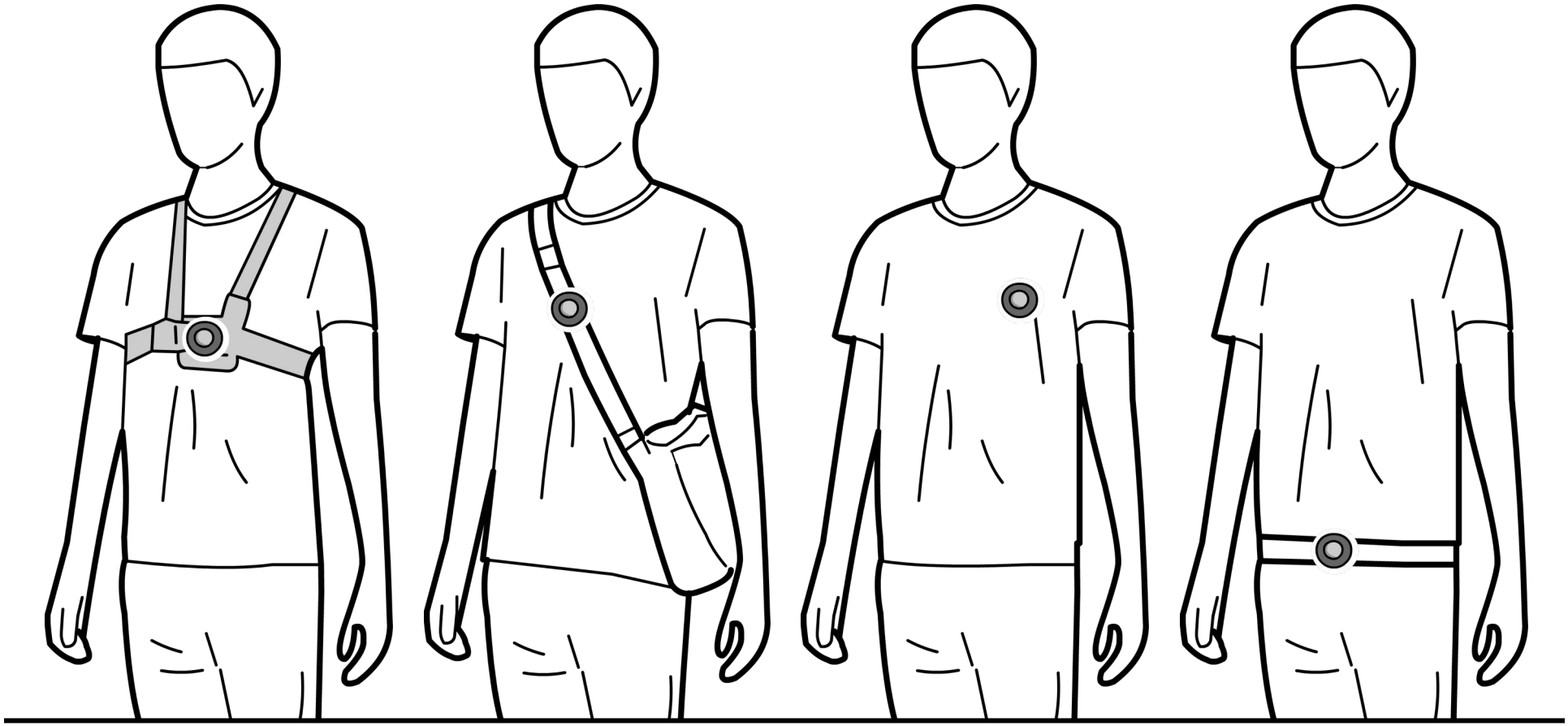


2. Differentiate gesture types

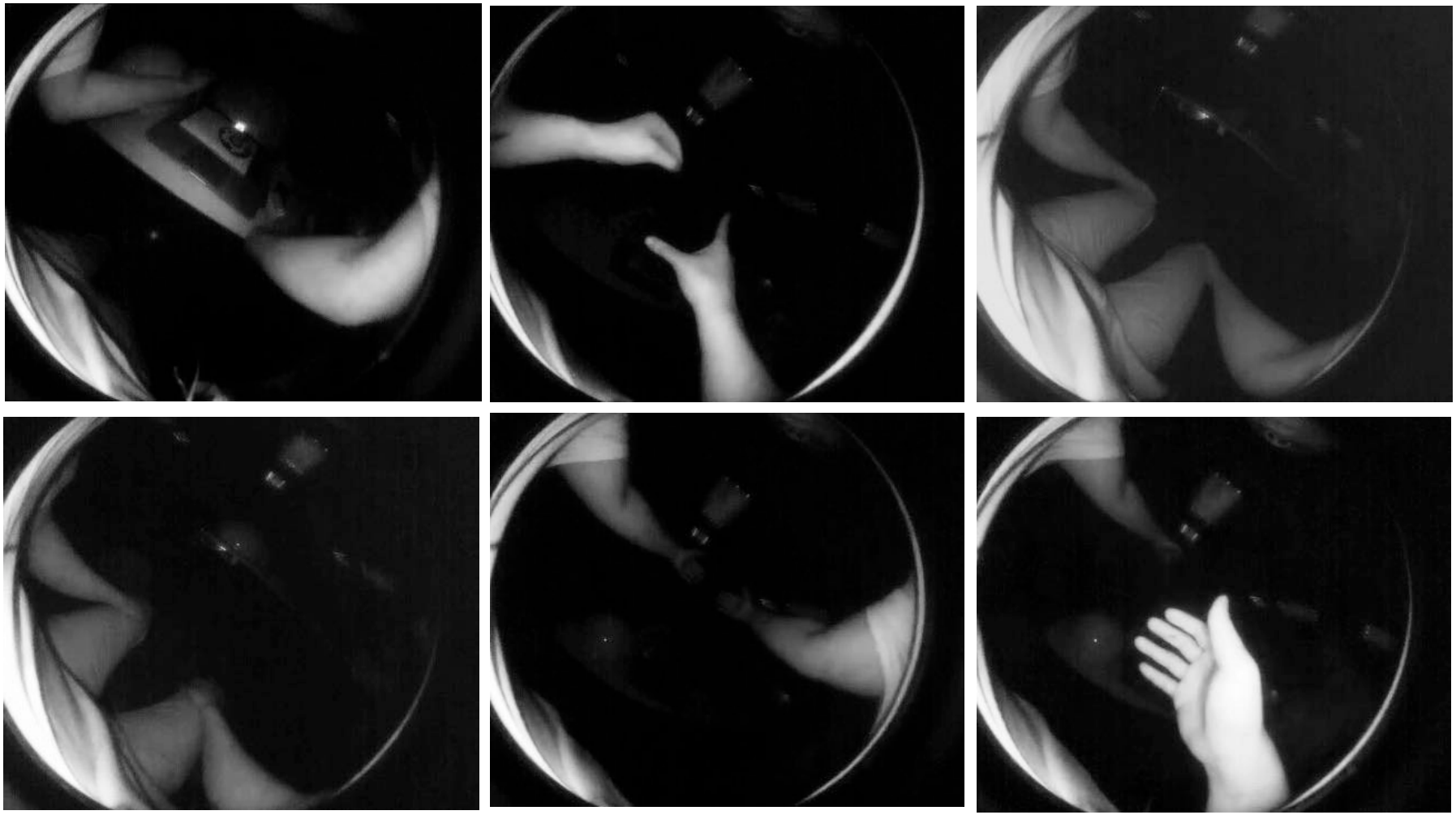




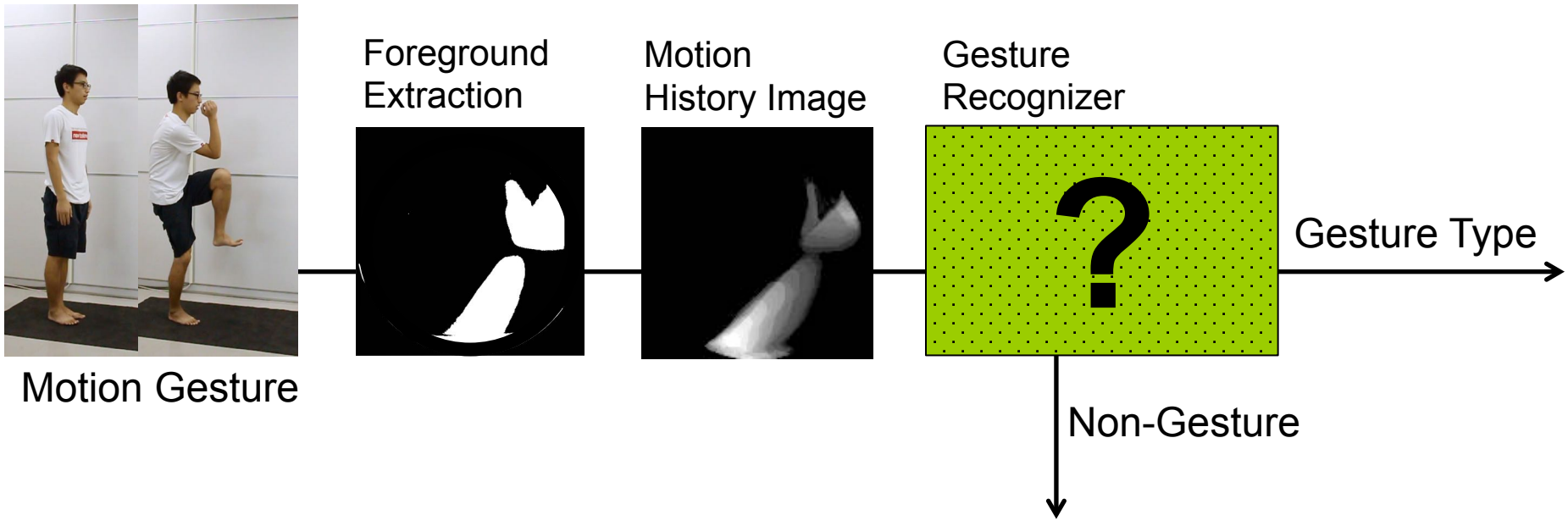
Wearable Forms



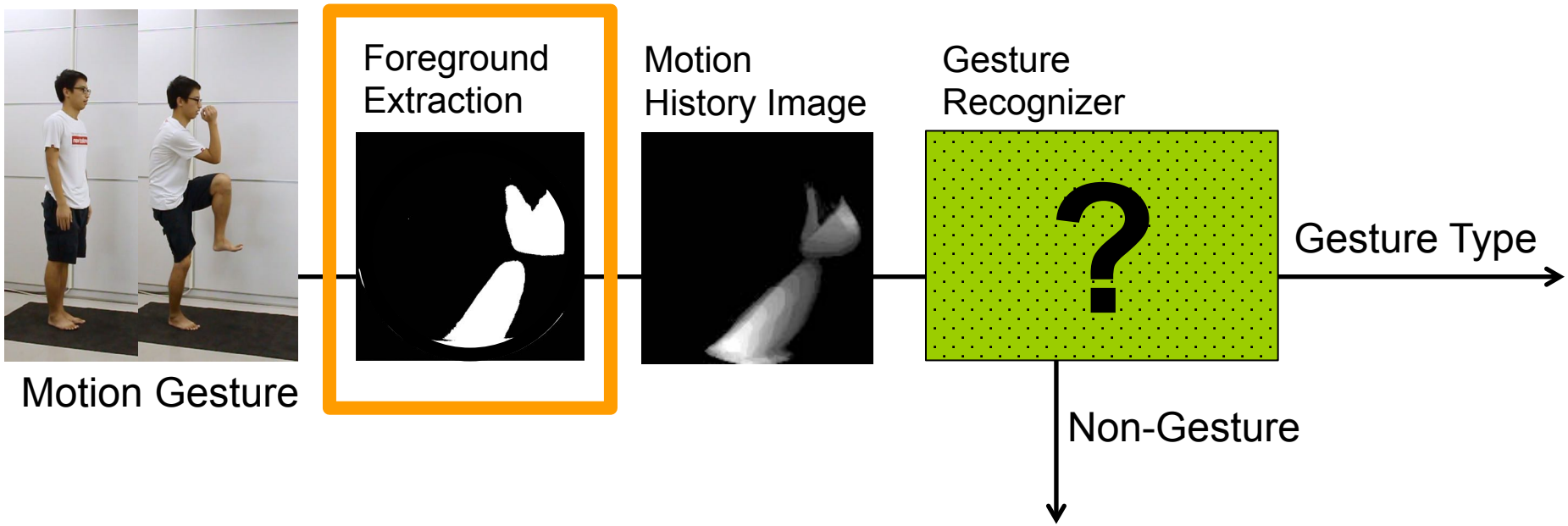
Eco-Centric View of Body Gestures



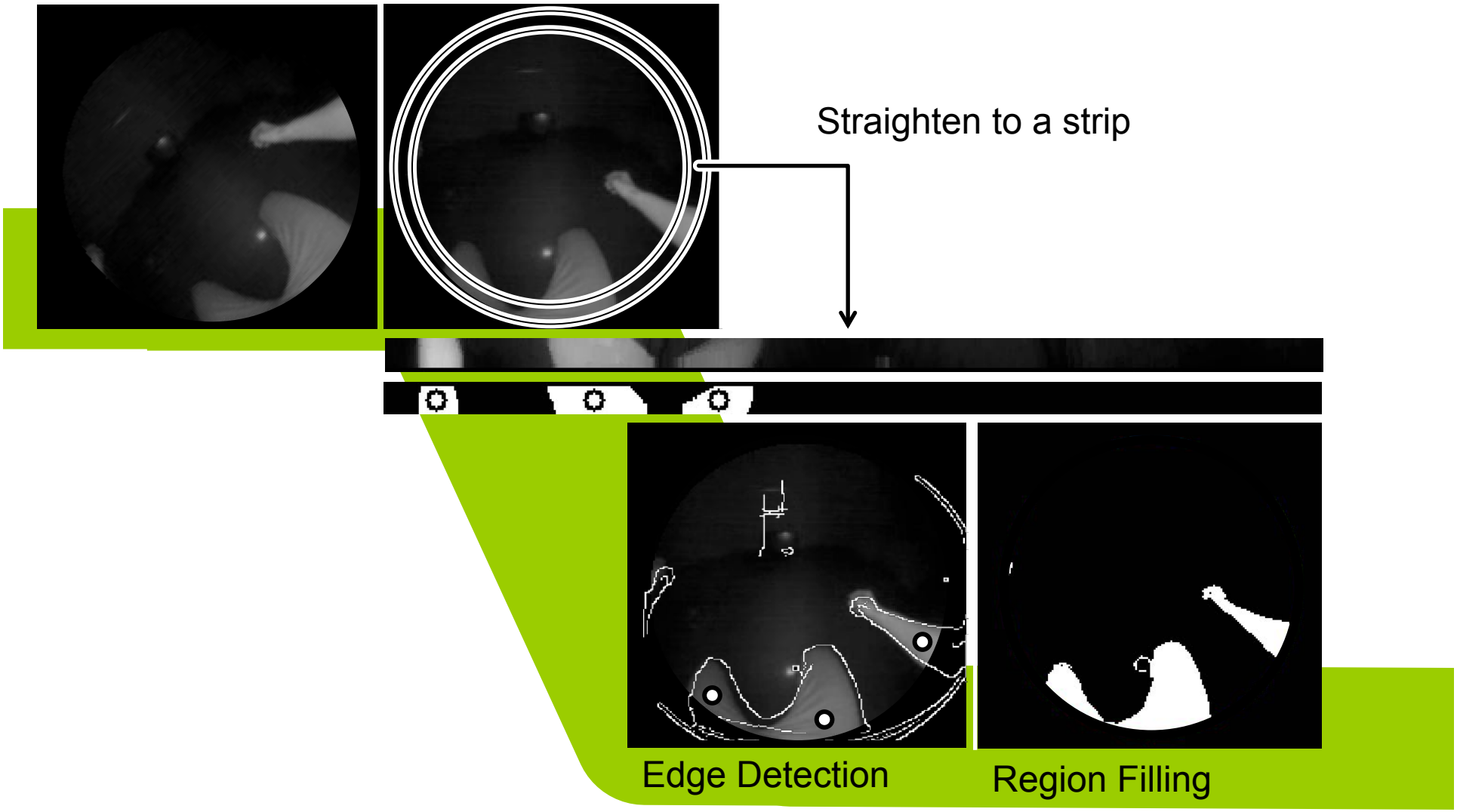
Pipeline of Body Gesture Recognition



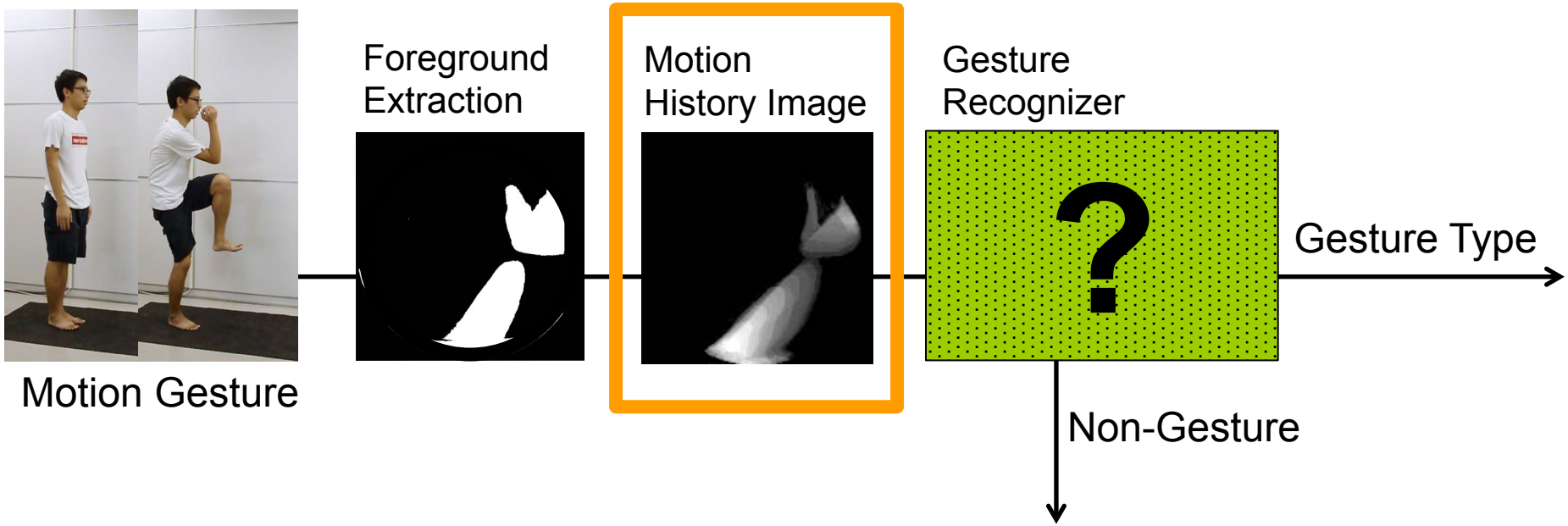
Pipeline of Body Gesture Recognition



Foreground Extraction



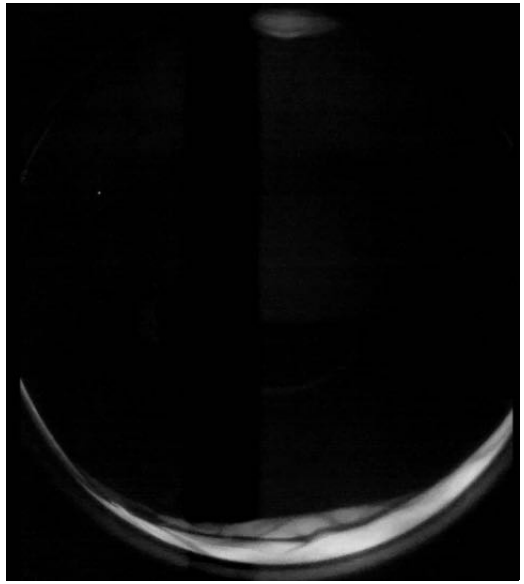
Pipeline of Body Gesture Recognition



Motion History Image

:: an image template in which non-zero pixels simultaneously record the **spatial** and **temporal** aspects of motion.

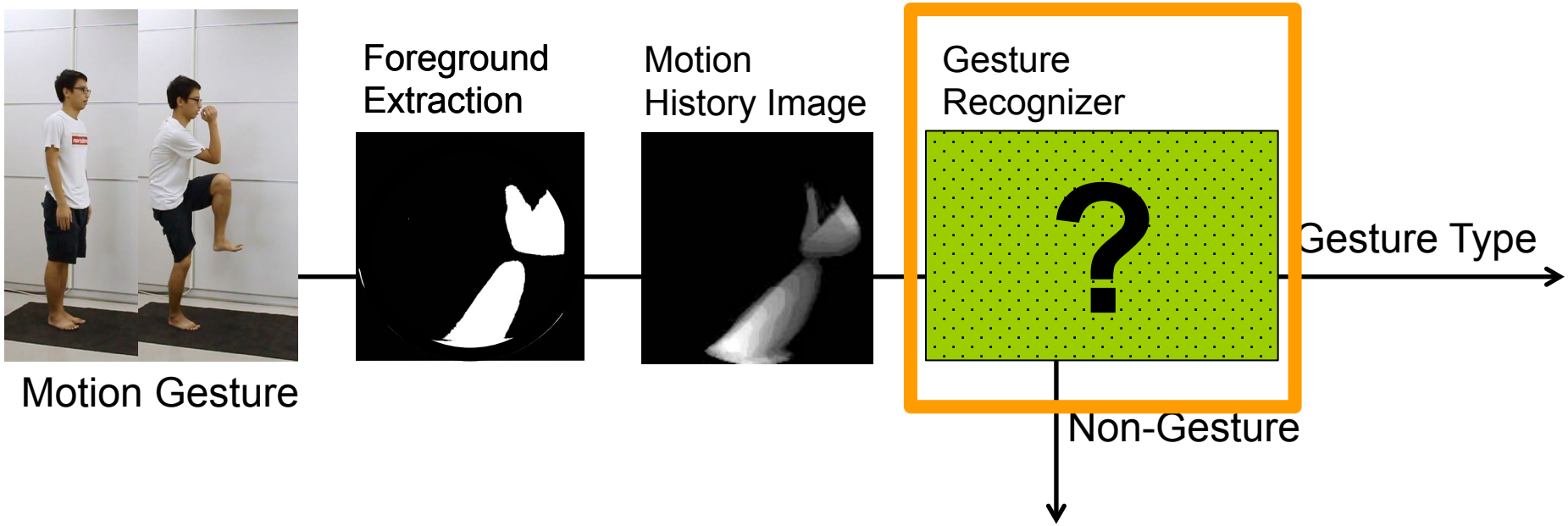
Motion History Image



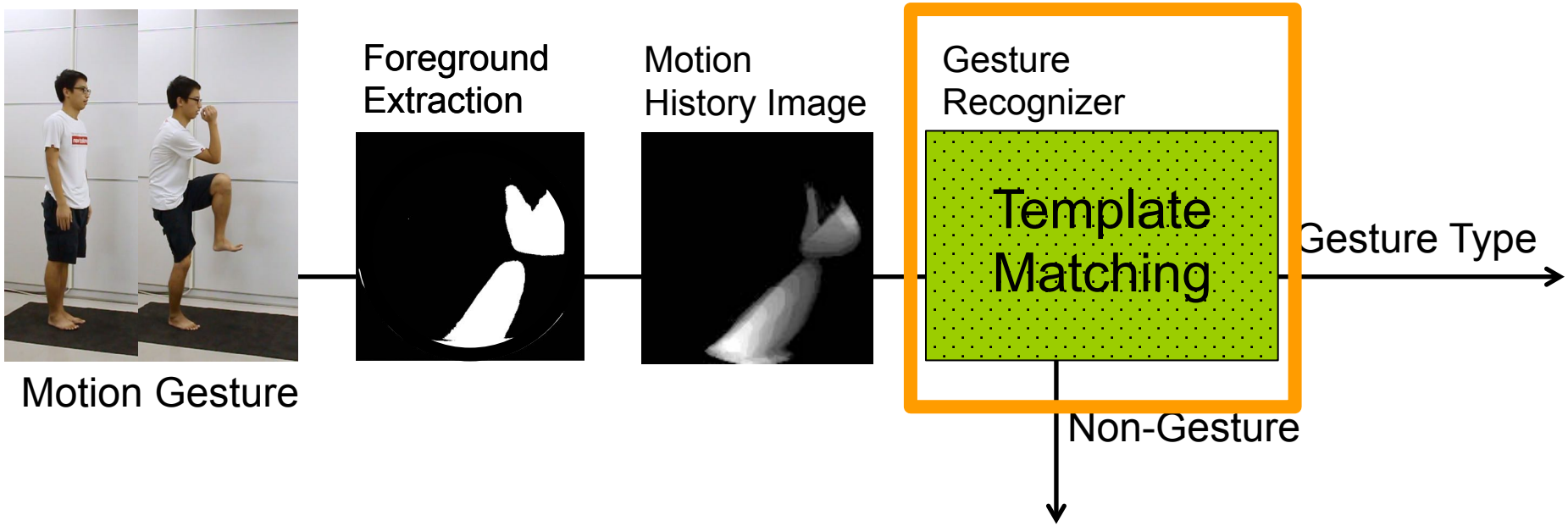
Foreground

MHI

Pipeline of Body Gesture Recognition

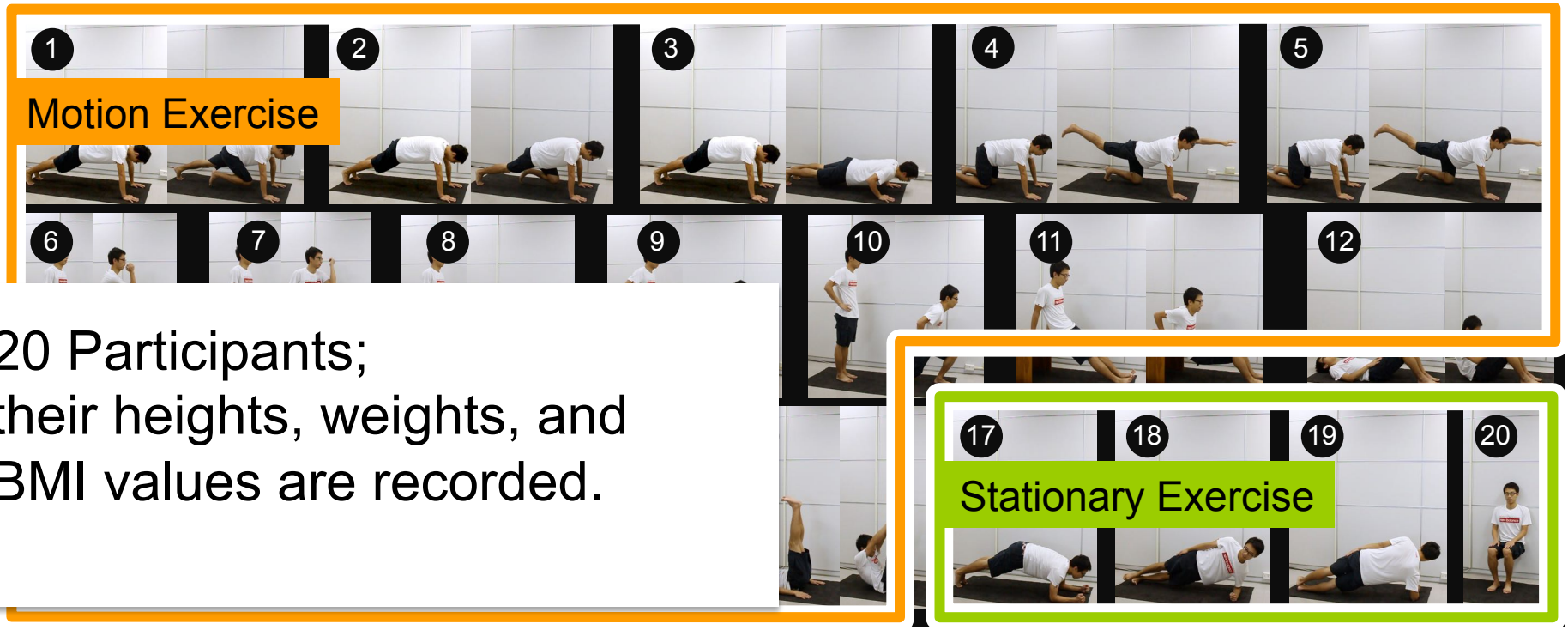


Pipeline of Body Gesture Recognition



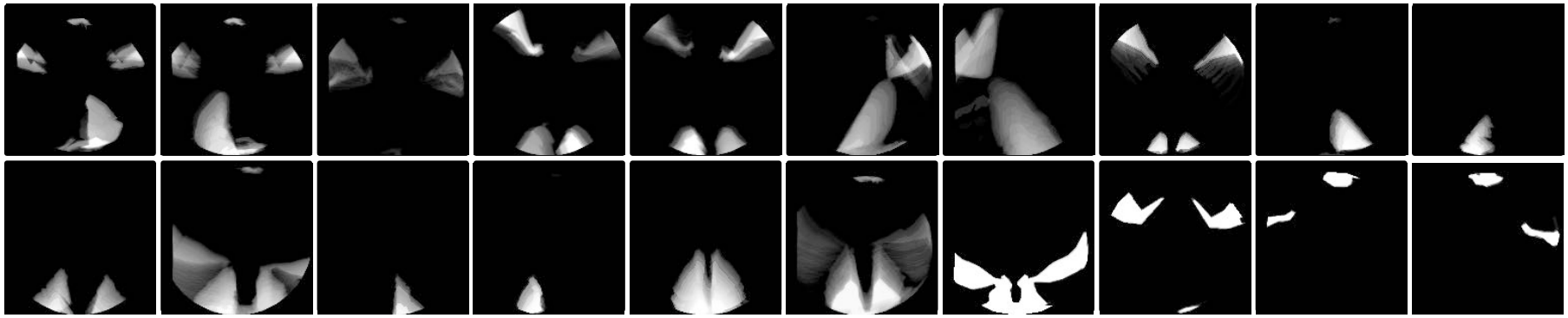
Experiment

Experiment

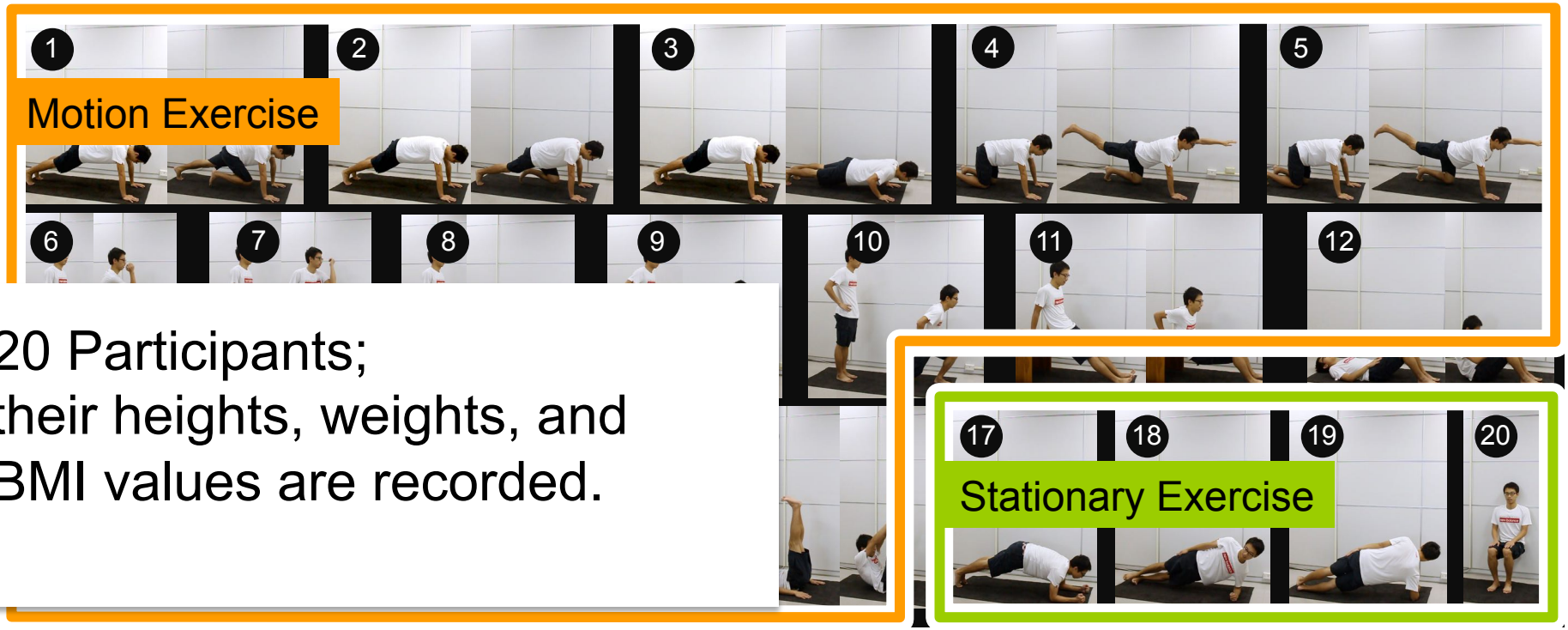


20 Participants;
their heights, weights, and
BMI values are recorded.

iMHI



Experiment



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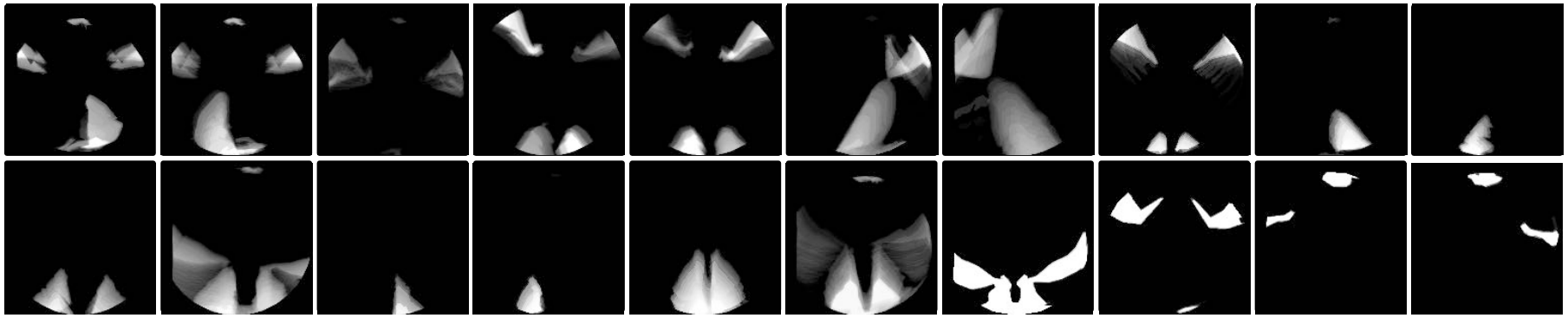
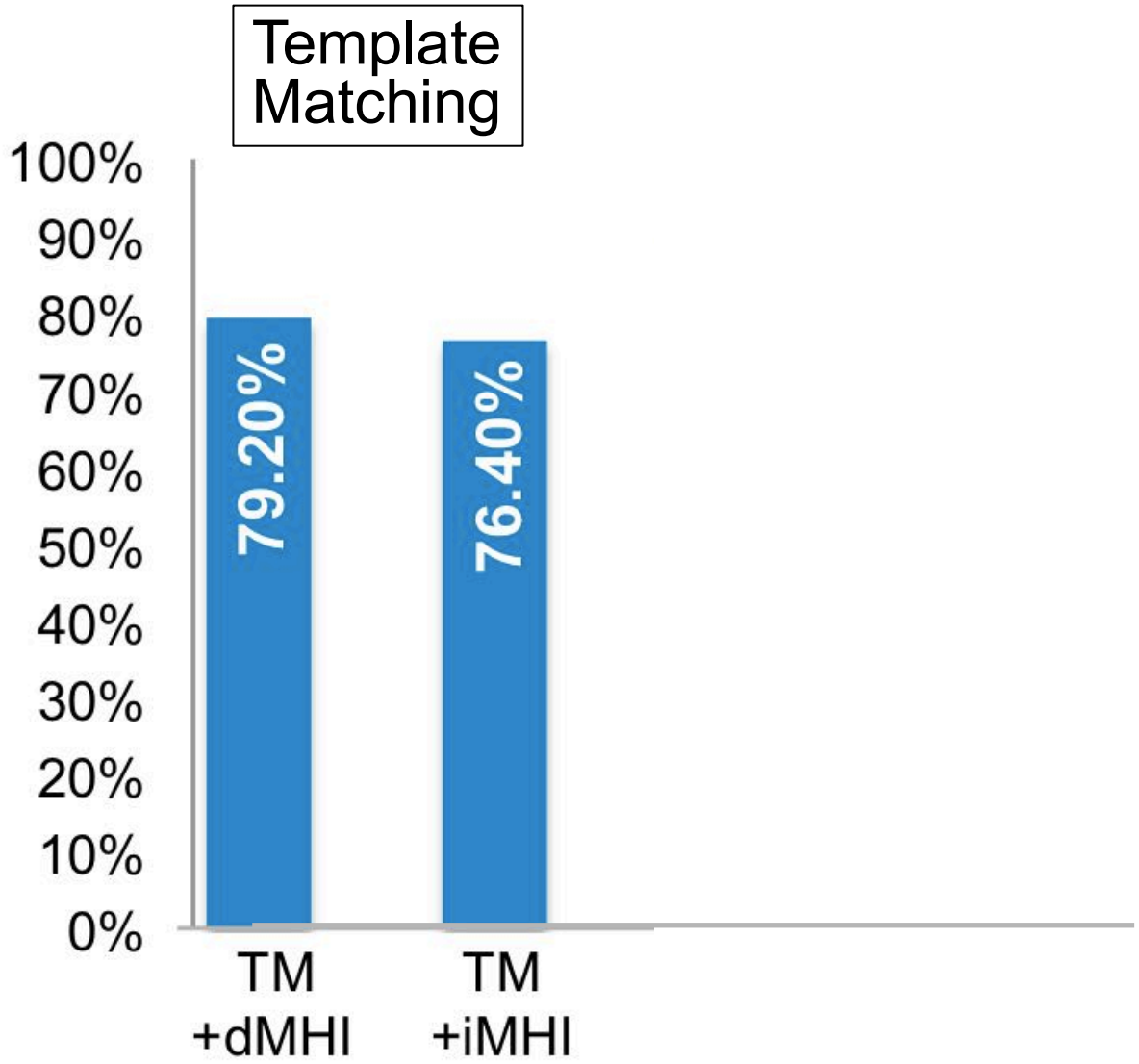


dMHI

Experiment Result



Random Decision Forest (RDF)

- Data-driven learning algorithm
- Notable example: Kinect
- RDF: a set of decision trees;
  each internal node is
  a weak learner

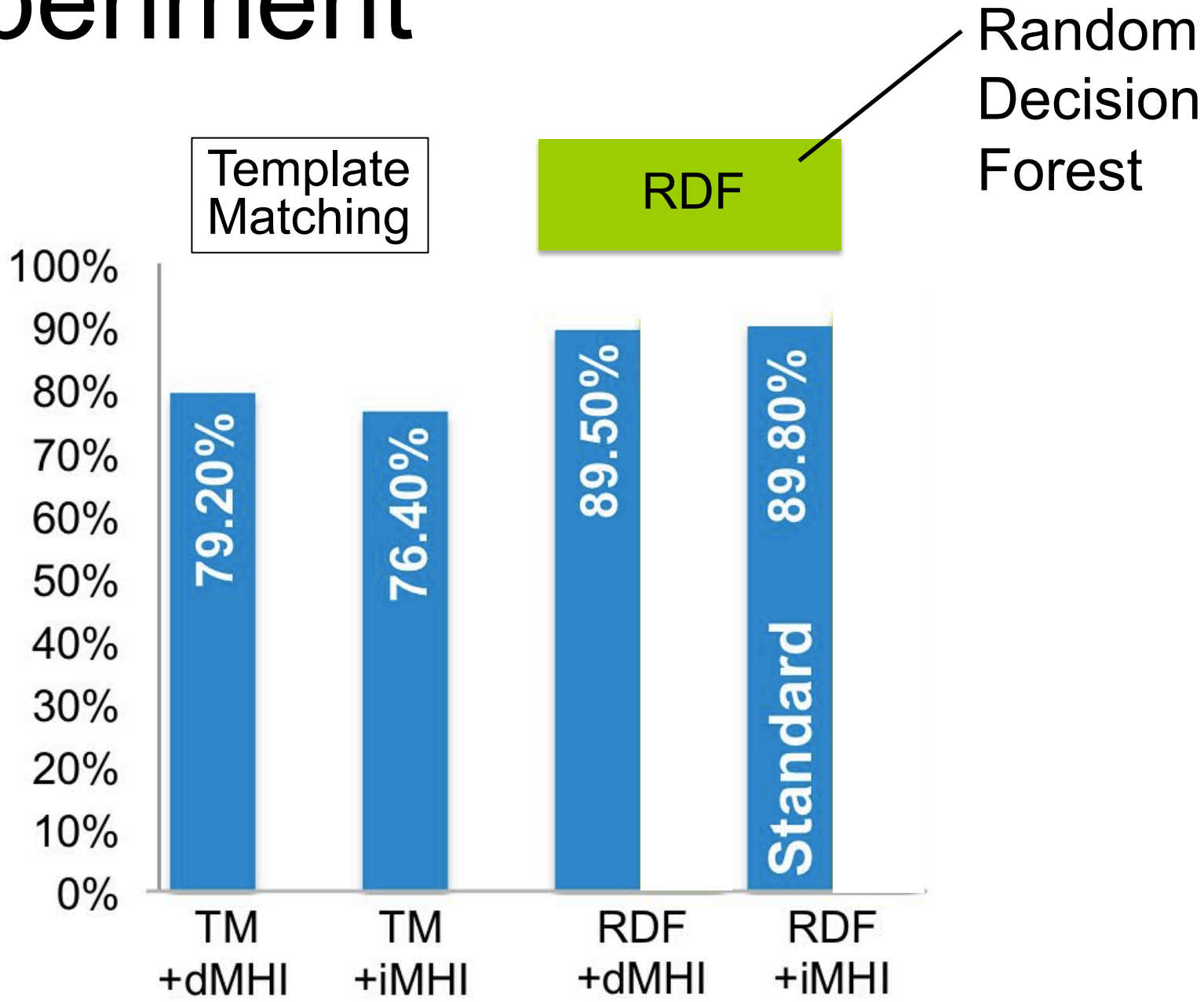
Feature response

image offset intensity offset intensity

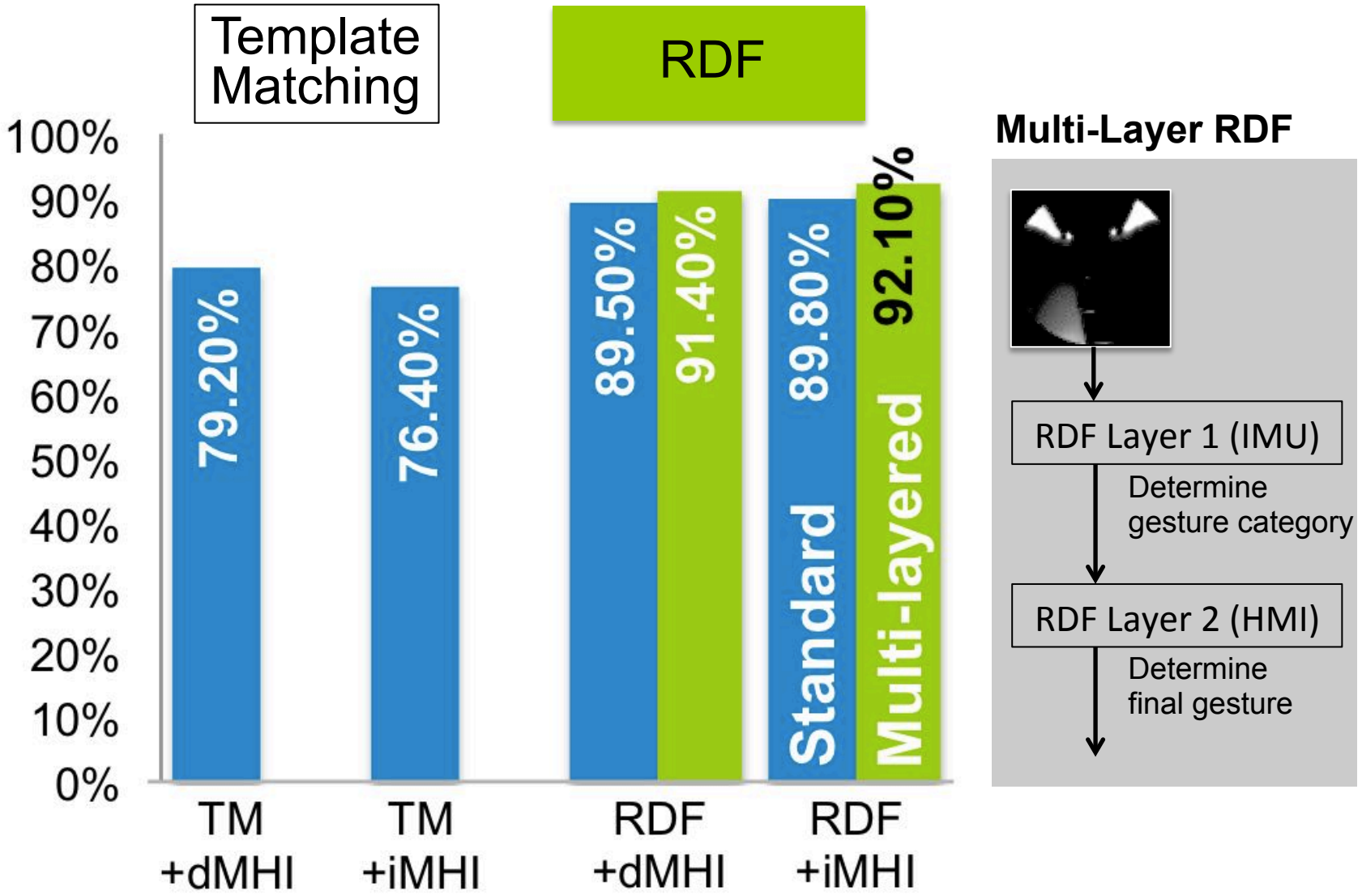
$$f(I,x) = i(x + u) - i(x + v)$$

image coordinate

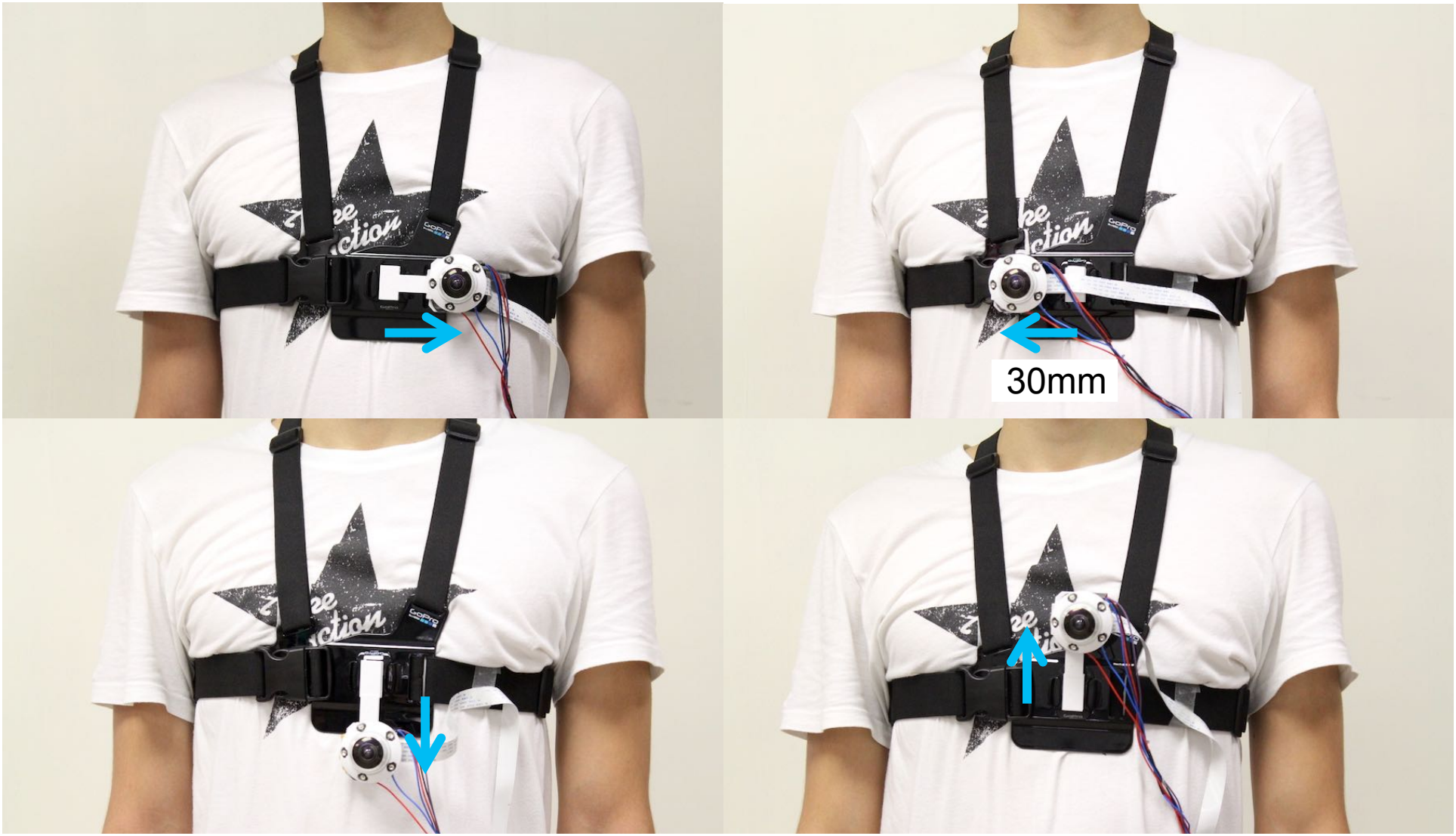
Experiment


Random Decision Forest
Template Matching
RDF
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
79.20%
76.40%
89.50%
89.80%
Standard
TM +dMHI
TM +iMHI
RDF +dMHI
RDF +iMHI

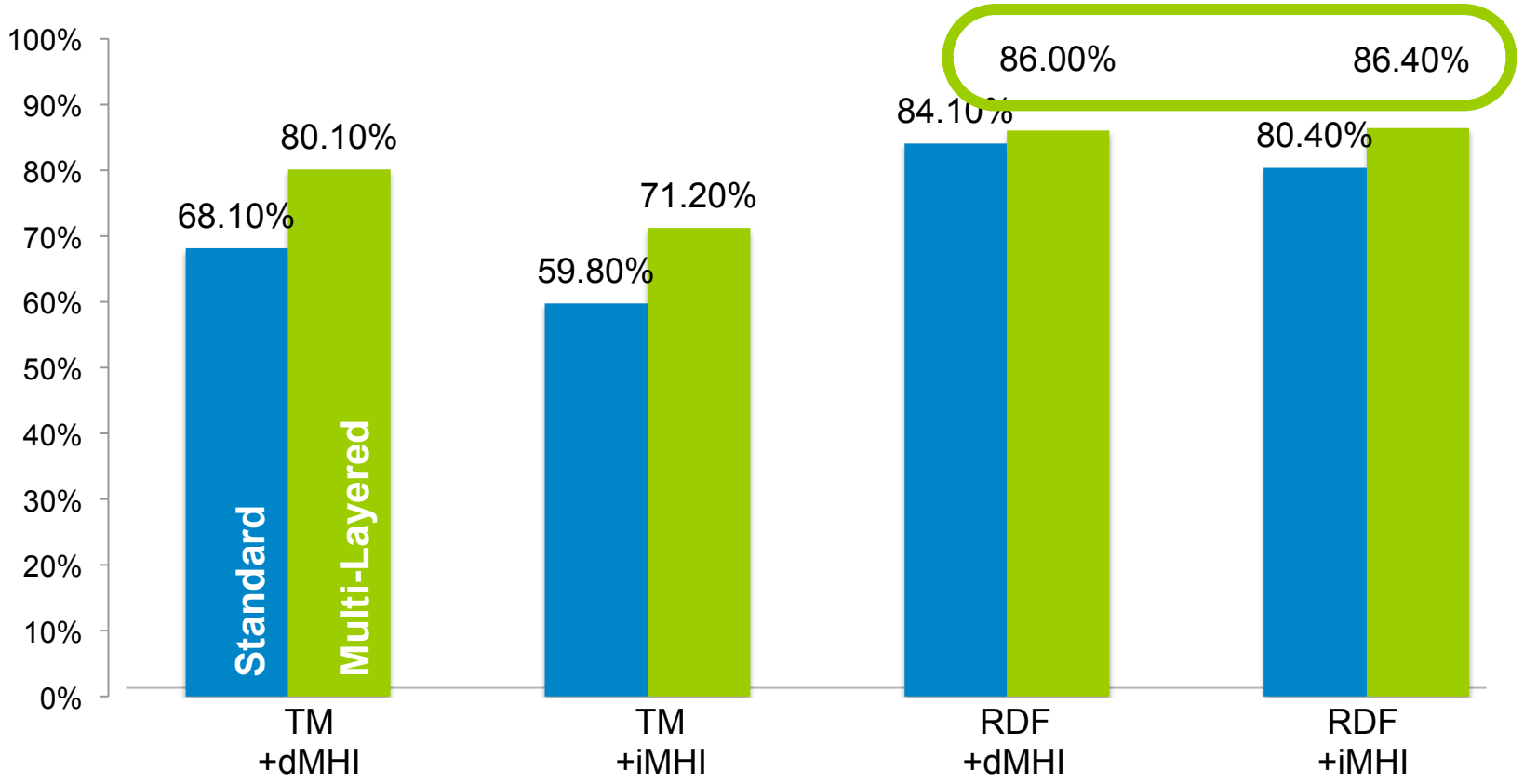
Experiment


Template Matching
RDF
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
79.20%
76.40%
89.50%
91.40%
89.80%
92.10%
Standard
Multi-layered
TM +dMHI
TM +iMHI
RDF +dMHI
RDF +iMHI
Multi-Layer RDF
RDF Layer 1 (IMU)
Determine gesture category
RDF Layer 2 (HMI)
Determine final gesture

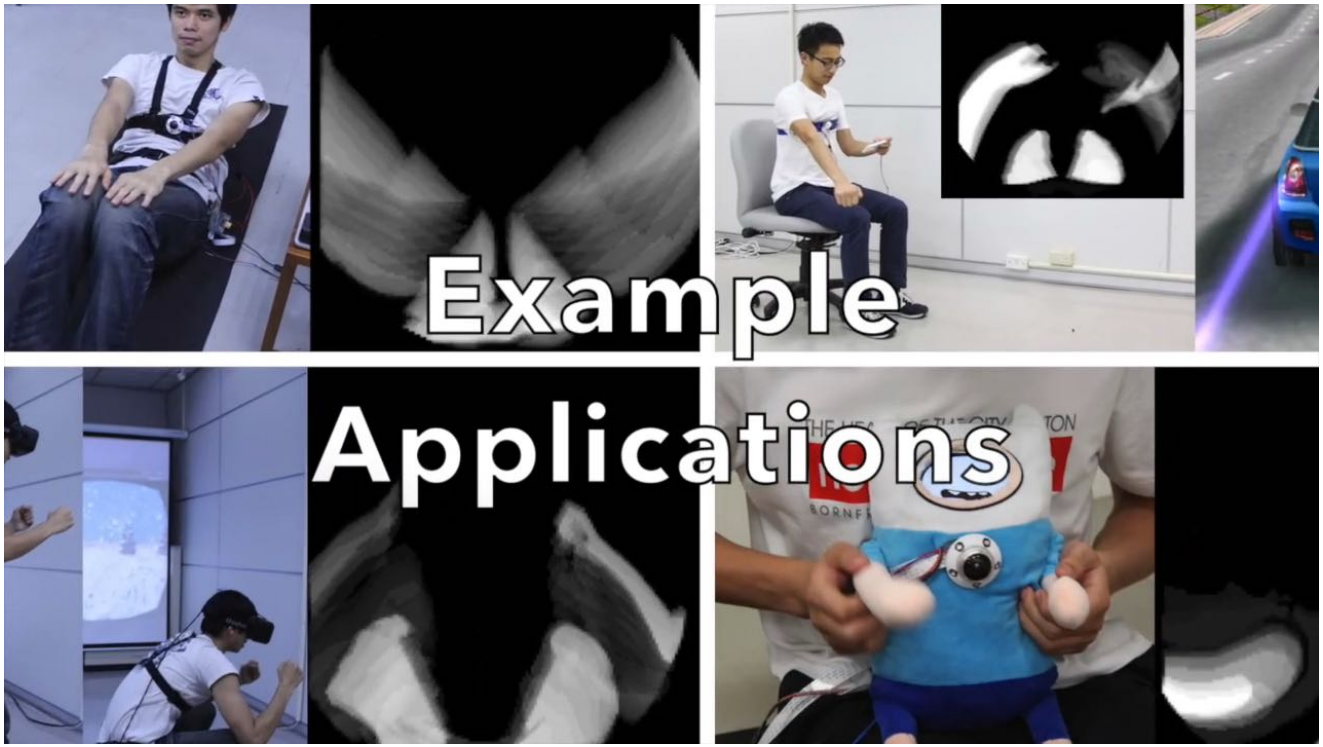
Experiment with offset

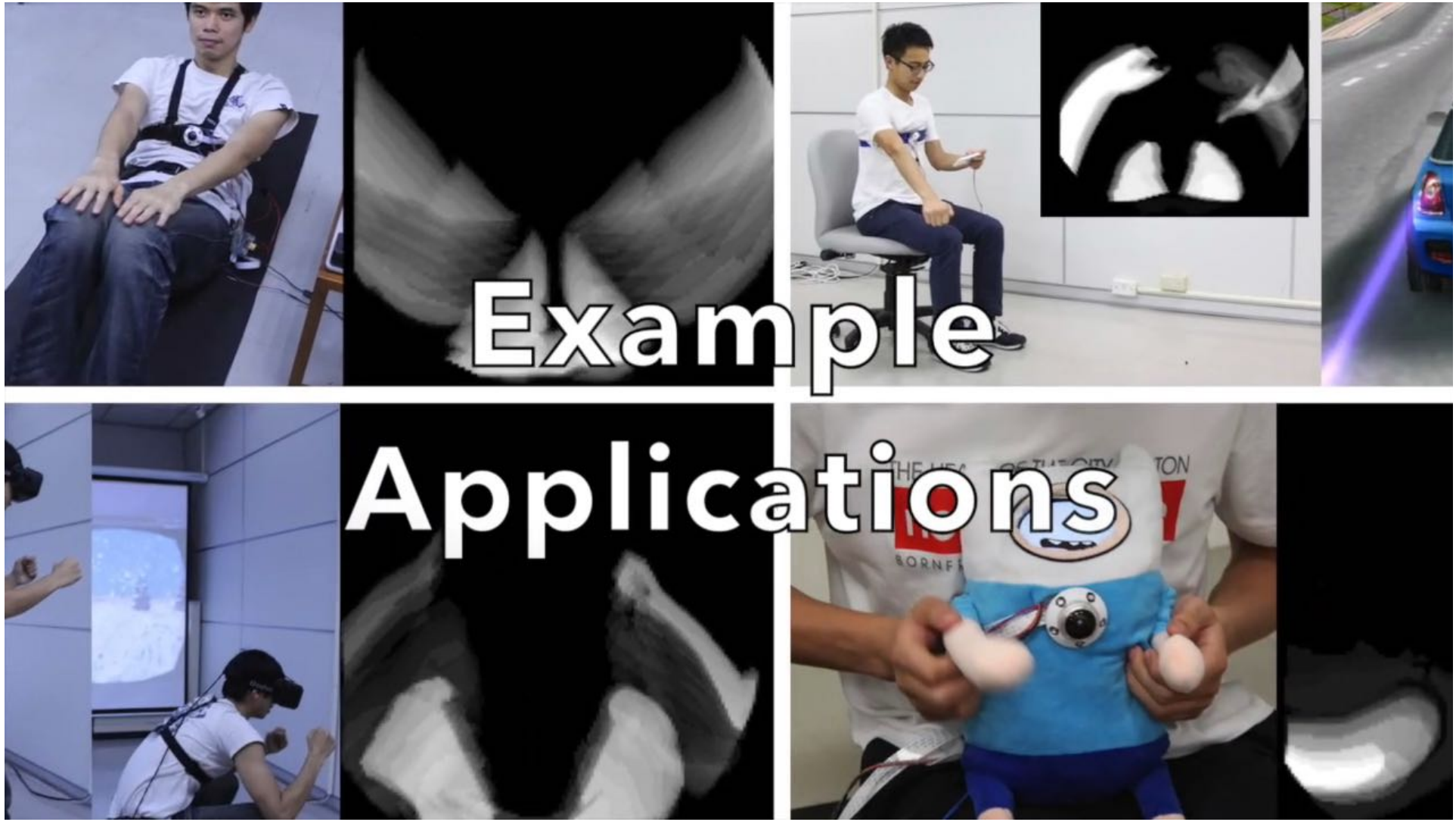


Experiment with offset



Applications




Example
Applications

Discussion

- Computer Vision Challenge
  - fisheye depth sensor

- Social Acceptance by Gender
  - further design for female users

Discussion

- Computer Vision Challenge
  - fisheye depth sensor

- Social Acceptance by Gender
  - further design for female users

Conclusion

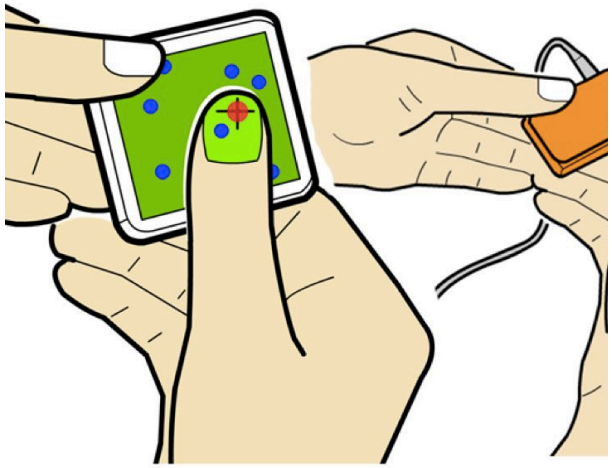
- Cyclops: a single-piece wearable device for full-body gesture input
- The main contribution:
  - the idea of determining body posture using an ego-centric perspective of the user.
- We developed a proof-of-concept device to demonstrate the feasibility of cycplos device.

Thank you.

CHI 2013

NailDisplay

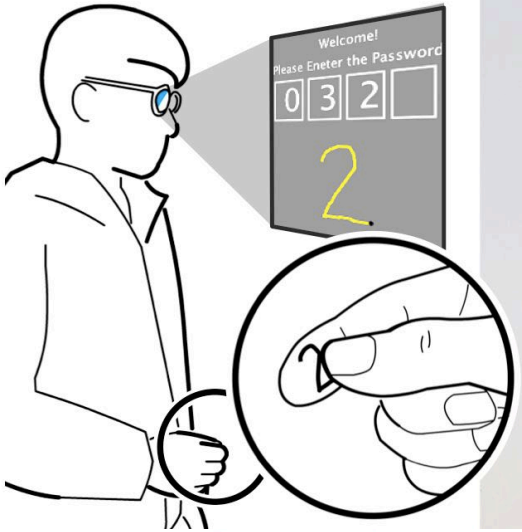
Bringing Always-Available
Visual Display to Fingertips



UIST 2013

FingerPad

Private and Subtle Interaction
Using Fingertips



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Full-Body Gesture Input Devices