The Rich-Touch Revolution is Coming

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FUTURE INTERFACES GROUP

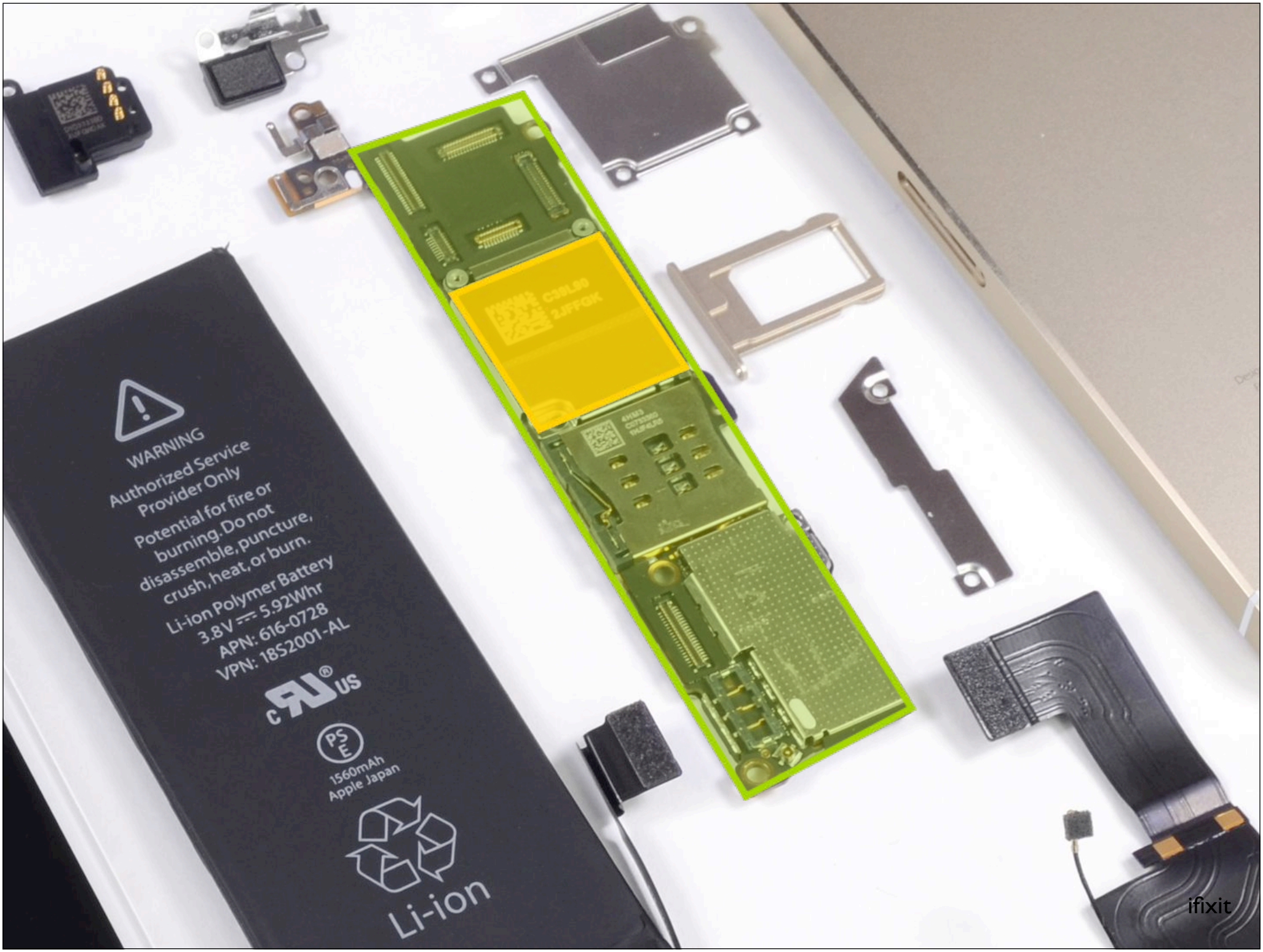
Carnegie Mellon University

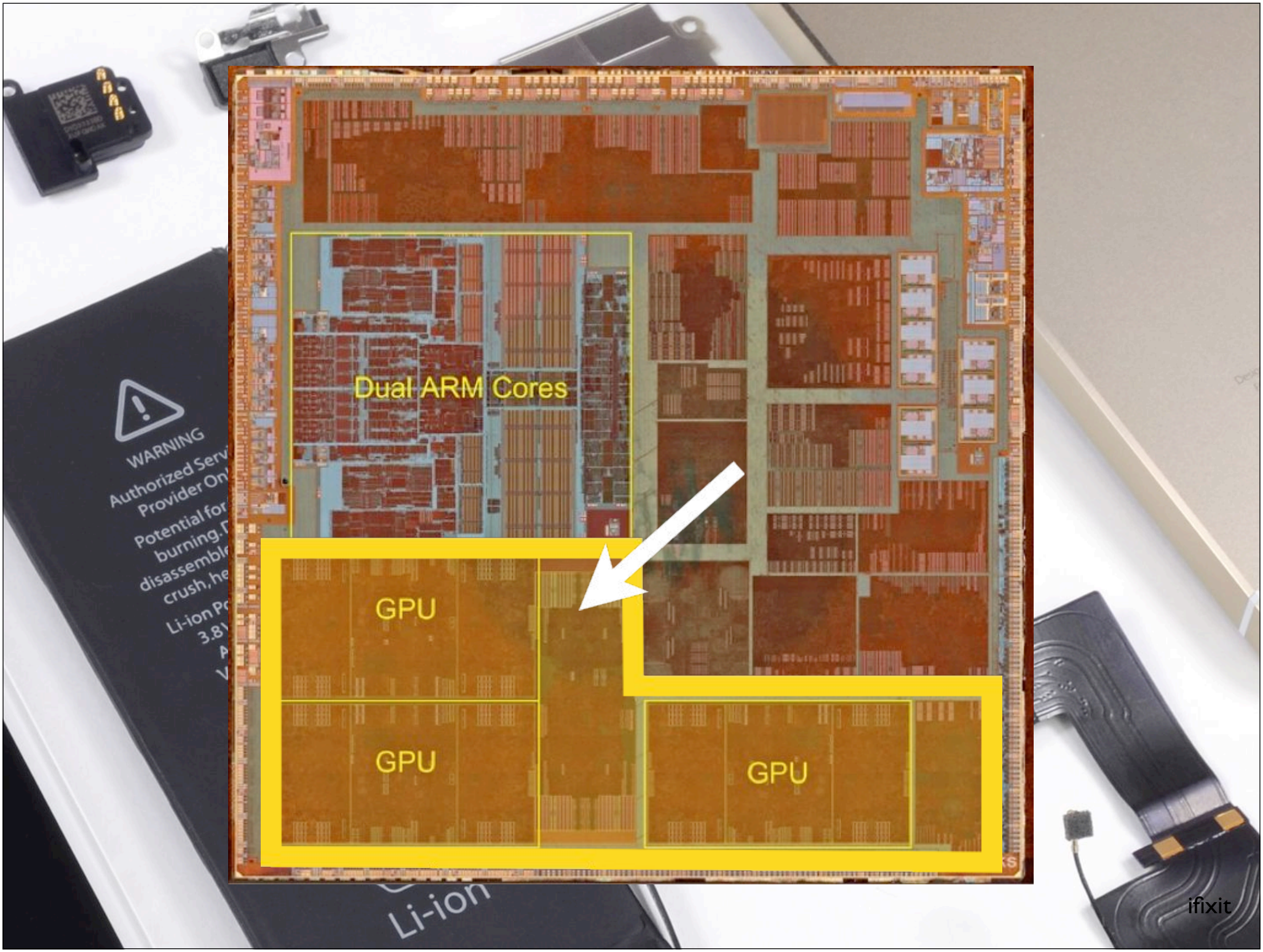
Apple iPhone 5s

Thinking Machines Corporation CM-5 (1993)
65.5 GFlop/s (peak)

Apple iPhone 5s

ifixit


WARNING
Authorized Service Provider Only
Potential for fire or burning. Do not disassemble, puncture, crush, heat, or burn.
Li-ion Polymer Battery
3.8V ⎓ 5.92Whr
APN: 616-0728
VPN: 18S2001-AL
1560mAh
Apple Japan
Li-ion
ifixit

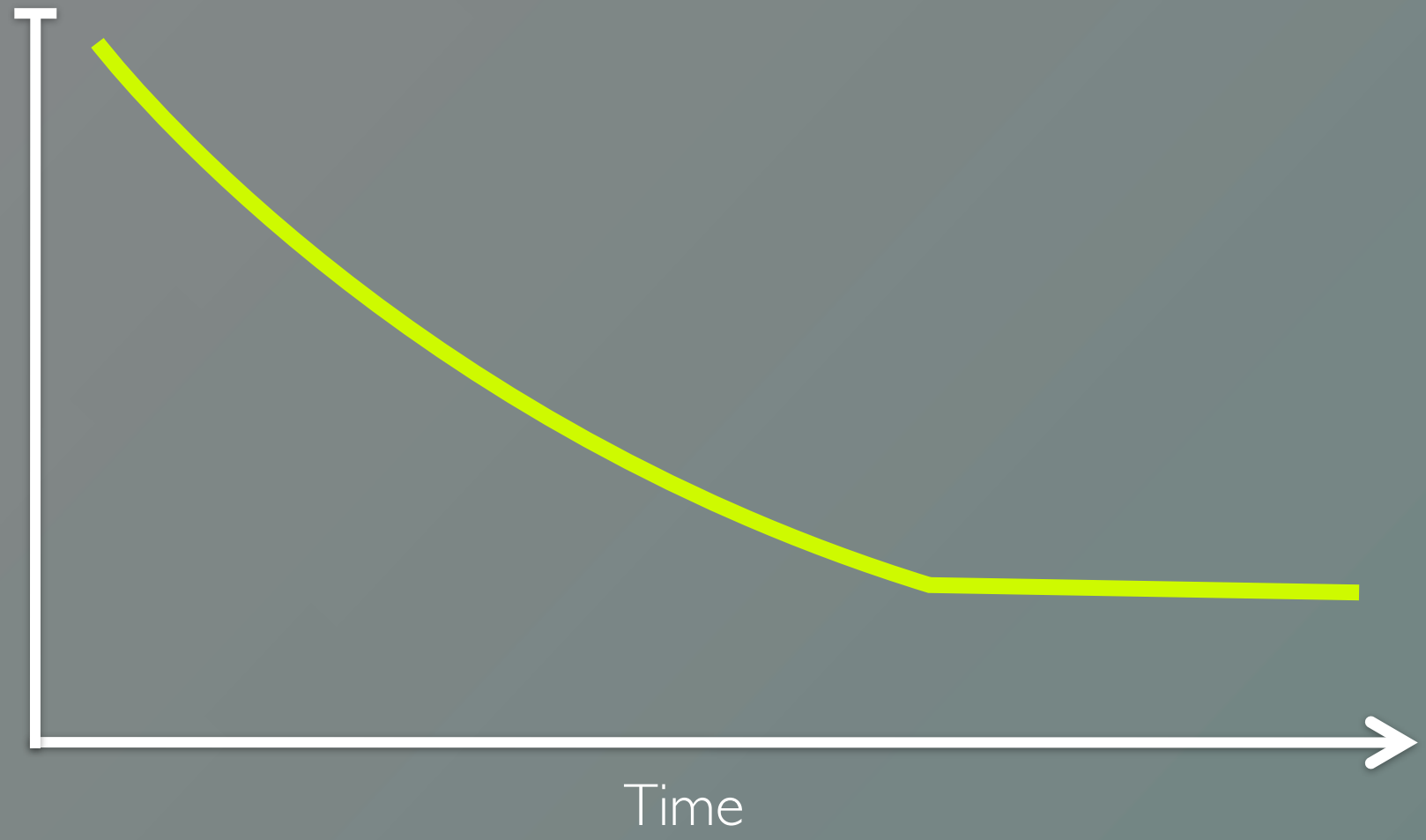

Dual ARM Cores
GPU
GPU
GPU
WARNING
Li-ion
ifixit

Thinking Machines Corporation CM-5
1993

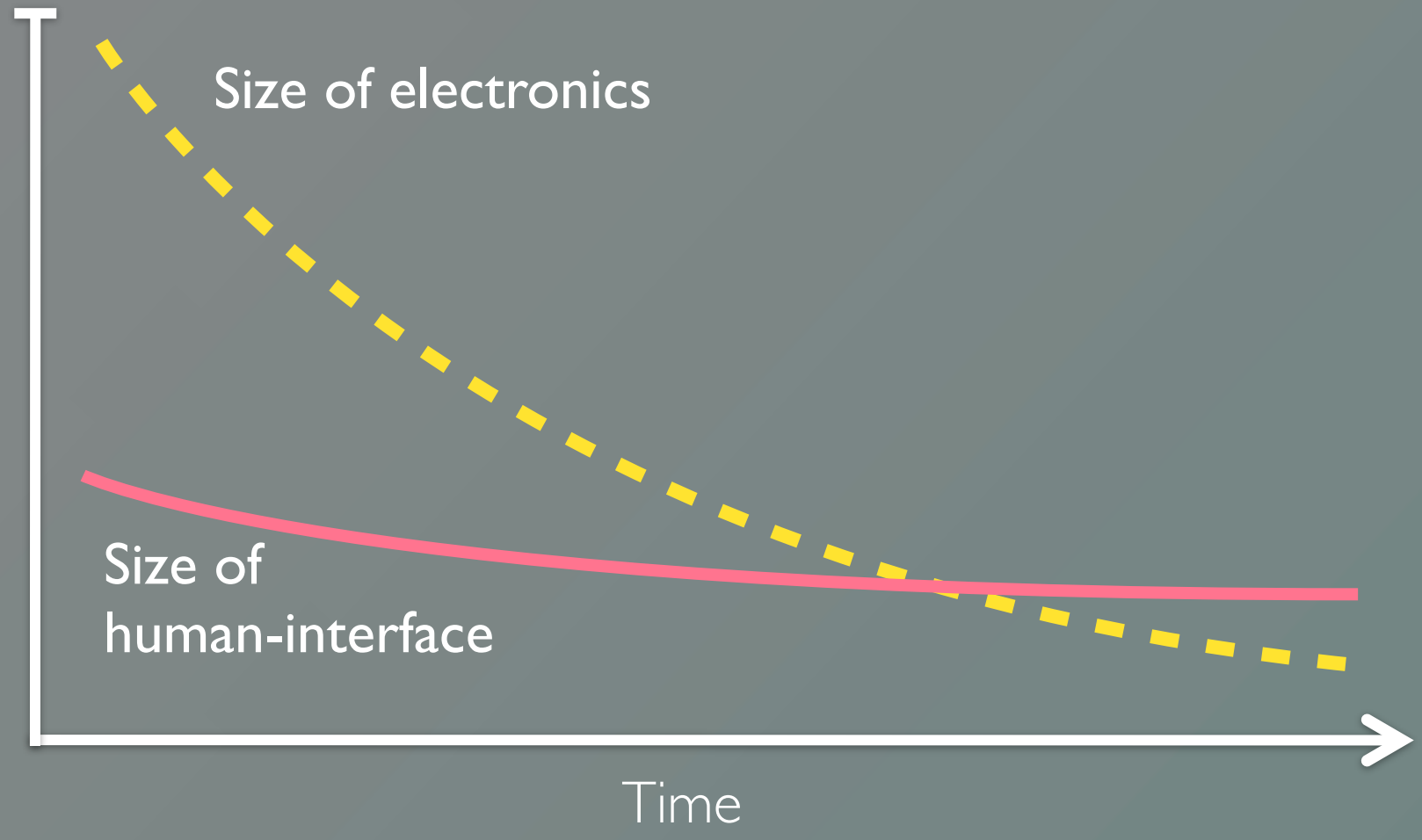
David Niblack, Imagebase.net.
You!
Fingers, visual acuity, focal range, hearing, dexterity, intelligence

Sony Smartwatch
2013

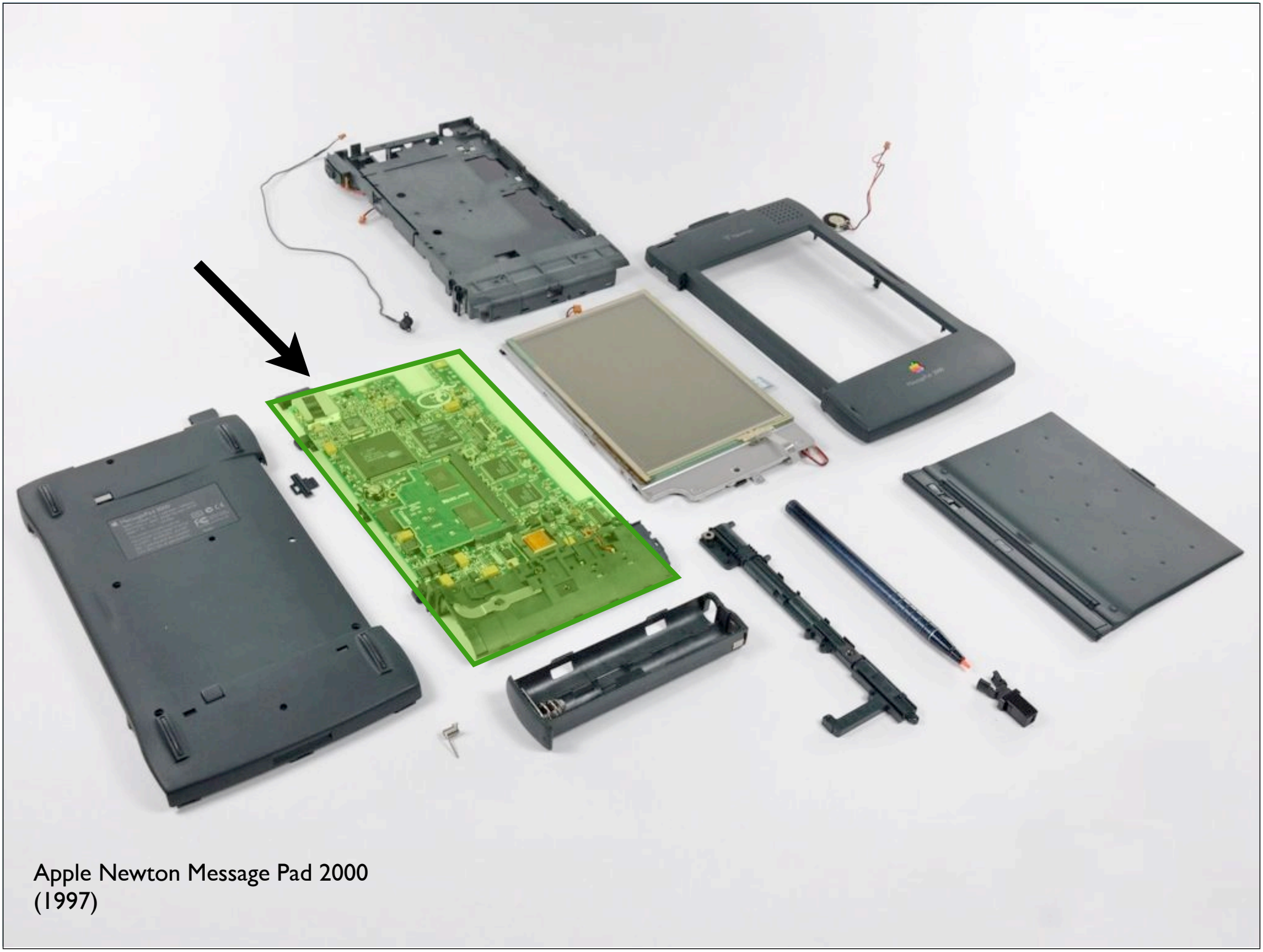
Size of Devices



Size of Devices



Apple Newton Message Pad 2000
(1997)



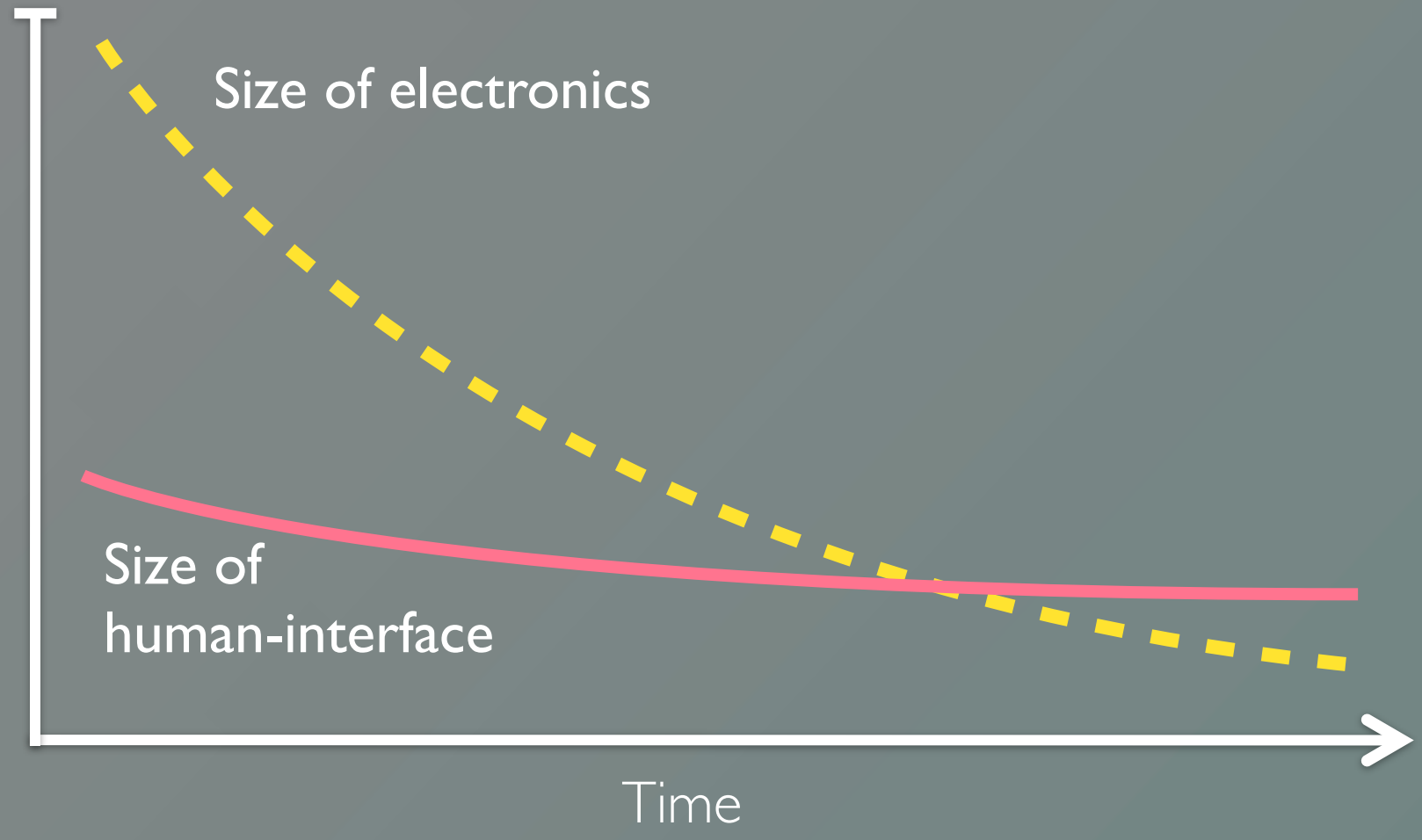
Apple Newton Message Pad 2000
(1997)

Apple iPad 3

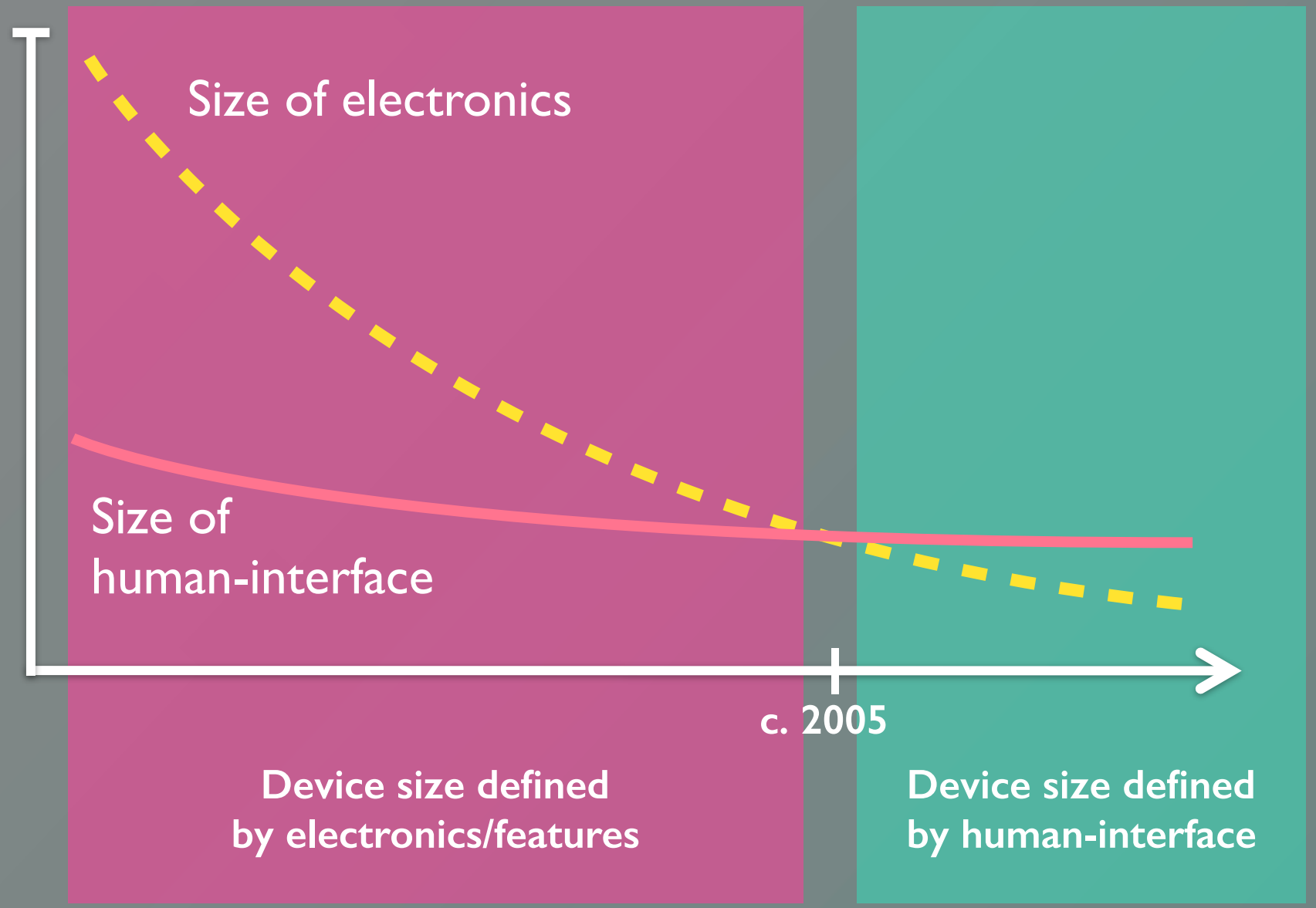
Apple iPad 3

ifixit

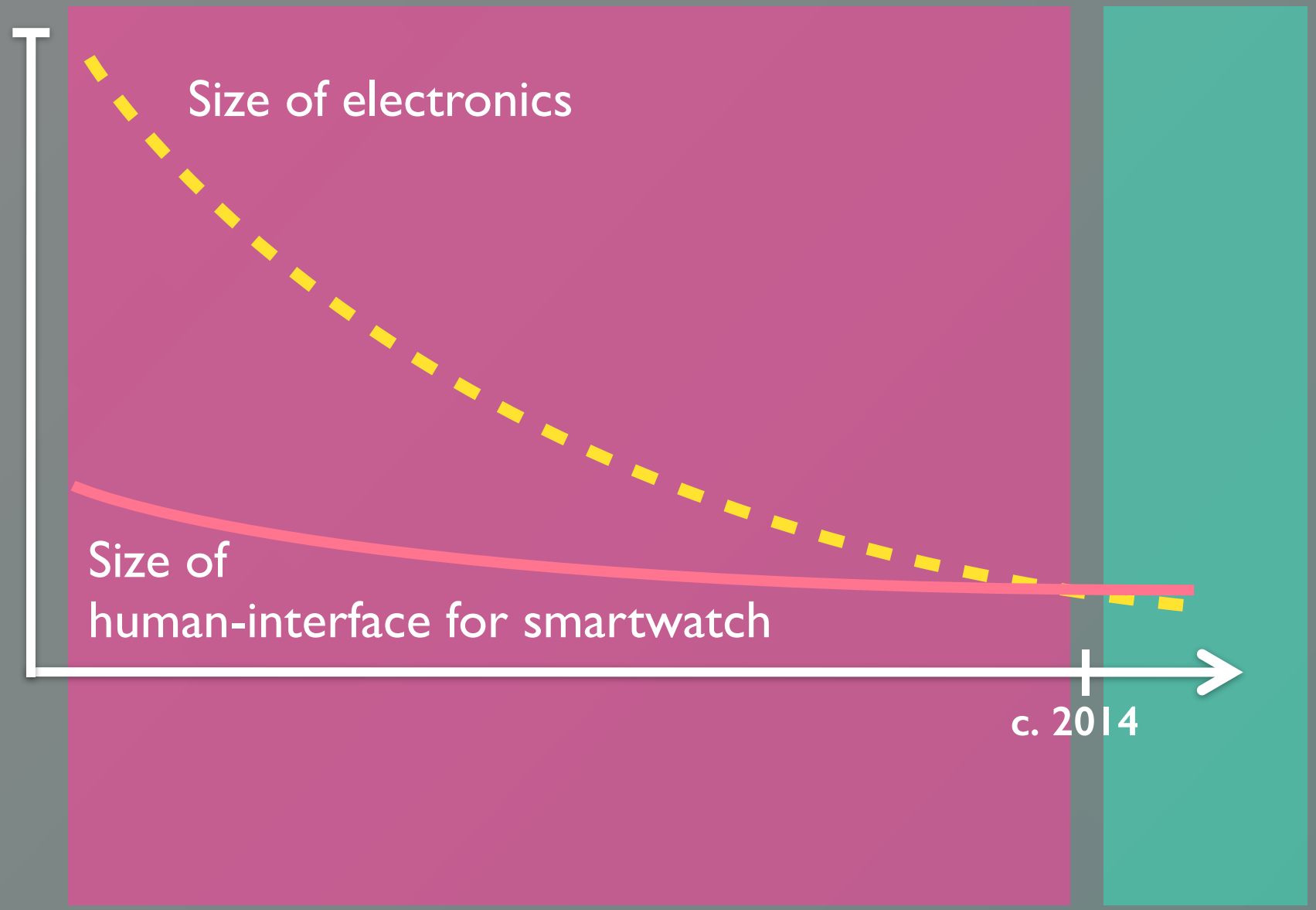
Size of Devices



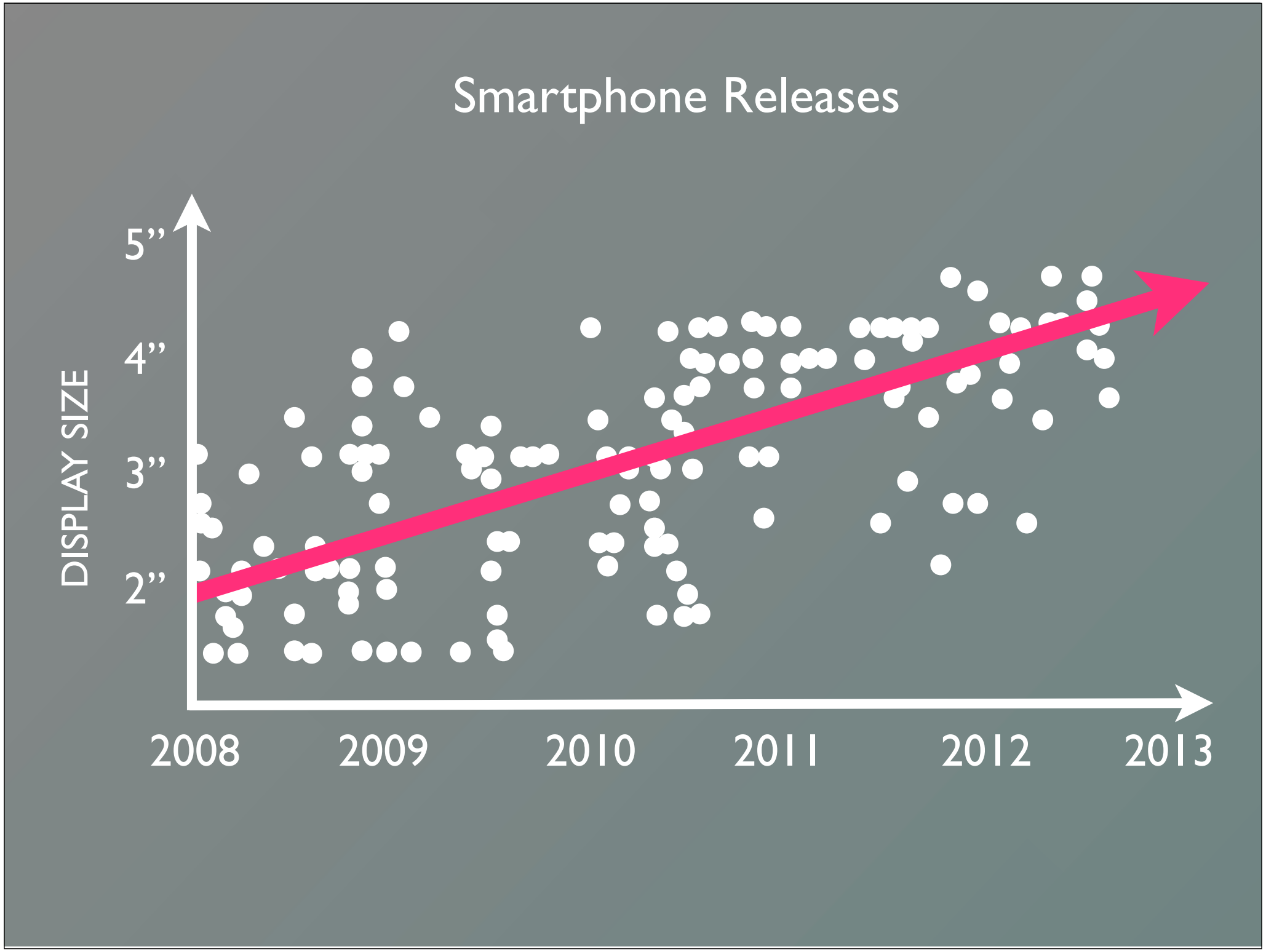
Size of Devices



Size of Devices



Sony Xperia Z Ultra
2013
SONY
My Stream
Greetings from the top of the world! We are going to stay around here until next weekend.
Took this photo with my new SLR digital camera.
What a nice game last night, I was so excited ! ...
Fantastic Rock Live in October
Latest Trend on Social Networking


Smartphone Releases
DISPLAY SIZE
5”
4”
3”
2”
2008
2009
2010
2011
2012
2013

Size ≠ Capability

HCI Grand Challenge!

Sony Smartwatch
2013

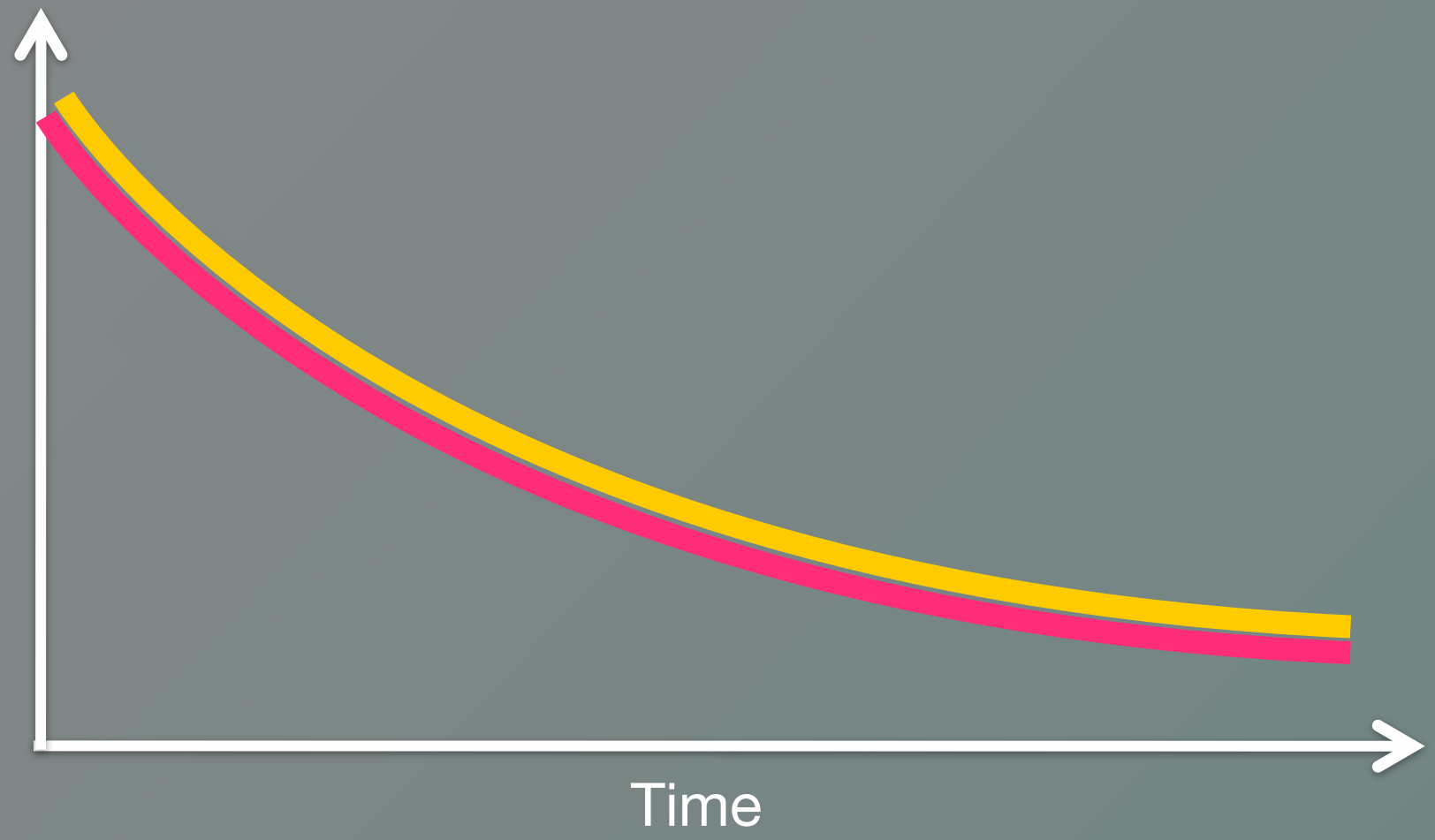
Decouple I/O from physical size

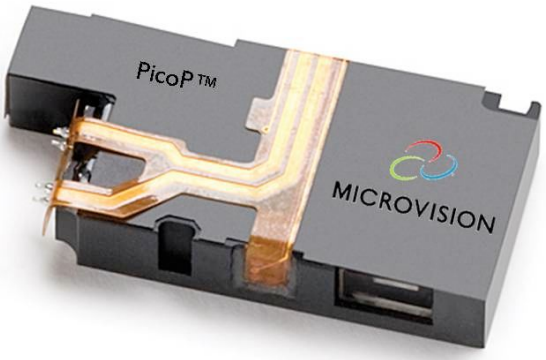
Google Glass
2013

Skinput (CHI 2010)

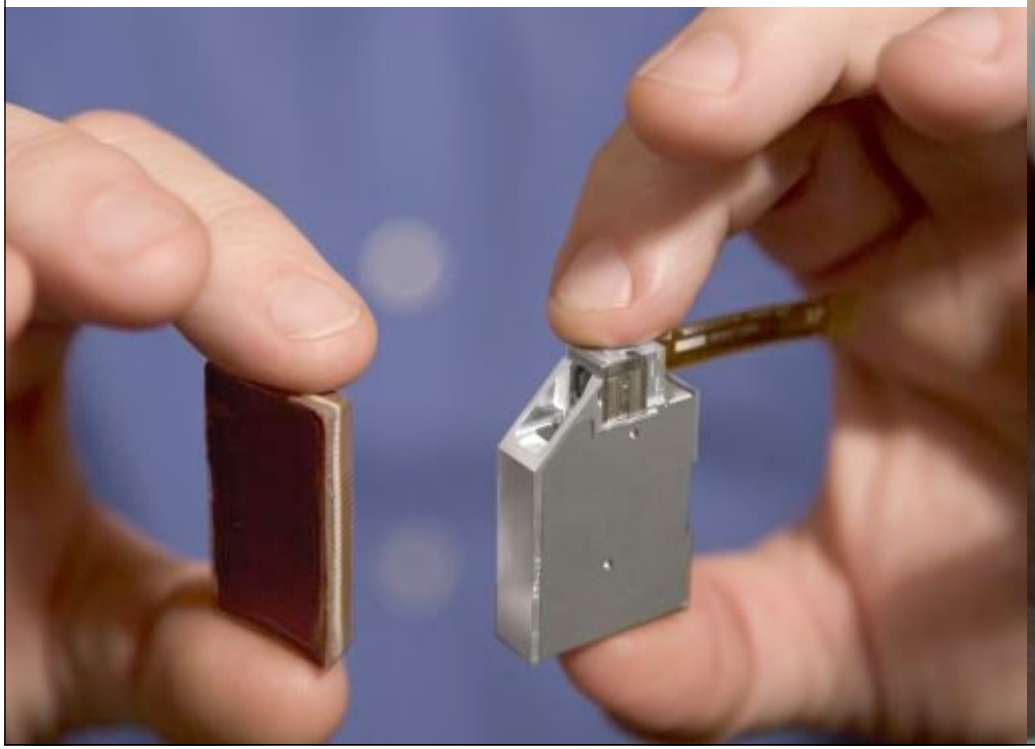
Armura (TEI 2012)

PROJECTOR COST & SIZE





MicroVision



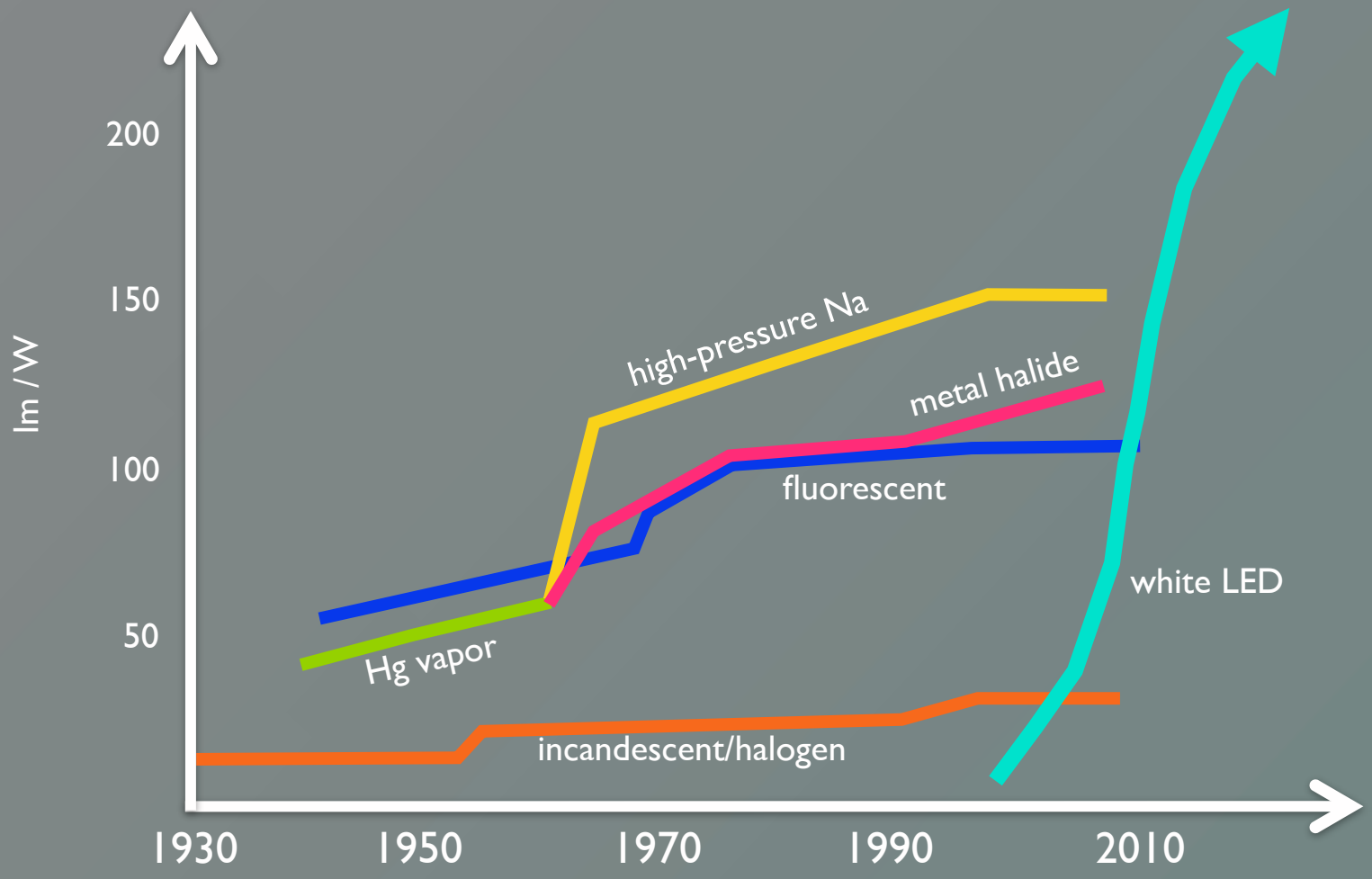
2003

Pentax Optio S
3.2 megapixels

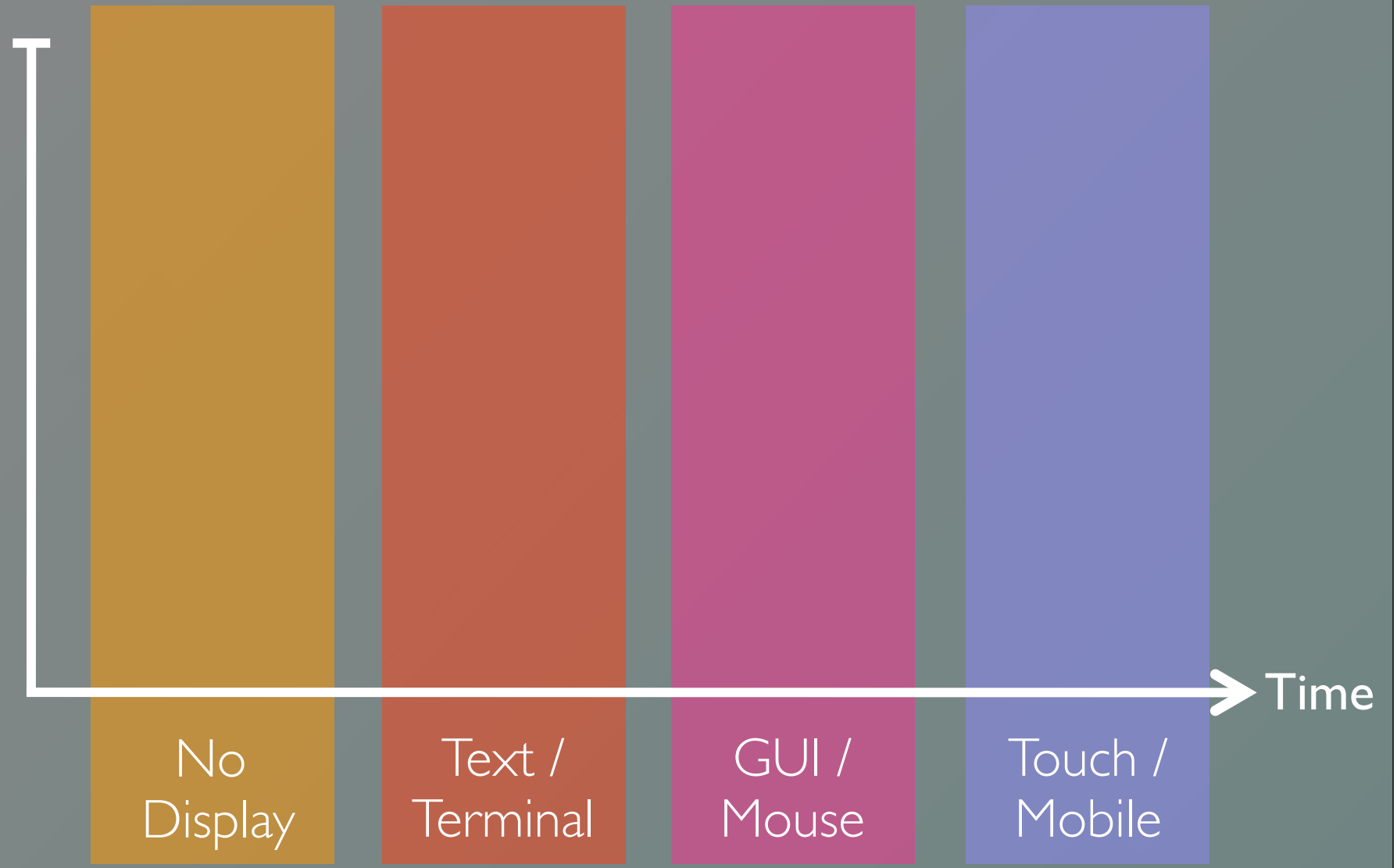
2013

Samsung S4
13 megapixels

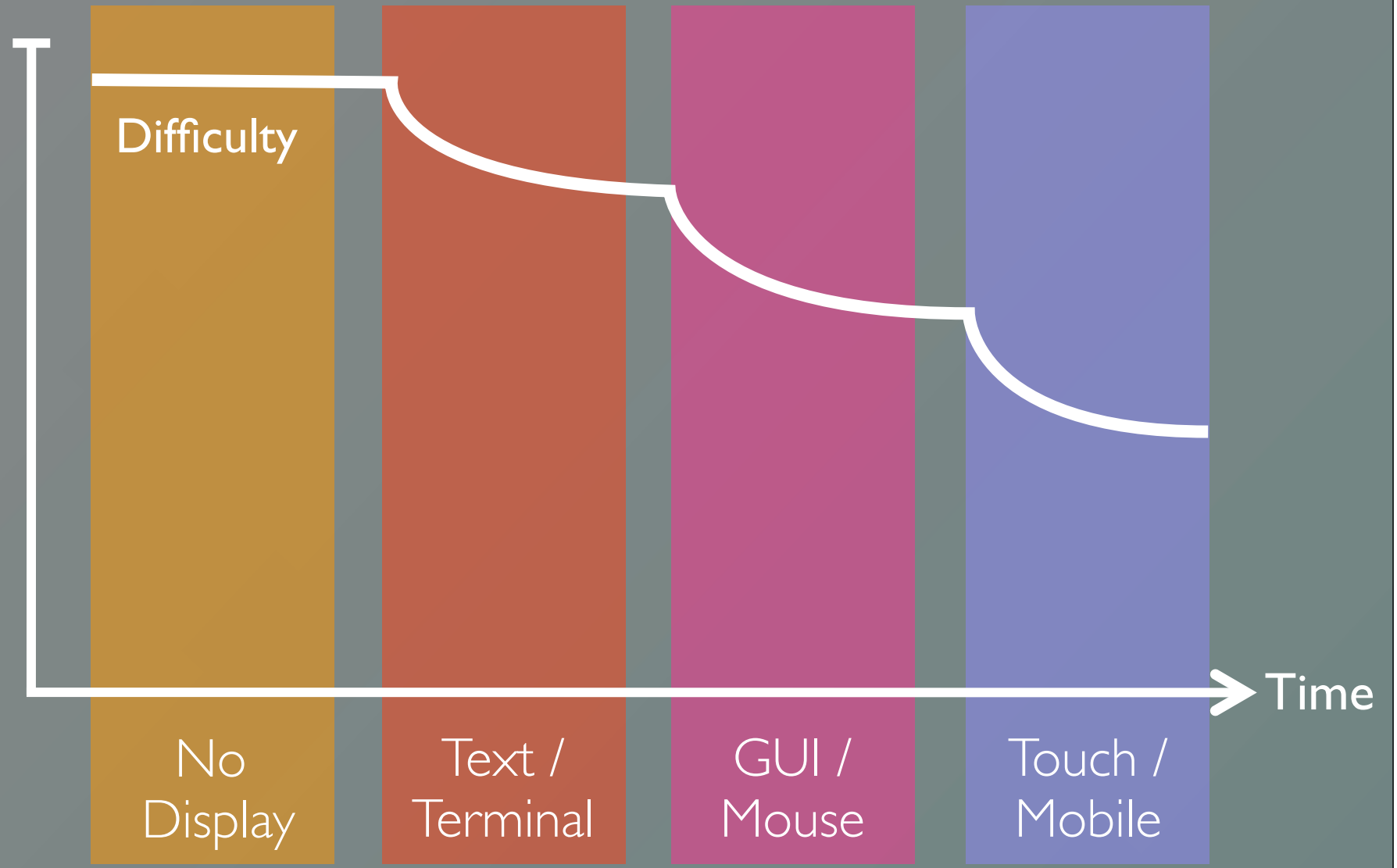
Lighting Efficiency



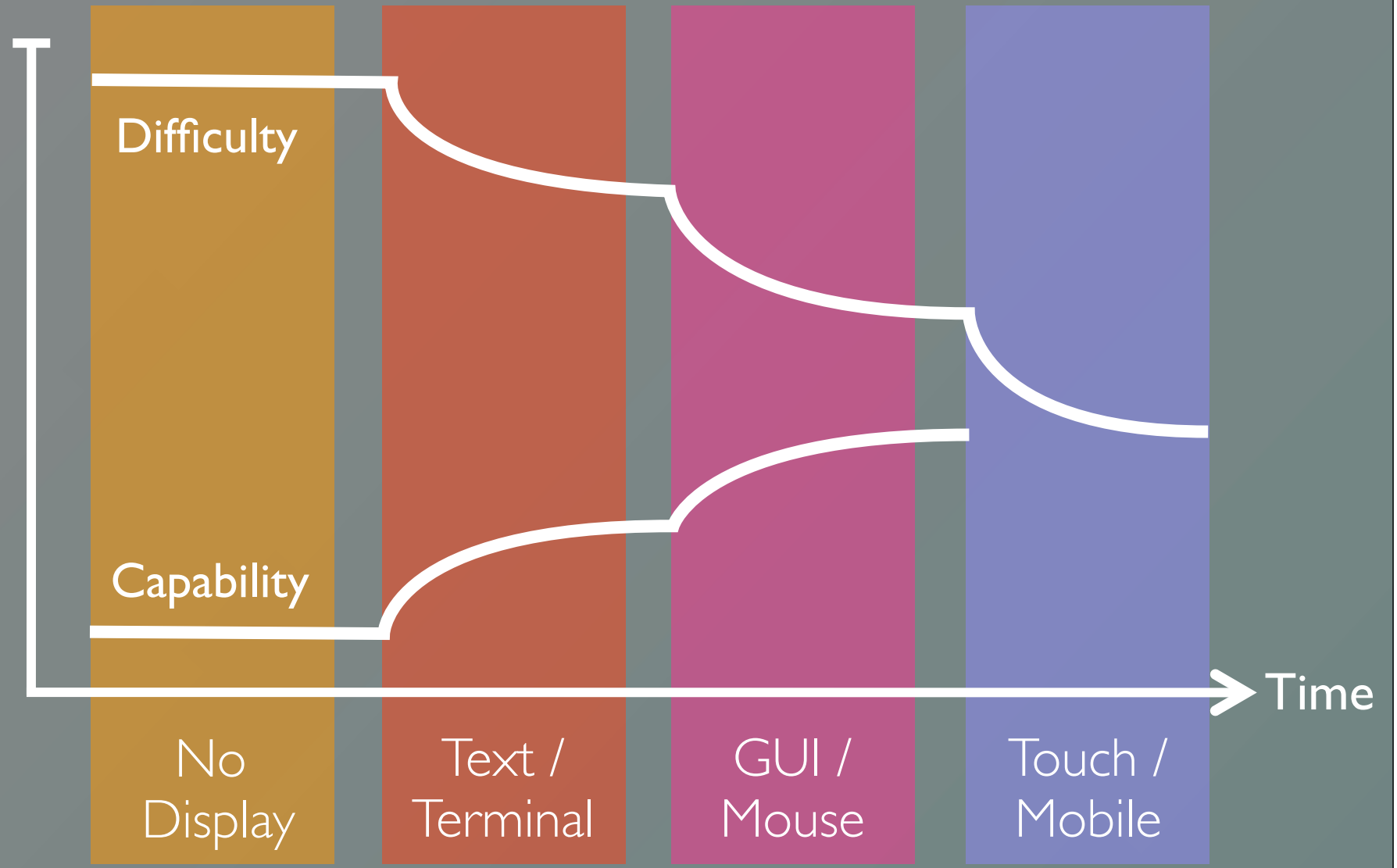
Evolution of Interfaces



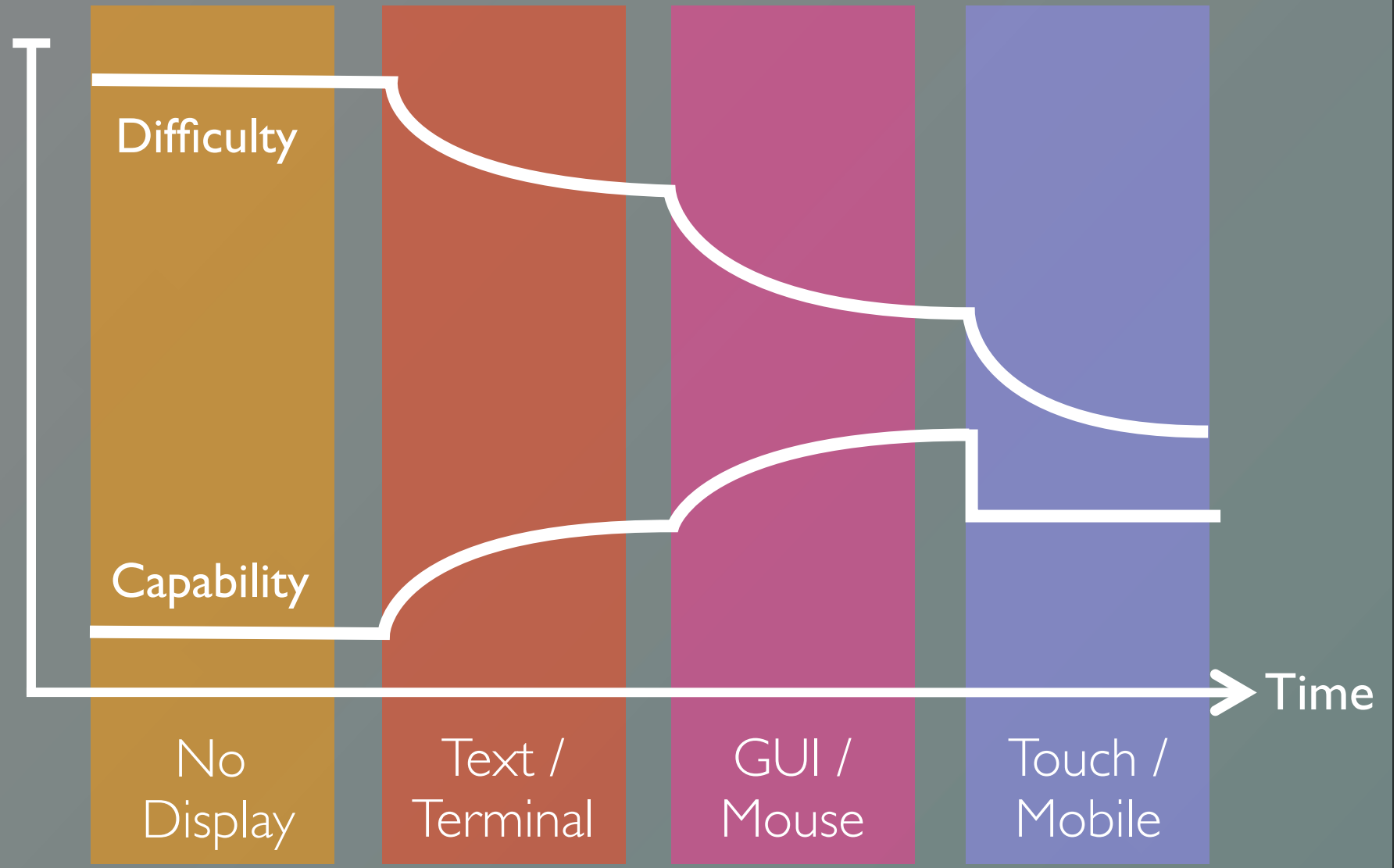
Evolution of Interfaces



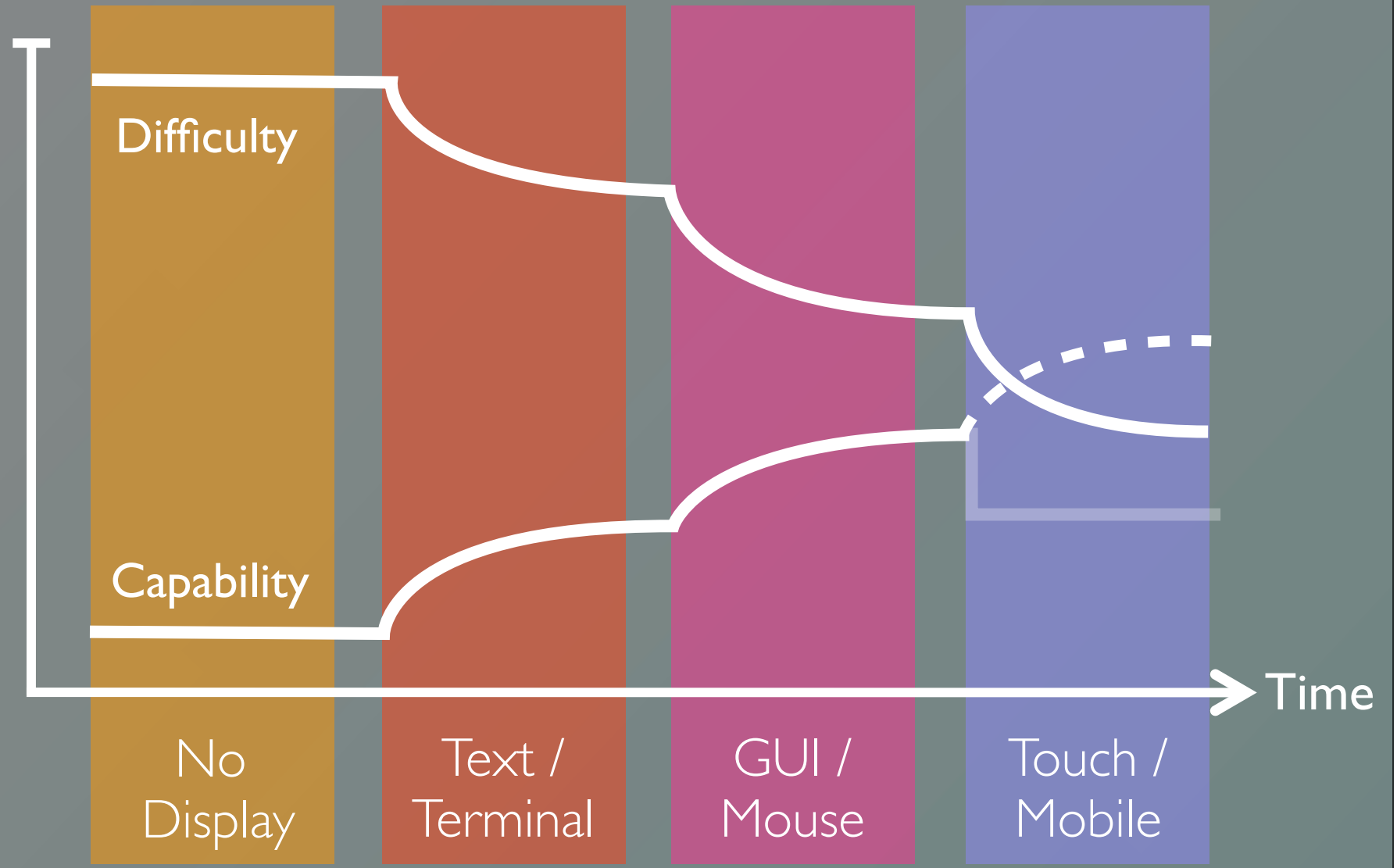
Evolution of Interfaces



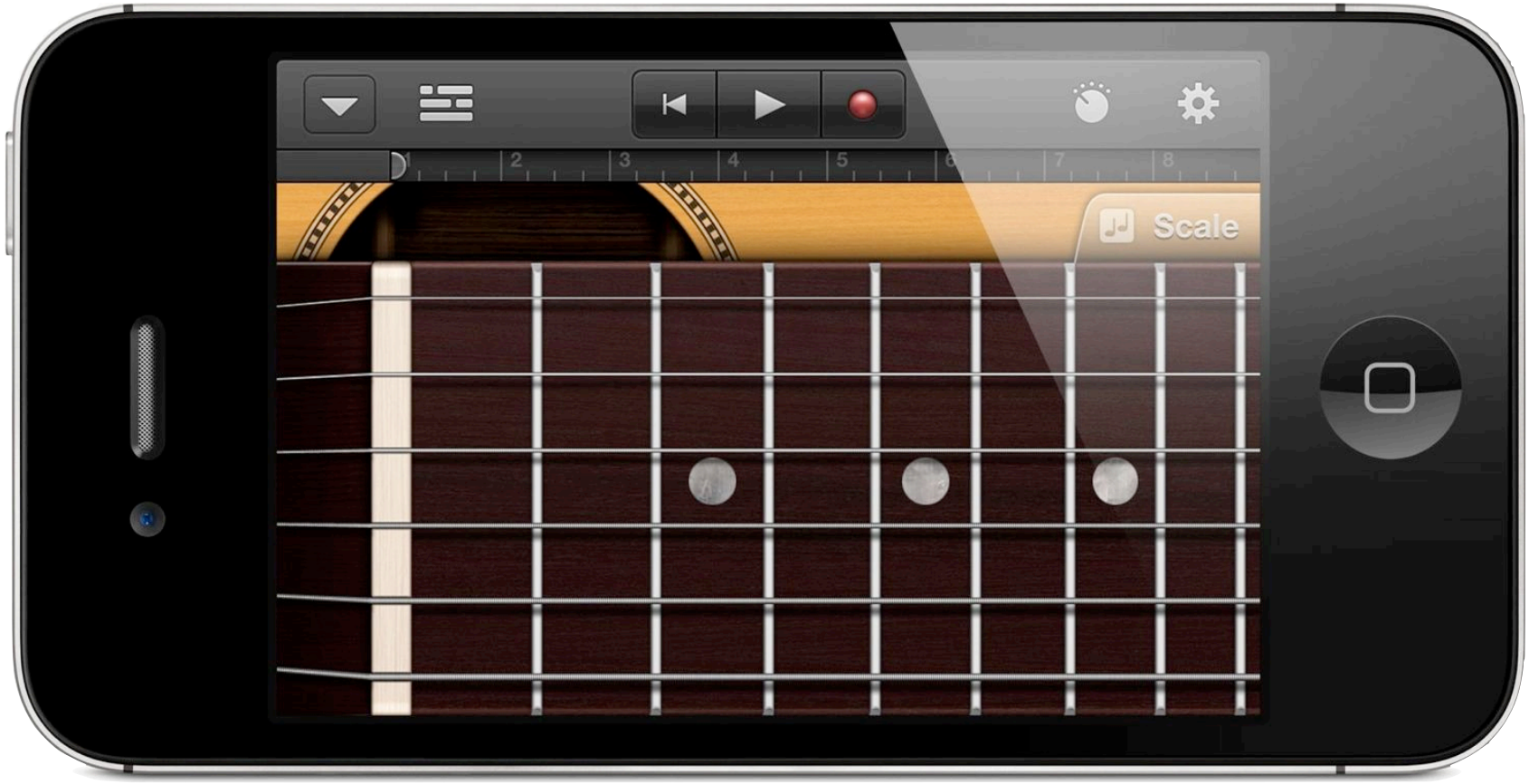
Evolution of Interfaces



Evolution of Interfaces



Apple iPhone 5s


1
2
3
4
5
6
7
8
Scale

command
option

Imagine interacting with the world like it was a touchscreen...

Kicki | flickr.com/photos/15133799@N02
Blue Minty Gel
Colgate
Colgate

David Amaya HB | flickr.com/photos/94022368@N04

//Rutger | flickr.com/photos/40391711@N00

stijn | flickr.com/photos/44124363356@N01

Linh H. Nguyen | flickr.com/photos/22439010@N04

“Each morning begins with a ritual dash through our own private obstacle course – objects to be opened or closed, lifted or pushed, twisted or turned, pulled, twiddled, or tied, and some sort of breakfast to be peeled or unwrapped, toasted, brewed, boiled or fried. The hands move so ably over this terrain that we think nothing of the accomplishment.”

- Frank WIlson (“The Hand”)

command
option

Lots of rich (and unused) dimensions

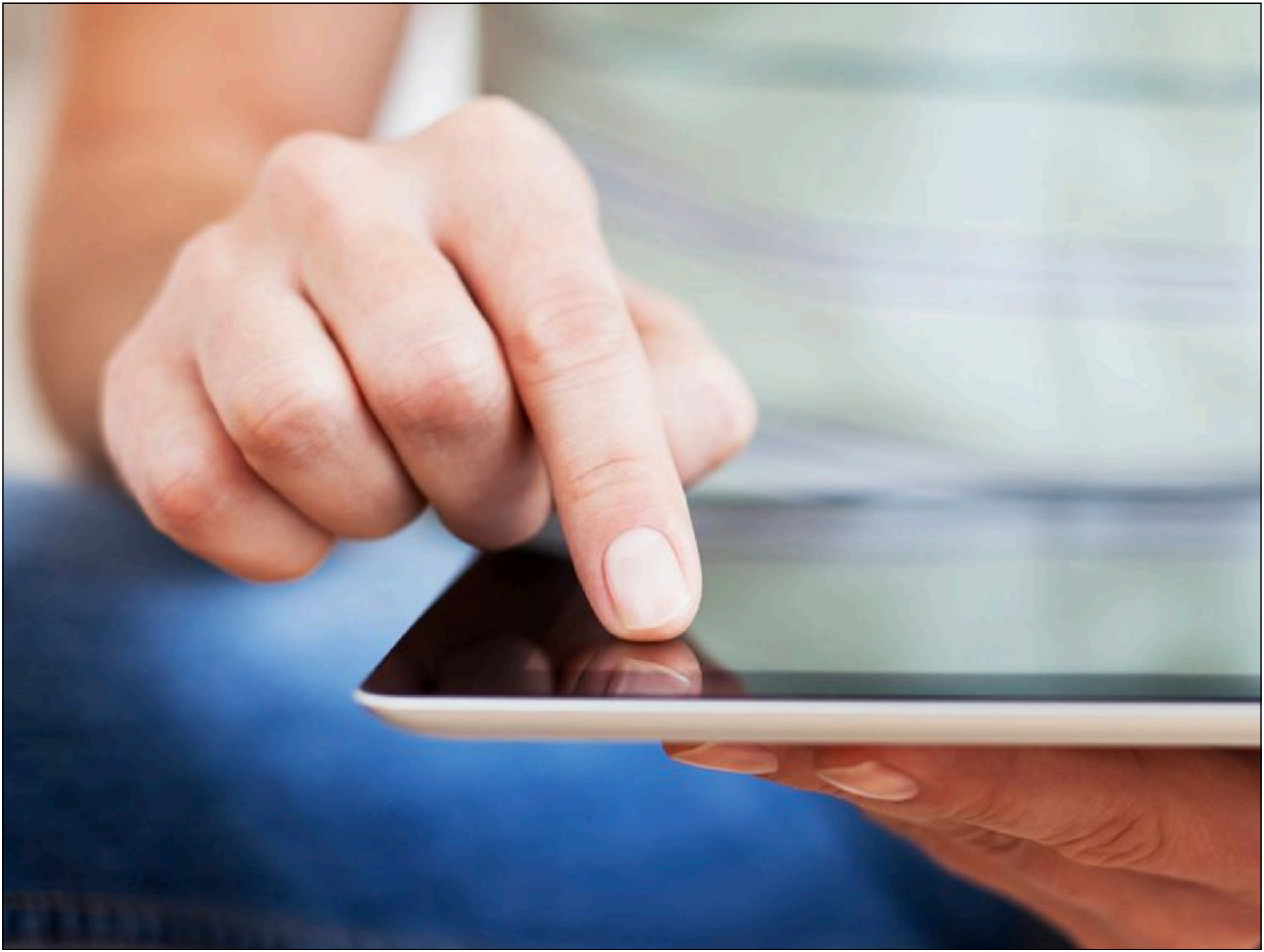
Lots of rich (and unused) dimensions

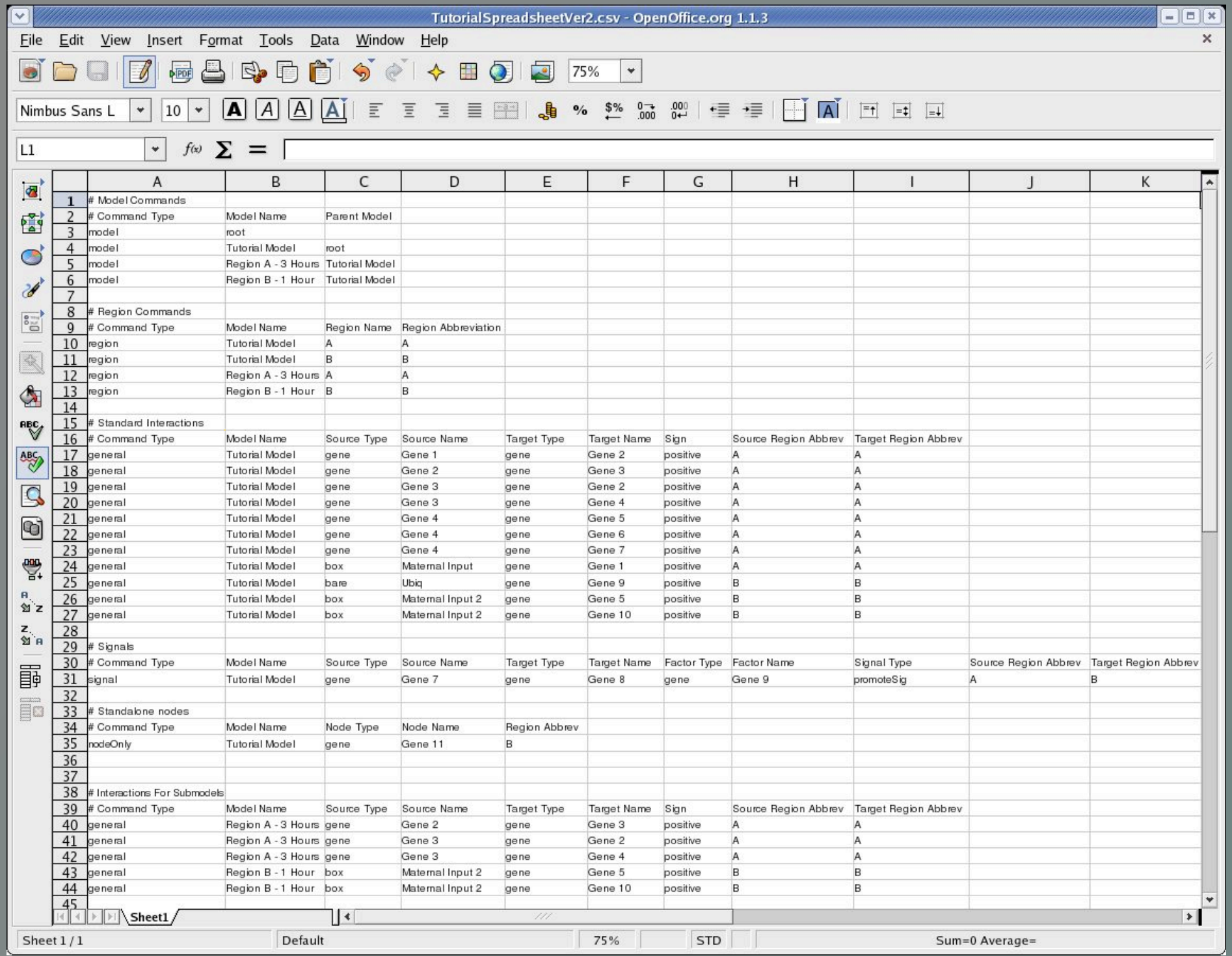
Good at a variety of operational sizes

Touch Type

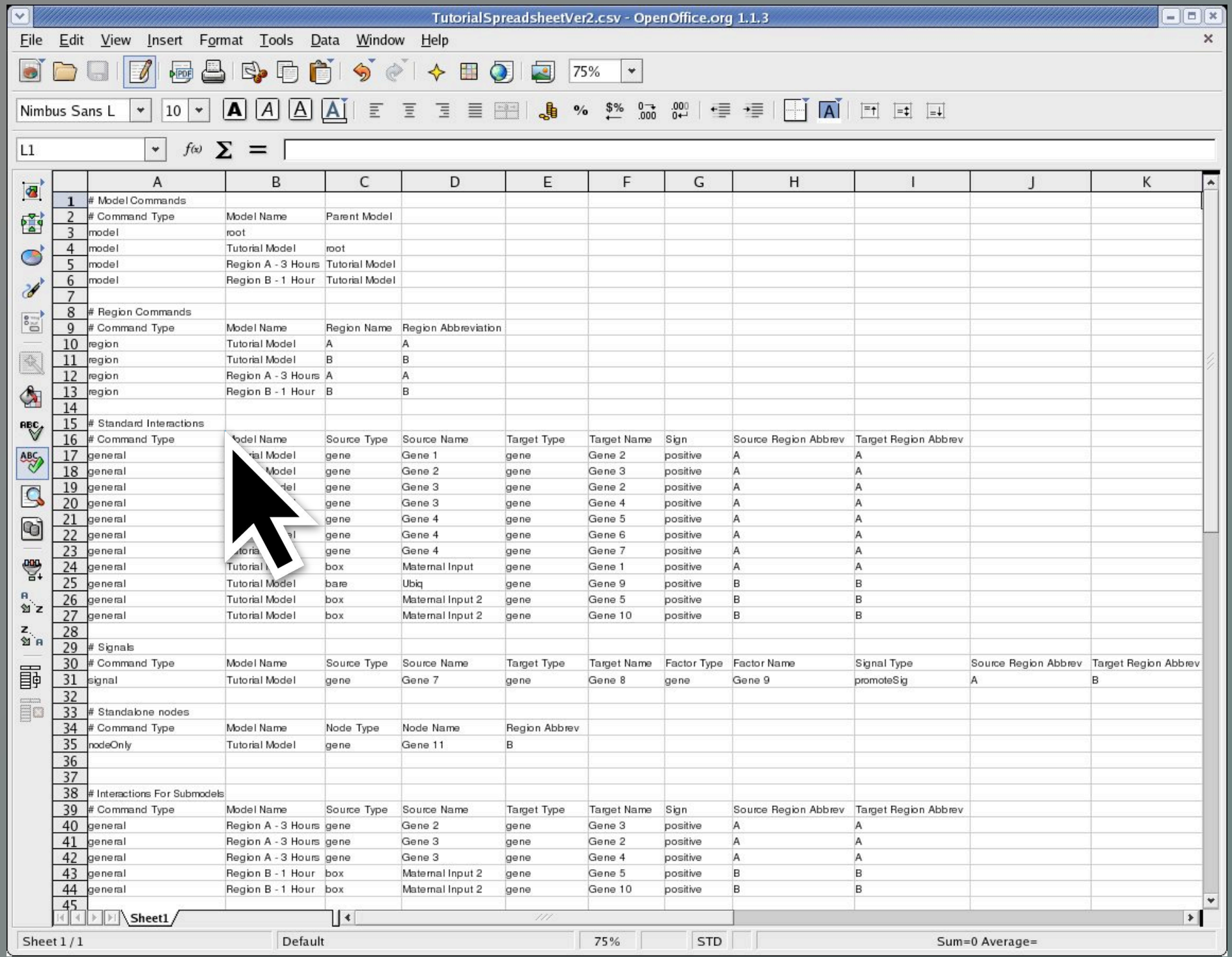
TapSense (UIST 2011)

Chris Harrison Julia Schwarz Scott Hudson





	A	B	C	D	E	F	G	H	I	J	K
1	# Model Commands										
2	# Command Type	Model Name	Parent Model								
3	model	root									
4	model	Tutorial Model	root								
5	model	Region A - 3 Hours	Tutorial Model								
6	model	Region B - 1 Hour	Tutorial Model								
7											
8	# Region Commands										
9	# Command Type	Model Name	Region Name	Region Abbreviation							
10	region	Tutorial Model	A	A							
11	region	Tutorial Model	B	B							
12	region	Region A - 3 Hours	A	A							
13	region	Region B - 1 Hour	B	B							
14											
15	# Standard Interactions										
16	# Command Type	Model Name	Source Type	Source Name	Target Type	Target Name	Sign	Source Region Abbrev	Target Region Abbrev		
17	general	Tutorial Model	gene	Gene 1	gene	Gene 2	positive	A	A		
18	general	Tutorial Model	gene	Gene 2	gene	Gene 3	positive	A	A		
19	general	Tutorial Model	gene	Gene 3	gene	Gene 2	positive	A	A		
20	general	Tutorial Model	gene	Gene 3	gene	Gene 4	positive	A	A		
21	general	Tutorial Model	gene	Gene 4	gene	Gene 5	positive	A	A		
22	general	Tutorial Model	gene	Gene 4	gene	Gene 6	positive	A	A		
23	general	Tutorial Model	gene	Gene 4	gene	Gene 7	positive	A	A		
24	general	Tutorial Model	box	Maternal Input	gene	Gene 1	positive	A	A		
25	general	Tutorial Model	bare	Ubiq	gene	Gene 9	positive	B	B		
26	general	Tutorial Model	box	Maternal Input 2	gene	Gene 5	positive	B	B		
27	general	Tutorial Model	box	Maternal Input 2	gene	Gene 10	positive	B	B		
28											
29	# Signals										
30	# Command Type	Model Name	Source Type	Source Name	Target Type	Target Name	Factor Type	Factor Name	Signal Type	Source Region Abbrev	Target Region Abbrev
31	signal	Tutorial Model	gene	Gene 7	gene	Gene 8	gene	Gene 9	promoteSig	A	B
32											
33	# Standalone nodes										
34	# Command Type	Model Name	Node Type	Node Name	Region Abbrev						
35	nodeOnly	Tutorial Model	gene	Gene 11	B						
36											
37											
38	# Interactions For Submodels										
39	# Command Type	Model Name	Source Type	Source Name	Target Type	Target Name	Sign	Source Region Abbrev	Target Region Abbrev		
40	general	Region A - 3 Hours	gene	Gene 2	gene	Gene 3	positive	A	A		
41	general	Region A - 3 Hours	gene	Gene 3	gene	Gene 2	positive	A	A		
42	general	Region A - 3 Hours	gene	Gene 3	gene	Gene 4	positive	A	A		
43	general	Region B - 1 Hour	box	Maternal Input 2	gene	Gene 5	positive	B	B		
44	general	Region B - 1 Hour	box	Maternal Input 2	gene	Gene 10	positive	B	B		
45											



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6	model	Region B - 1 Hour	Tutorial Model								
7											
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10	region	Tutorial Model	A	A							
11	region	Tutorial Model	B	B							
12	region	Region A - 3 Hours	A	A							
13	region	Region B - 1 Hour	B	B							
14											
15	# Standard Interactions										
16	# Command Type	odel Name	Source Type	Source Name	Target Type	Target Name	Sign	Source Region Abbrev	Target Region Abbrev		
17	general	ial Model	gene	Gene 1	gene	Gene 2	positive	A	A		
18	general	Model	gene	Gene 2	gene	Gene 3	positive	A	A		
19	general	del	gene	Gene 3	gene	Gene 2	positive	A	A		
20	general		gene	Gene 3	gene	Gene 4	positive	A	A		
21	general		gene	Gene 4	gene	Gene 5	positive	A	A		
22	general	l	gene	Gene 4	gene	Gene 6	positive	A	A		
23	general	toria	gene	Gene 4	gene	Gene 7	positive	A	A		
24	general	Tutorial	box	Maternal Input	gene	Gene 1	positive	A	A		
25	general	Tutorial Model	bare	Ubiq	gene	Gene 9	positive	B	B		
26	general	Tutorial Model	box	Maternal Input 2	gene	Gene 5	positive	B	B		
27	general	Tutorial Model	box	Maternal Input 2	gene	Gene 10	positive	B	B		
28											
29	# Signals										
30	# Command Type	Model Name	Source Type	Source Name	Target Type	Target Name	Factor Type	Factor Name	Signal Type	Source Region Abbrev	Target Region Abbrev
31	signal	Tutorial Model	gene	Gene 7	gene	Gene 8	gene	Gene 9	promoteSig	A	B
32											
33	# Standalone nodes										
34	# Command Type	Model Name	Node Type	Node Name	Region Abbrev						
35	nodeOnly	Tutorial Model	gene	Gene 11	B						
36											
37											
38	# Interactions For Submodels										
39	# Command Type	Model Name	Source Type	Source Name	Target Type	Target Name	Sign	Source Region Abbrev	Target Region Abbrev		
40	general	Region A - 3 Hours	gene	Gene 2	gene	Gene 3	positive	A	A		
41	general	Region A - 3 Hours	gene	Gene 3	gene	Gene 2	positive	A	A		
42	general	Region A - 3 Hours	gene	Gene 3	gene	Gene 4	positive	A	A		
43	general	Region B - 1 Hour	box	Maternal Input 2	gene	Gene 5	positive	B	B		
44	general	Region B - 1 Hour	box	Maternal Input 2	gene	Gene 10	positive	B	B		
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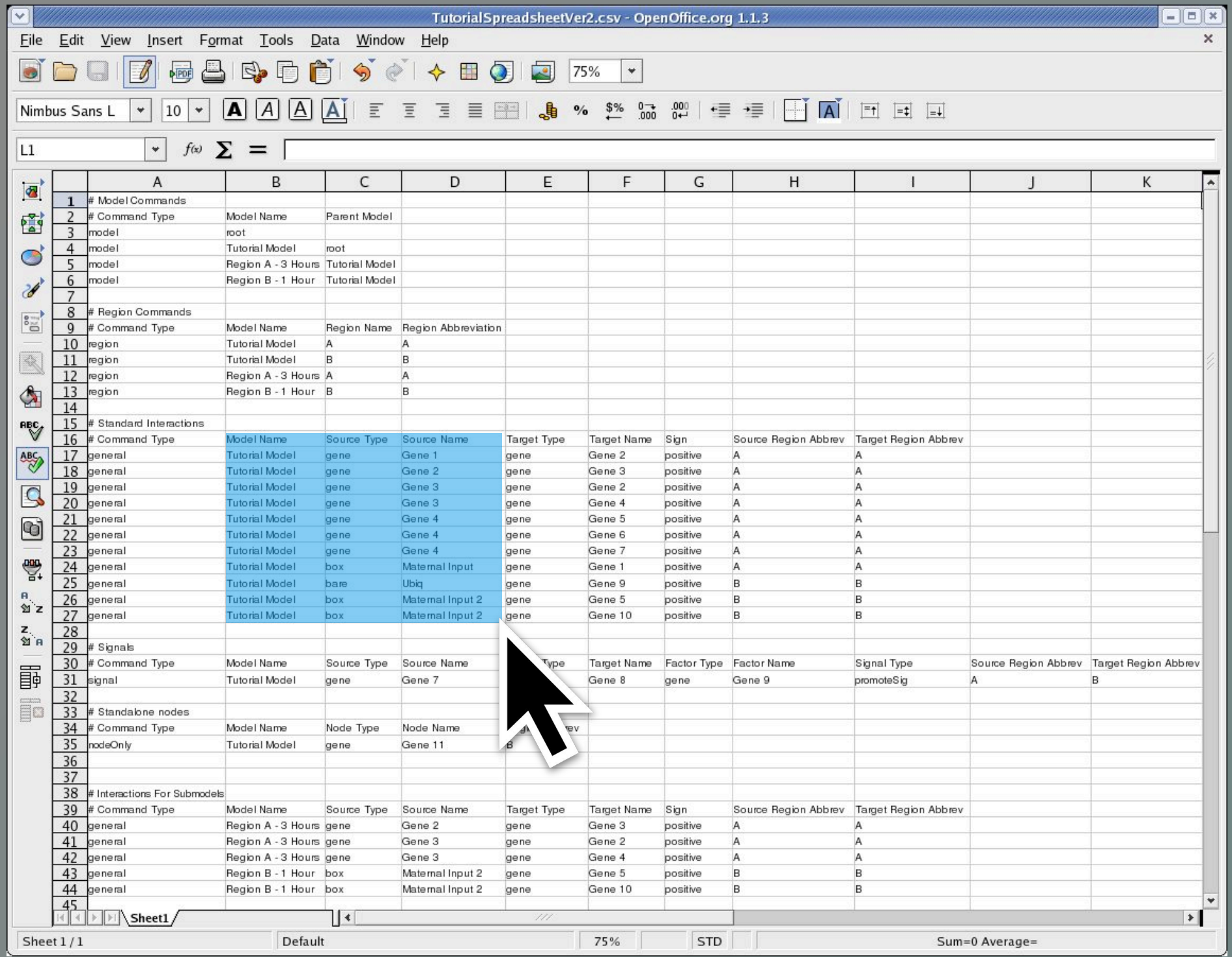

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31	signal	Tutorial Model	gene	Gene 7		Gene 8	gene	Gene 9	promoteSig	A	B
32											
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34	# Command Type	Model Name	Node Type	Node Name							
35	nodeOnly	Tutorial Model	gene	Gene 11	B						
36											
37											
38	# Interactions For Submodels										
39	# Command Type	Model Name	Source Type	Source Name	Target Type	Target Name	Sign	Source Region Abbrev	Target Region Abbrev		
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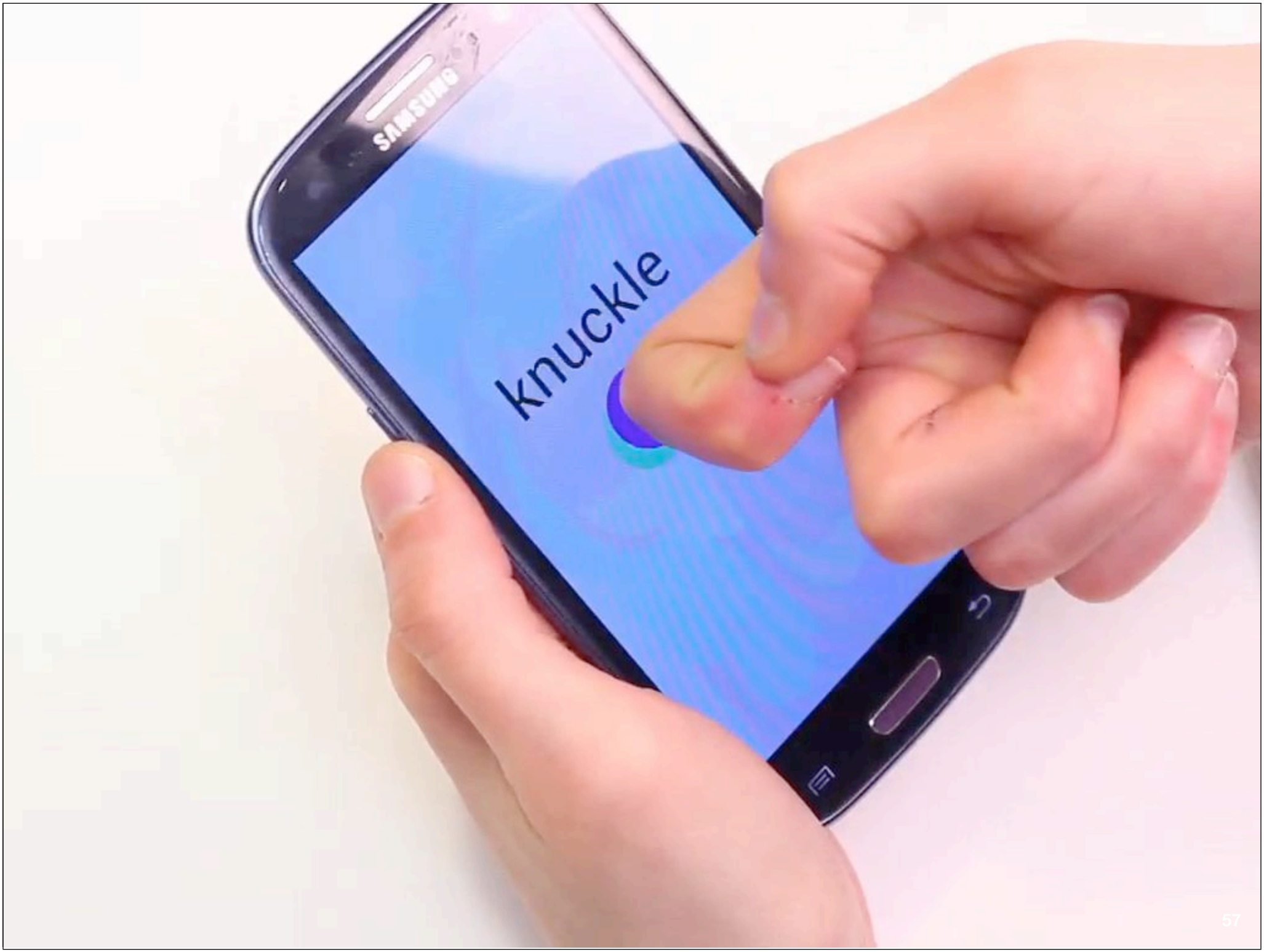
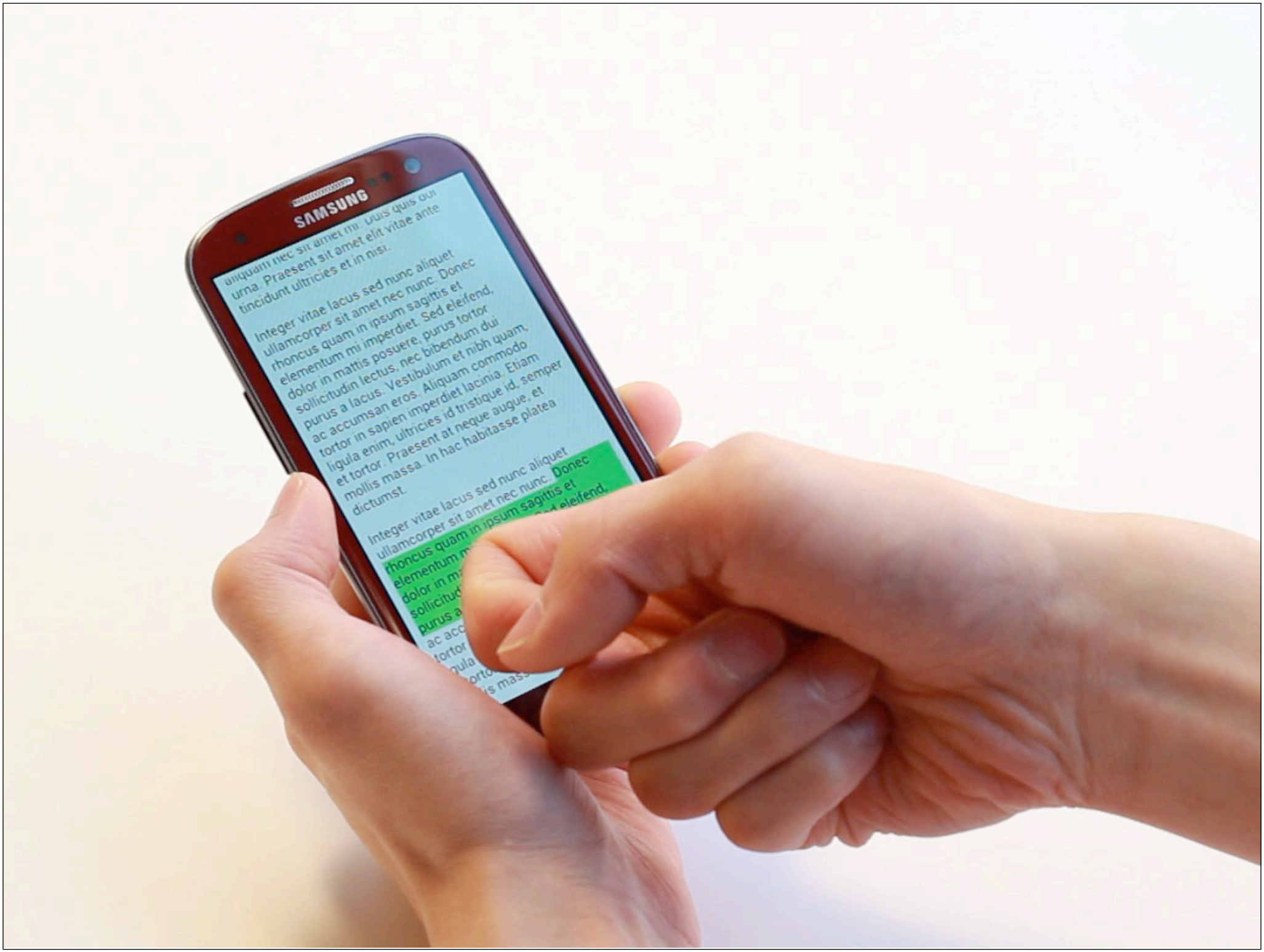
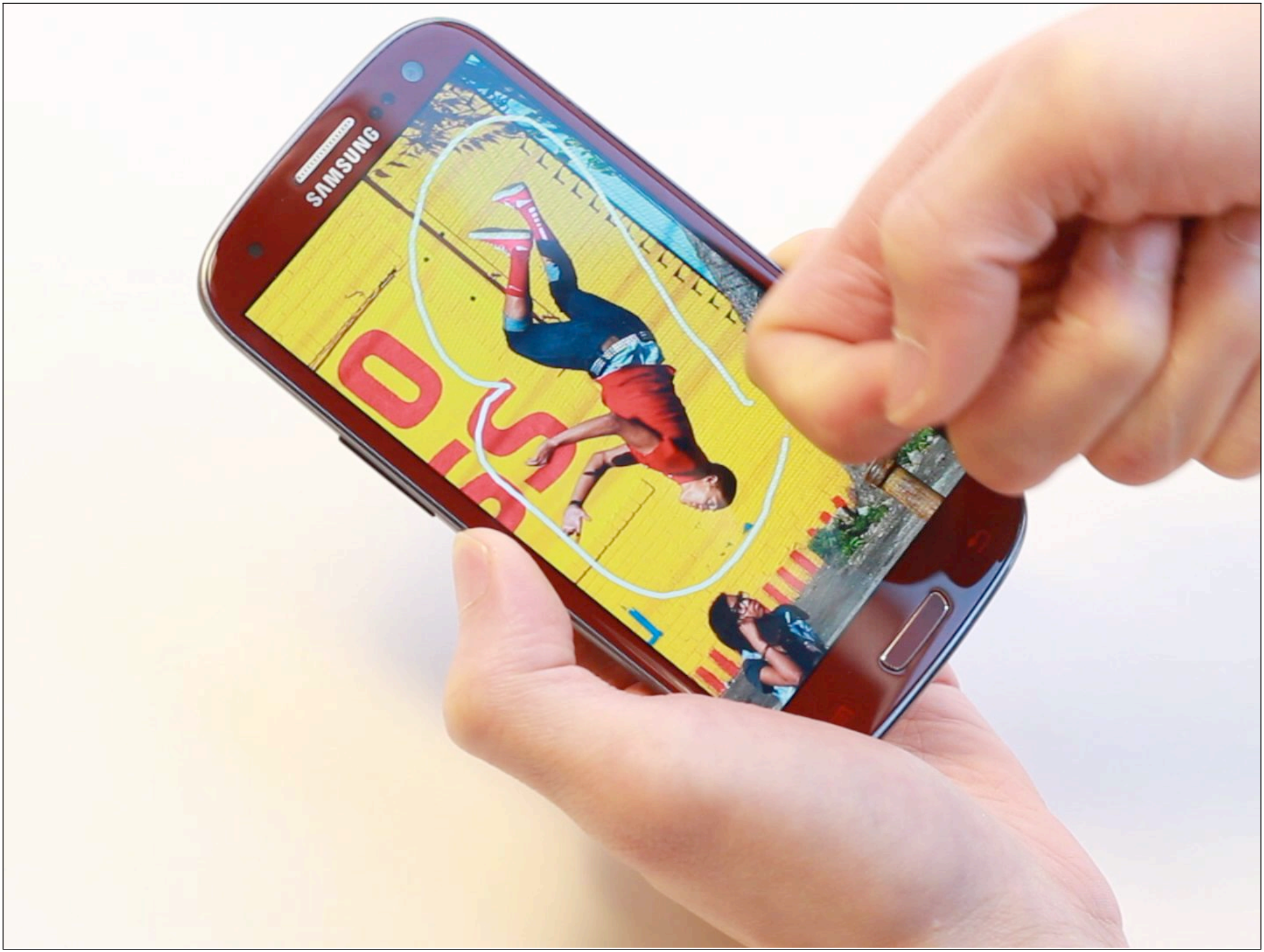
41	general	Region A - 3 Hours	gene	Gene 3	gene	Gene 2	positive	A	A		
42	general	Region A - 3 Hours	gene	Gene 3	gene	Gene 4	positive	A	A		
43	general	Region B - 1 Hour	box	Maternal Input 2	gene	Gene 5	positive	B	B		
44	general	Region B - 1 Hour	box	Maternal Input 2	gene	Gene 10	positive	B	B		
45											


SAMSUNG
knuckle


SAMSUNG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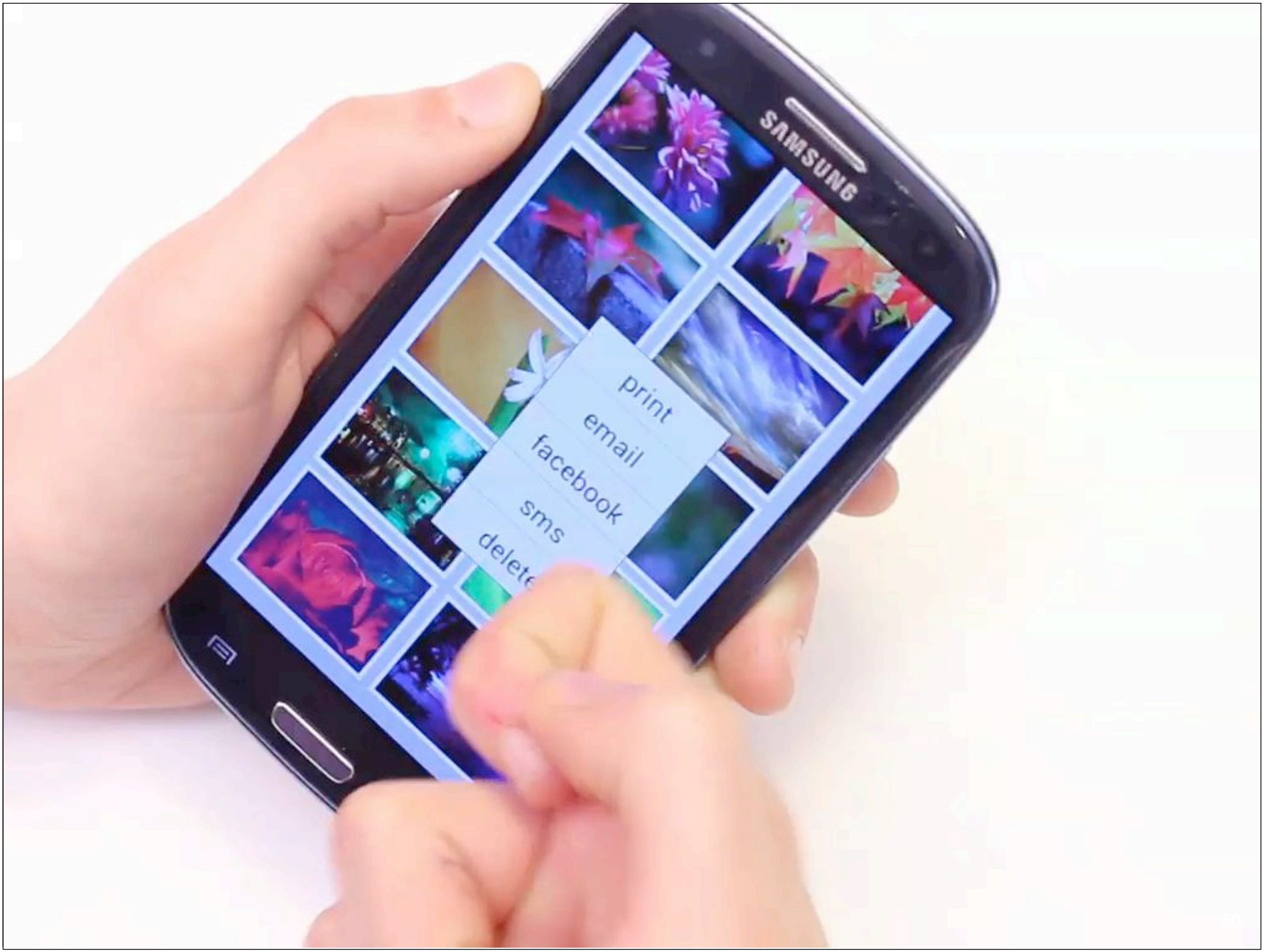
SAMSUNG
print
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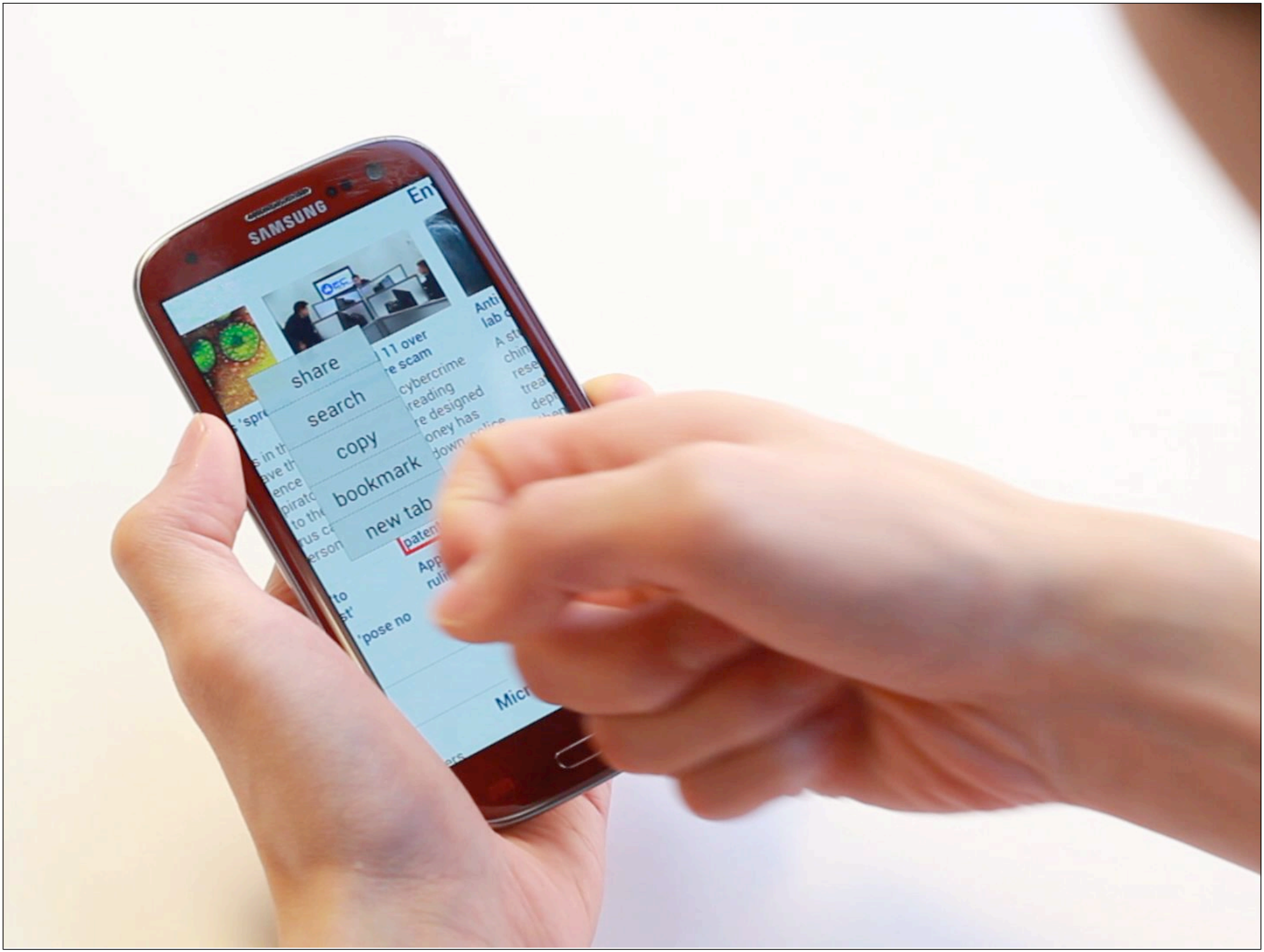
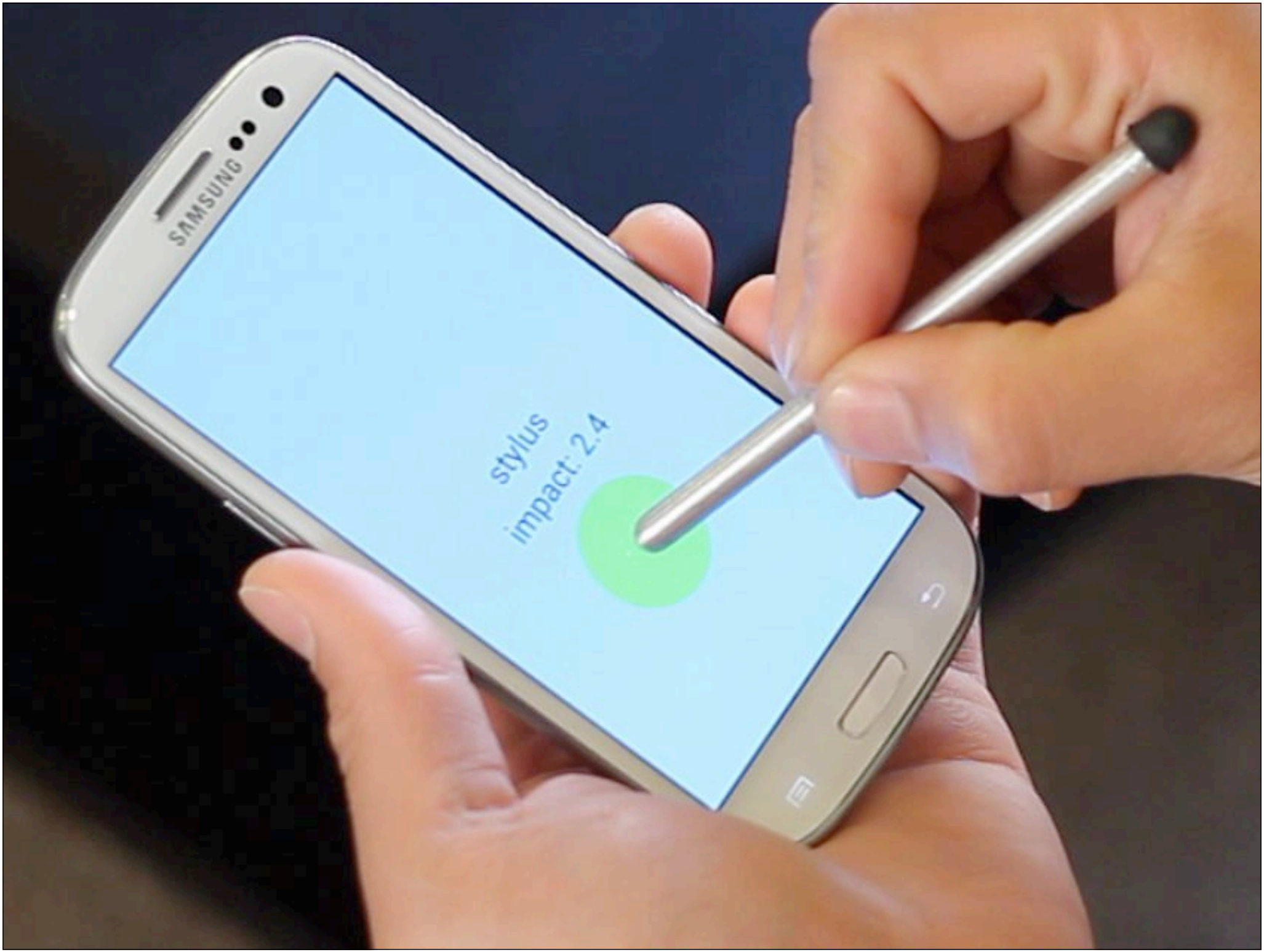
facebook
sms

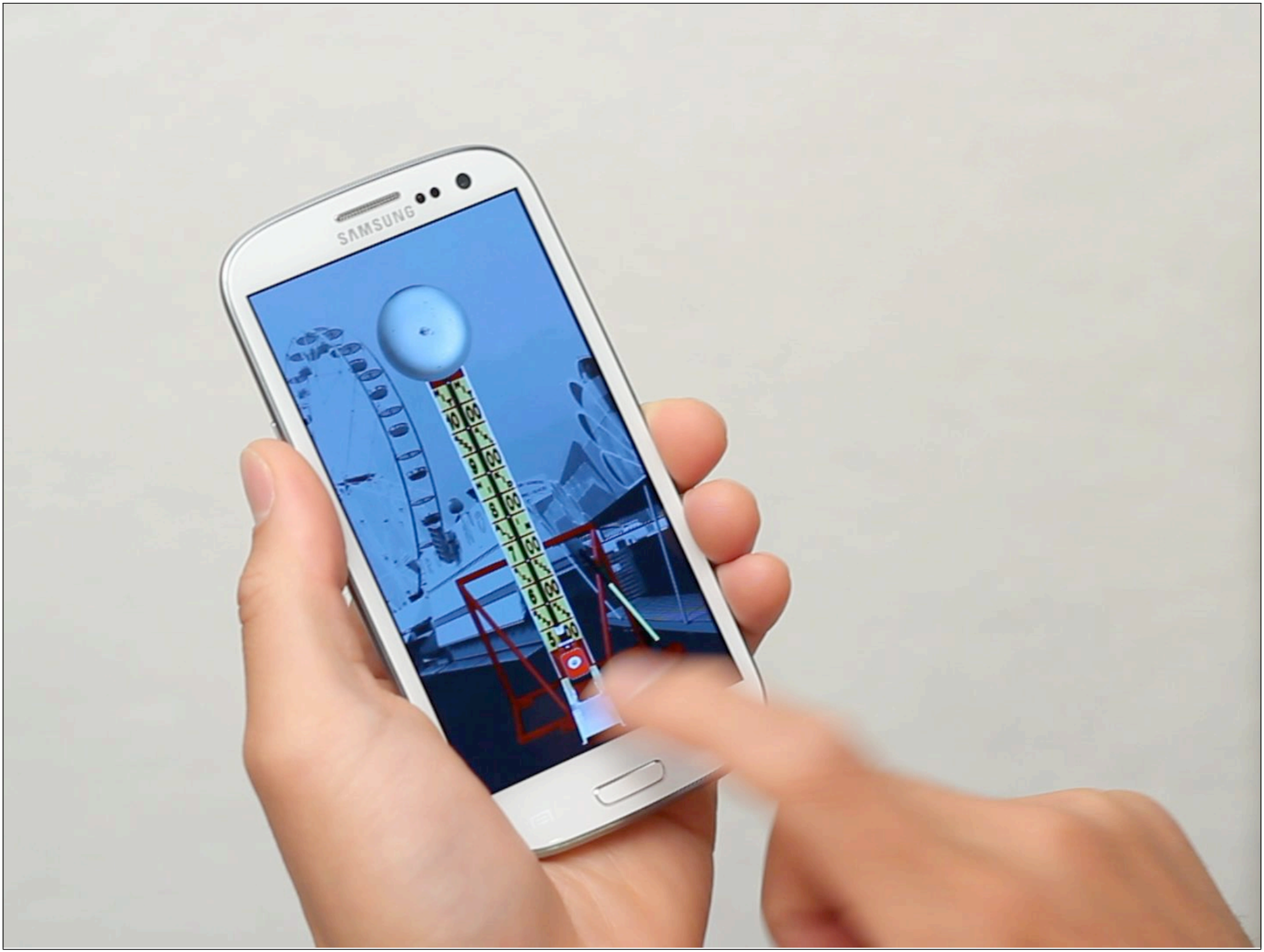

SAMSUNG
share
search
copy
bookmark
new tab

Impact Force

FingerSense

Chris Harrison Julia Schwarz Robert Xiao Scott Hudson

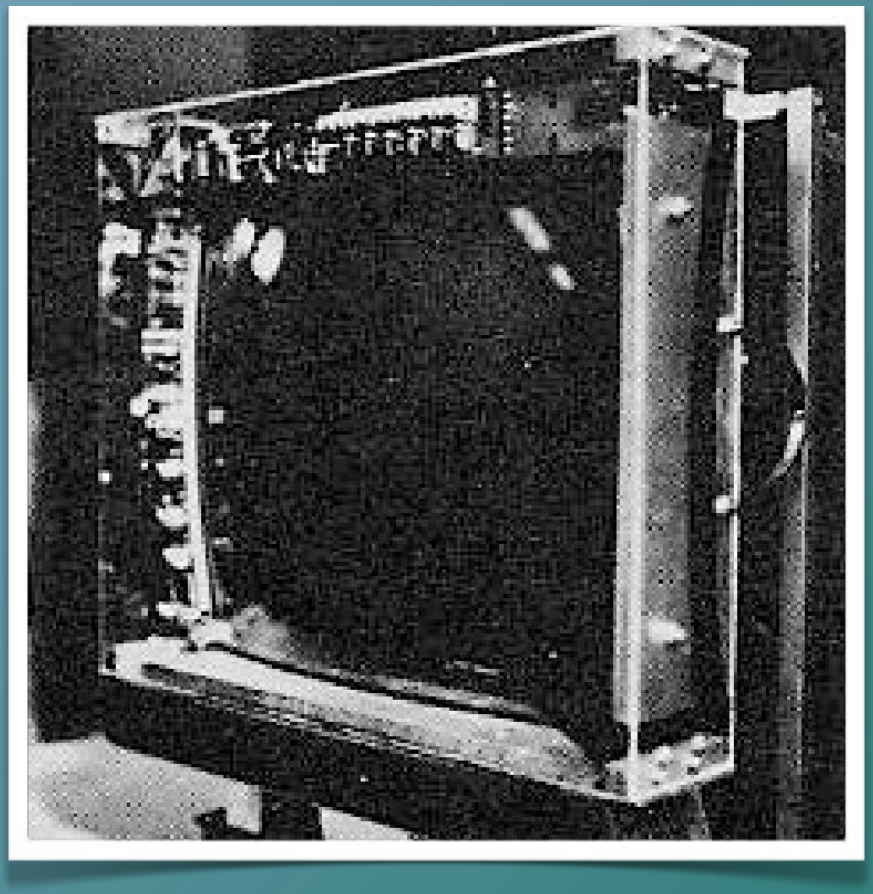

SAMSUNG
stylus
impact: 2.4


SAMSUNG

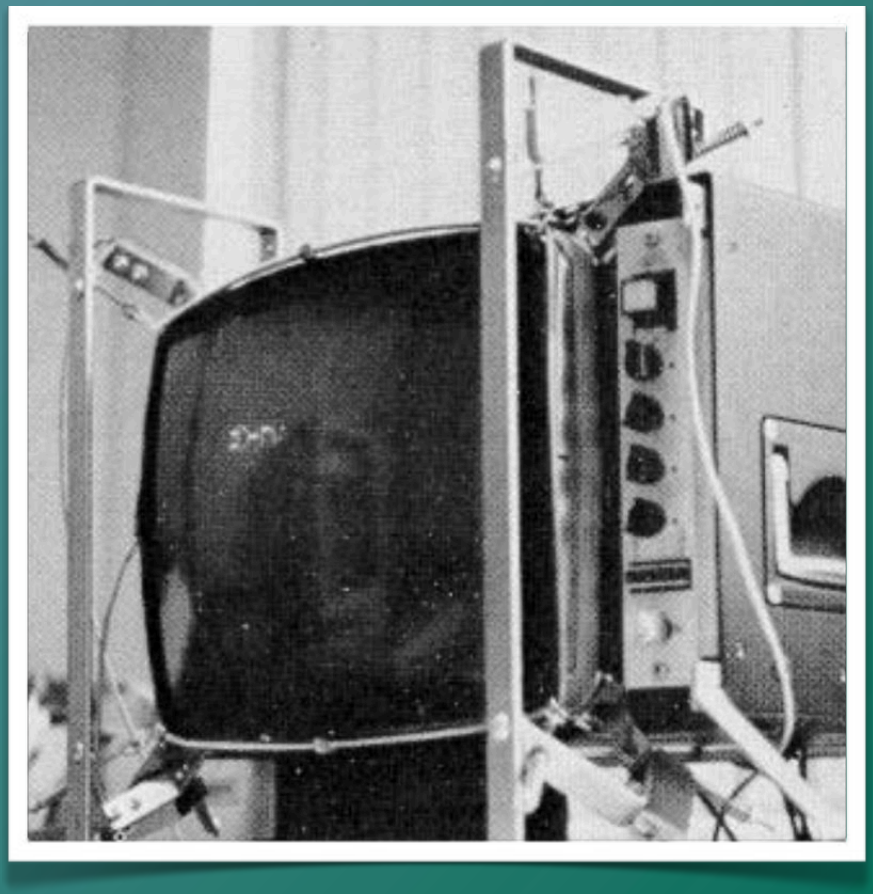
Shear

Shear Input (CHI 2012)

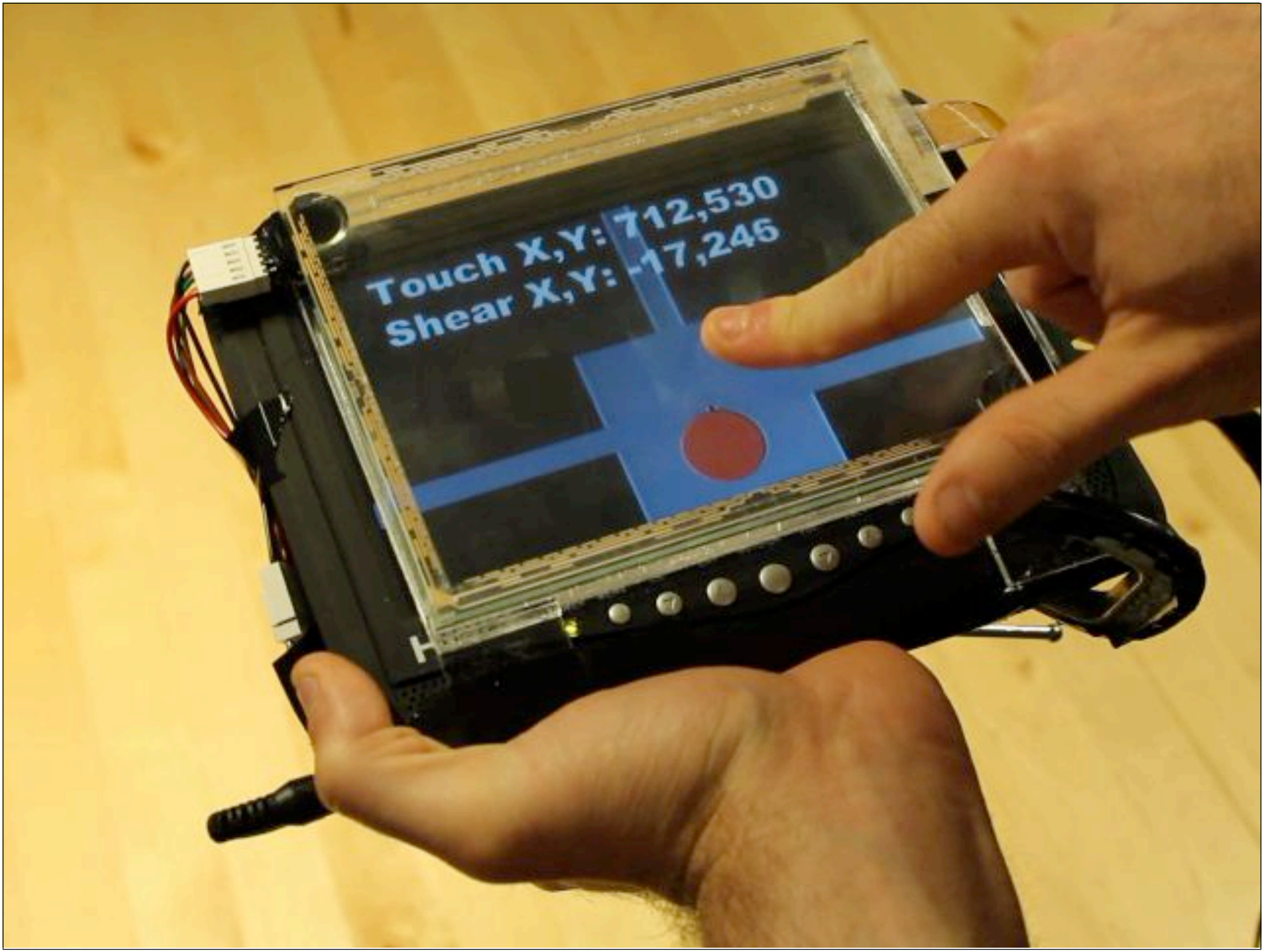
Chris Harrison Scott Hudson

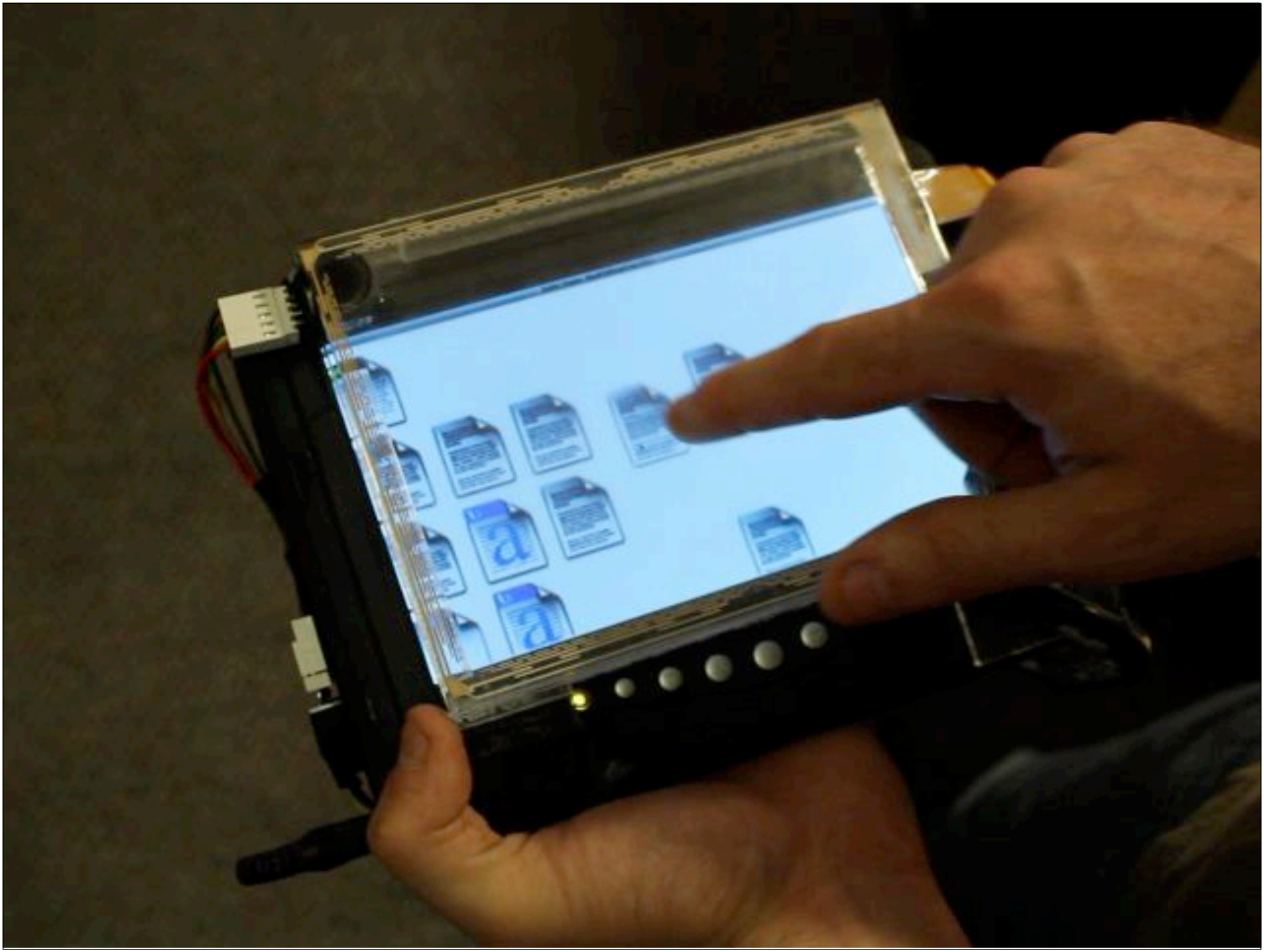


Herot '78

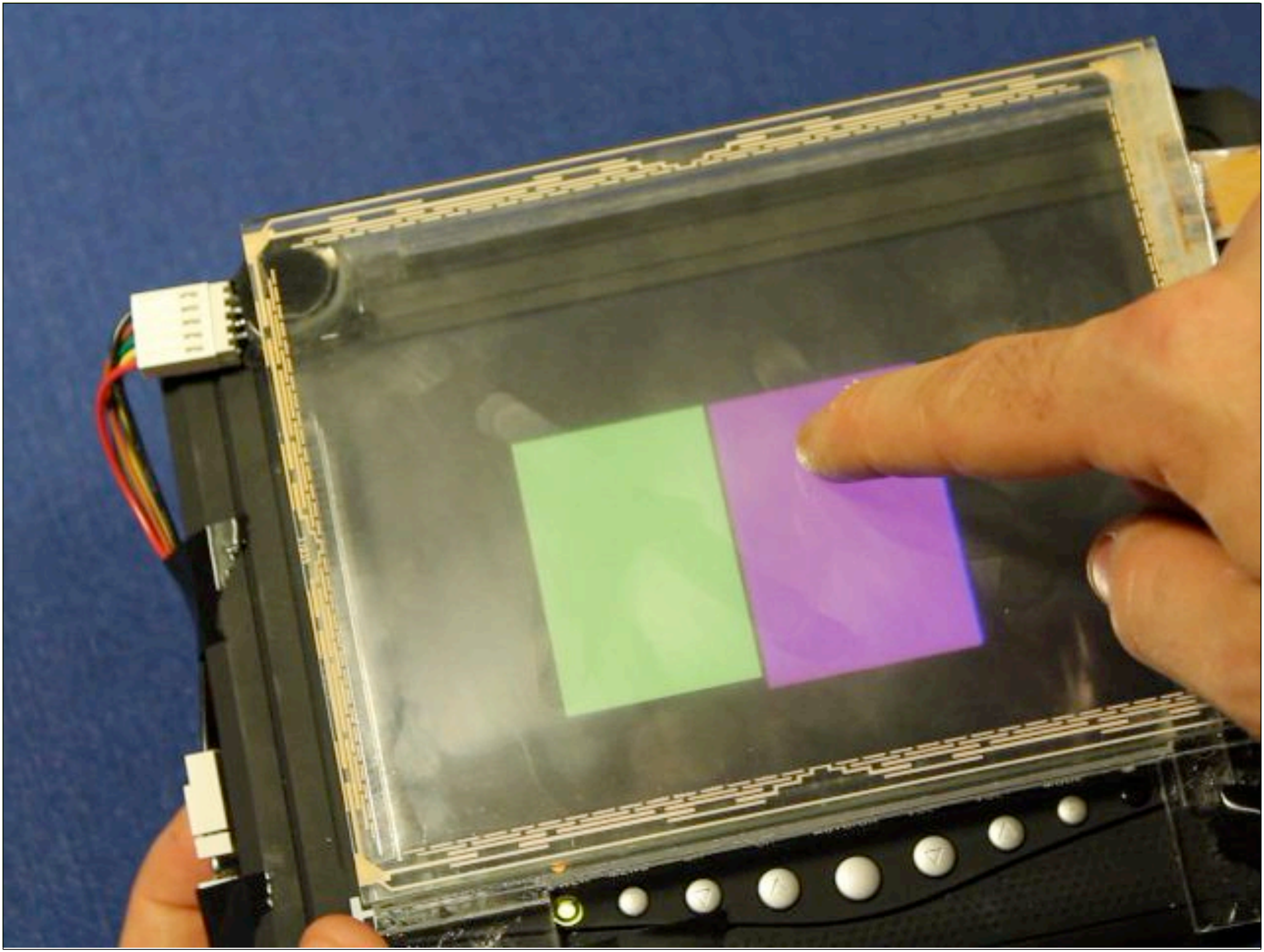


Minsky '84


Touch X,Y: 712,530
Shear X,Y: -17,246

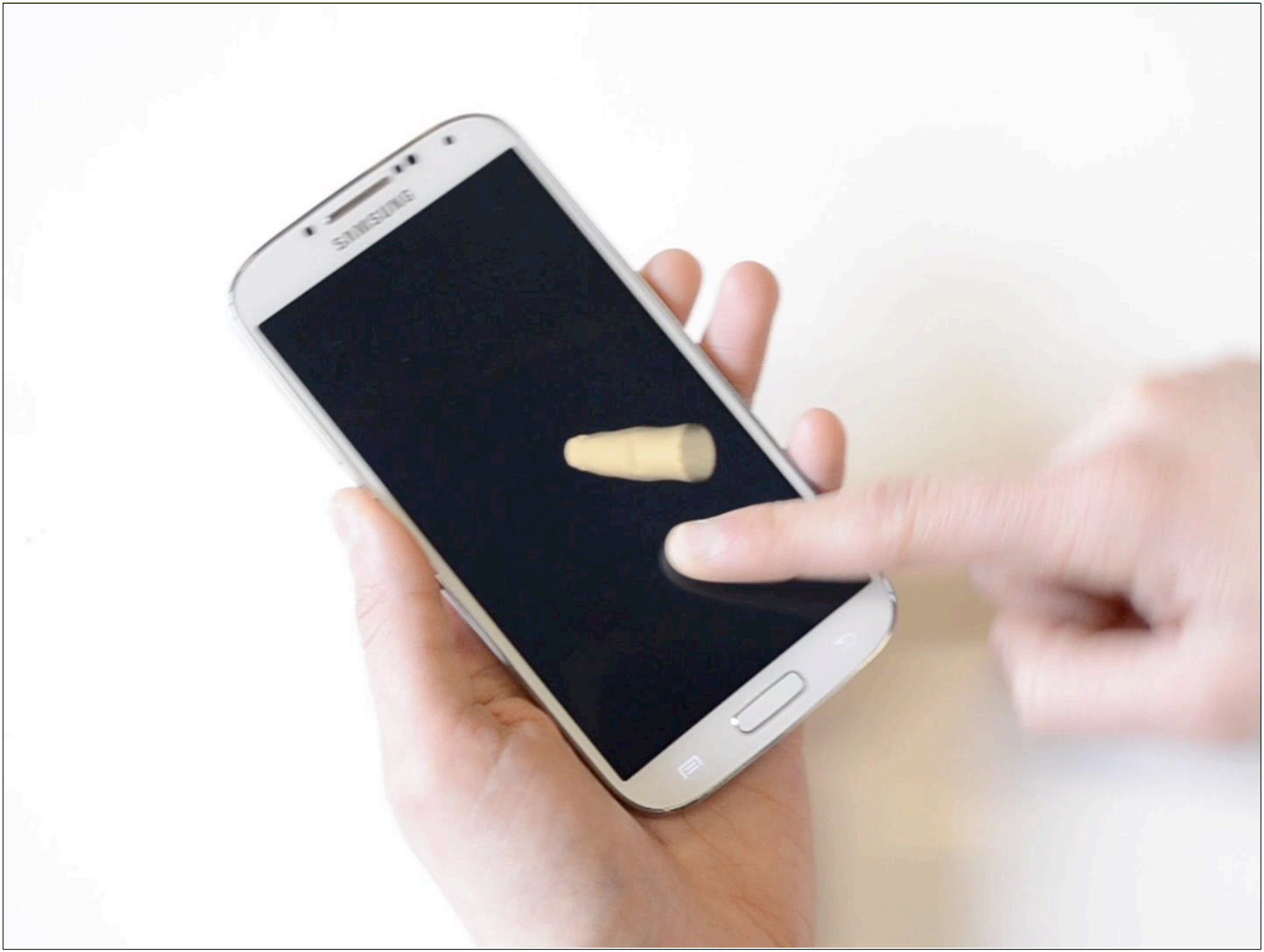


PROx
rop Not as Bad as Feared 52 minutes ago
ng Is Cut by S.&P.
G.E. of its highest rating, analysts cited
any's financial arm, GE Capital.
ers Defy Government Ban
48 AM ET
d force to disperse some of
akistanis who assembled for
s on Thursday
Read (11)

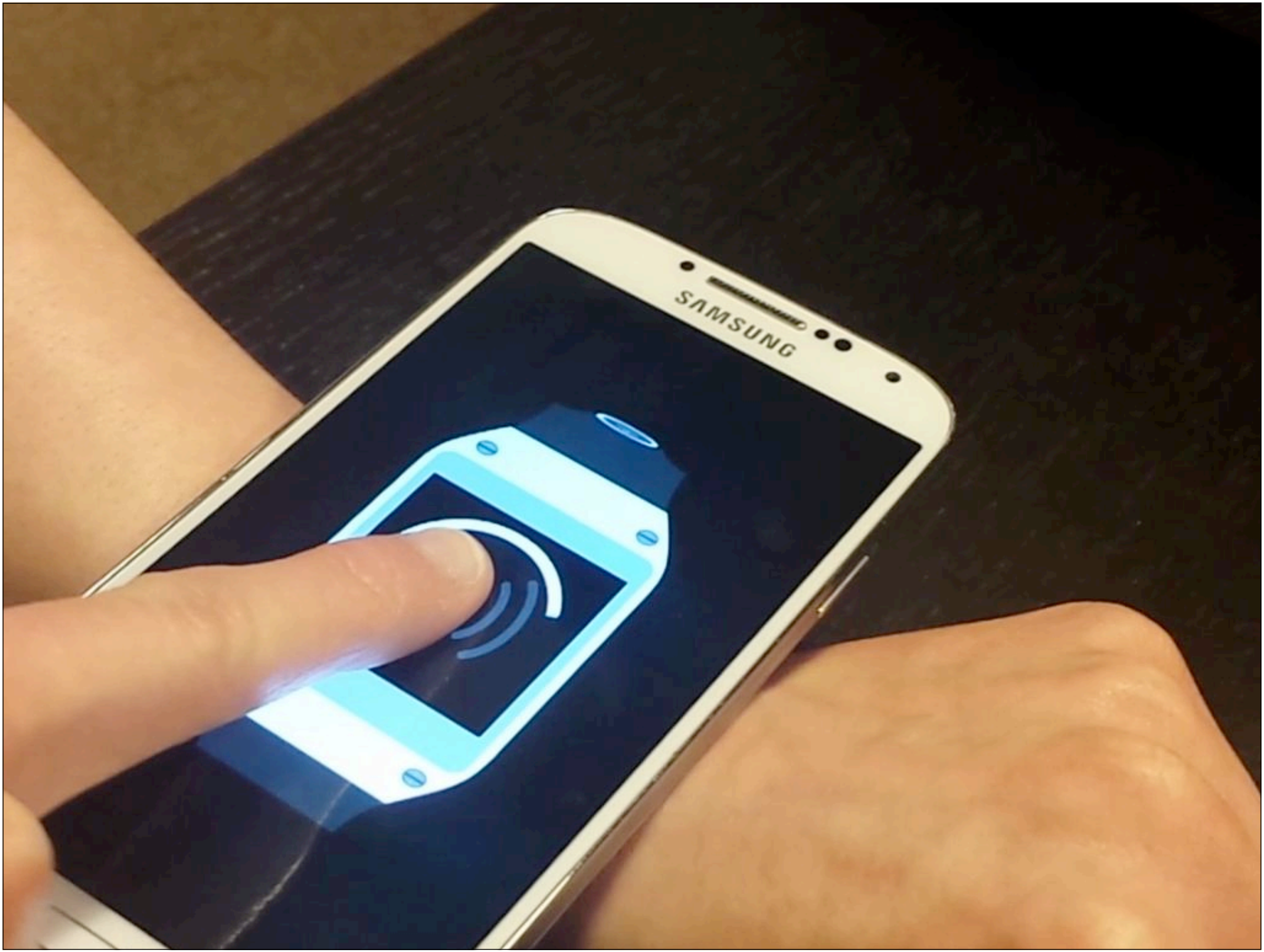


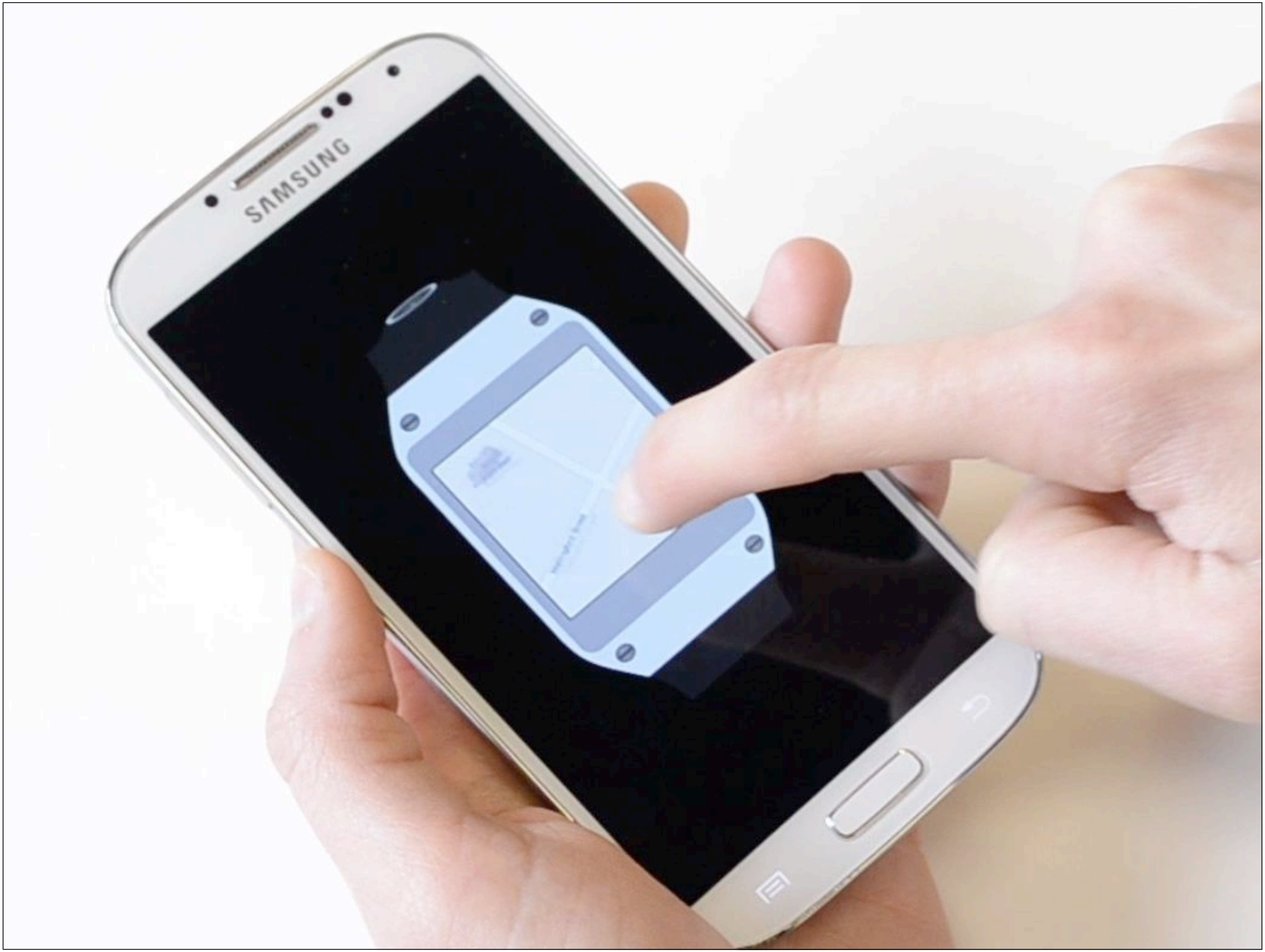
Finger Pose

Qeexo
Julia Schwarz Robert Xiao Chris Harrison


SAMSUNG

SAMSUNG


SAMSUNG


SAMSUNG

Who

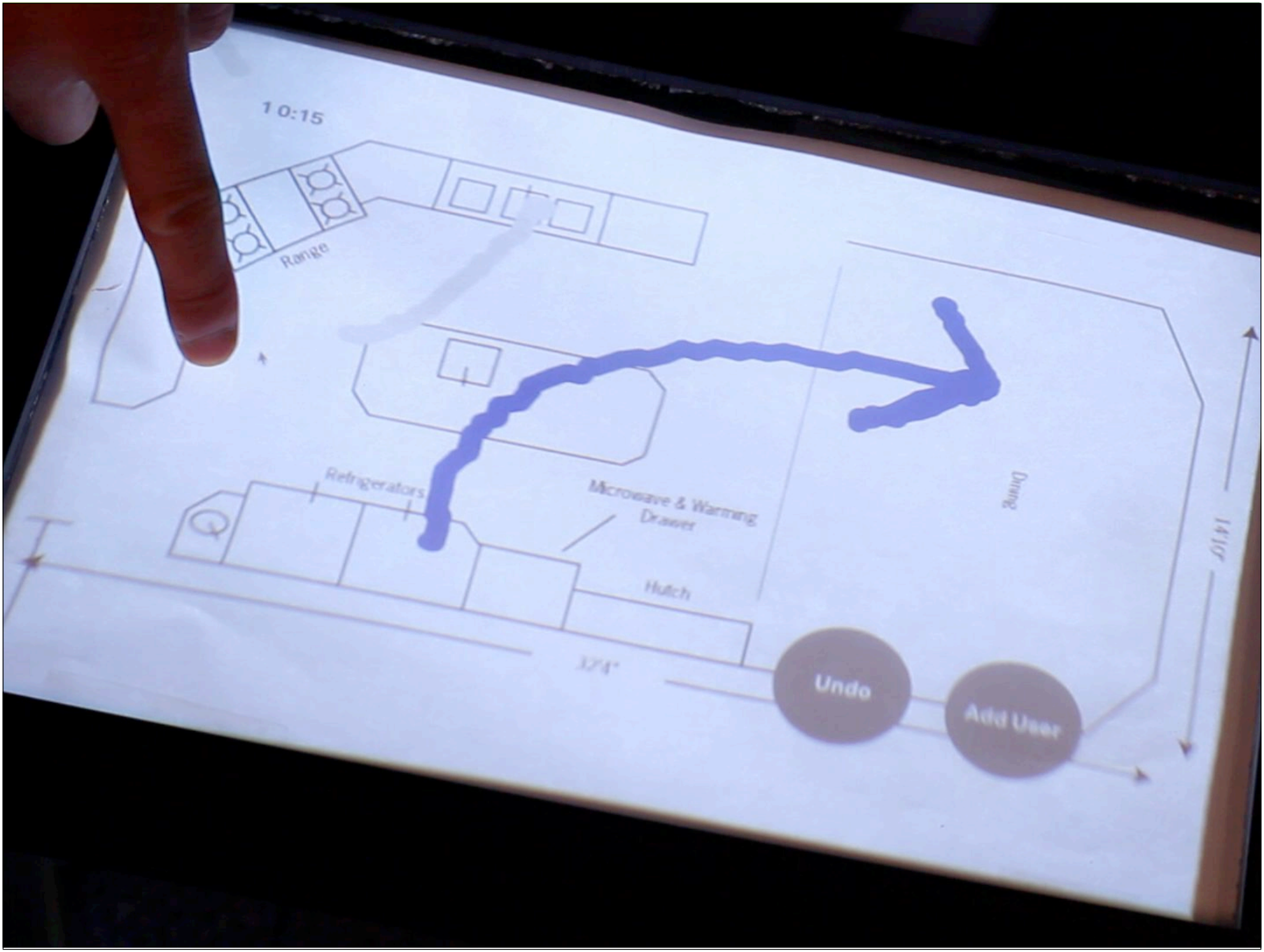
Capacitive Fingerprinting (UIST 2012)

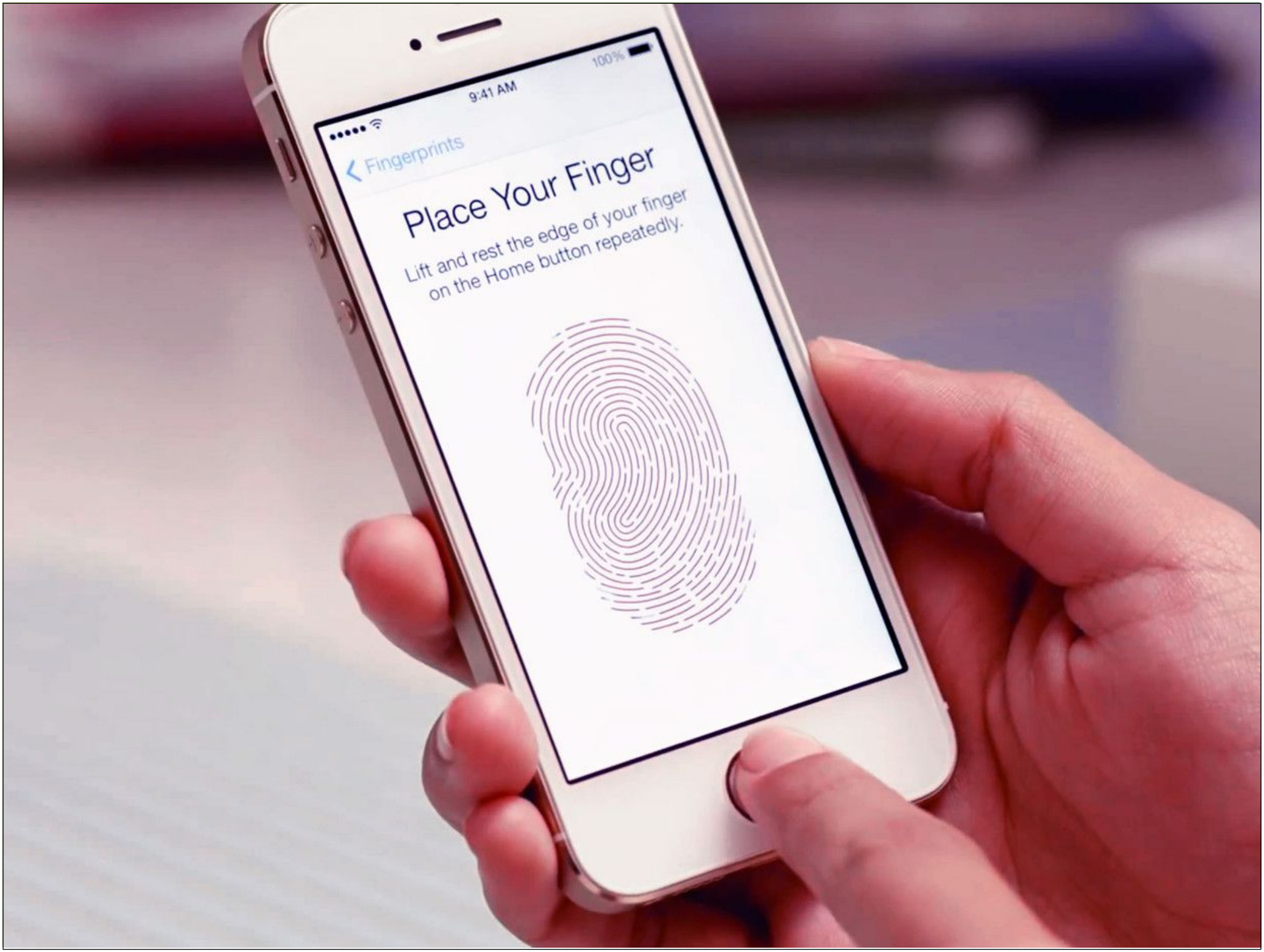
Chris Harrison Munehiko Sato Ivan Poupyrev

Disney Research Pittsburgh

SMART Table

Training Classifier...
Add User


10:15
Range
Refrigerators
Microwave & Warming Drawer
Hutch
Dining
Undo
Add User

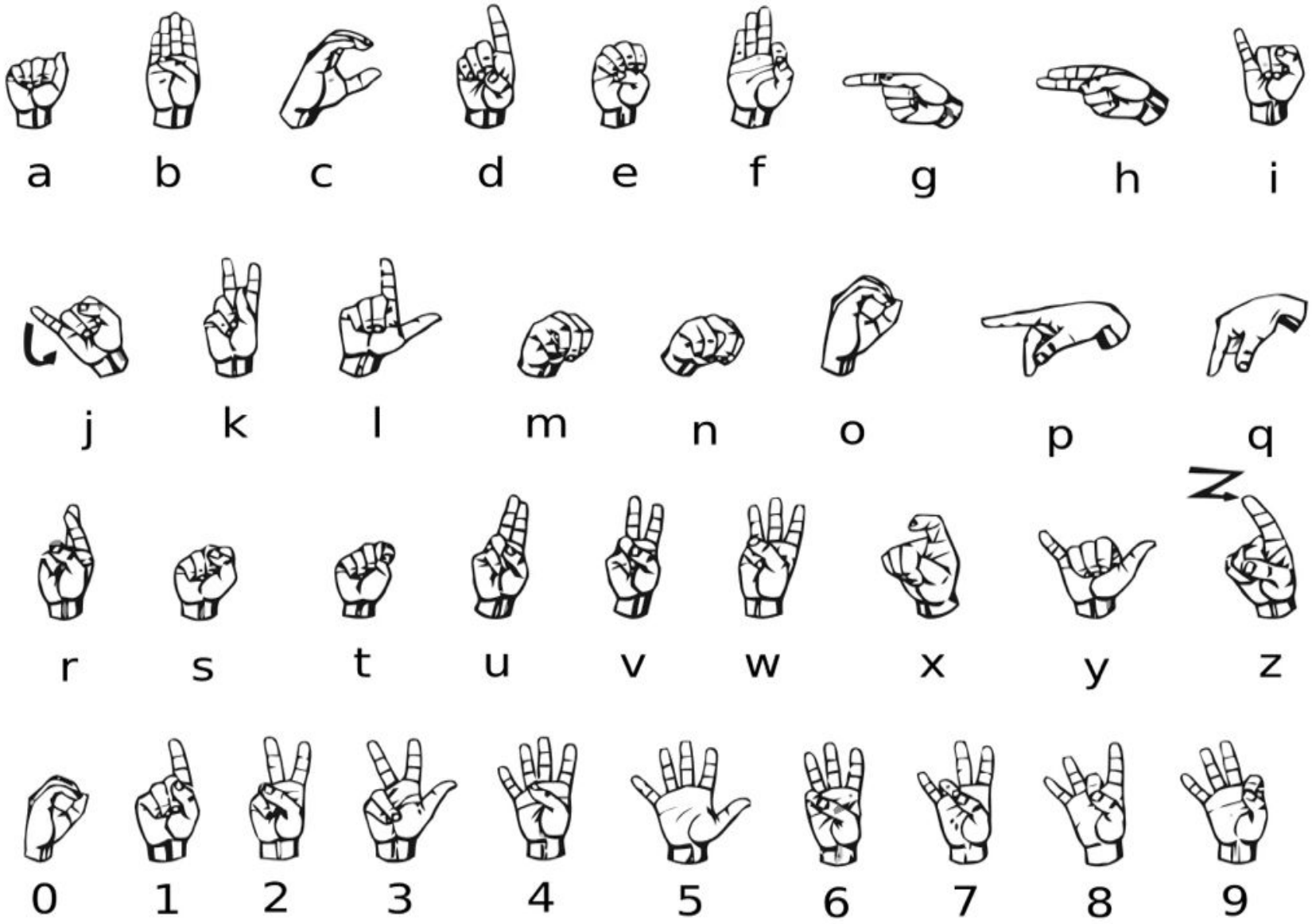

9:41 AM
100%
Fingerprints
Place Your Finger
Lift and rest the edge of your finger on the Home button repeatedly.

Hand Configuration

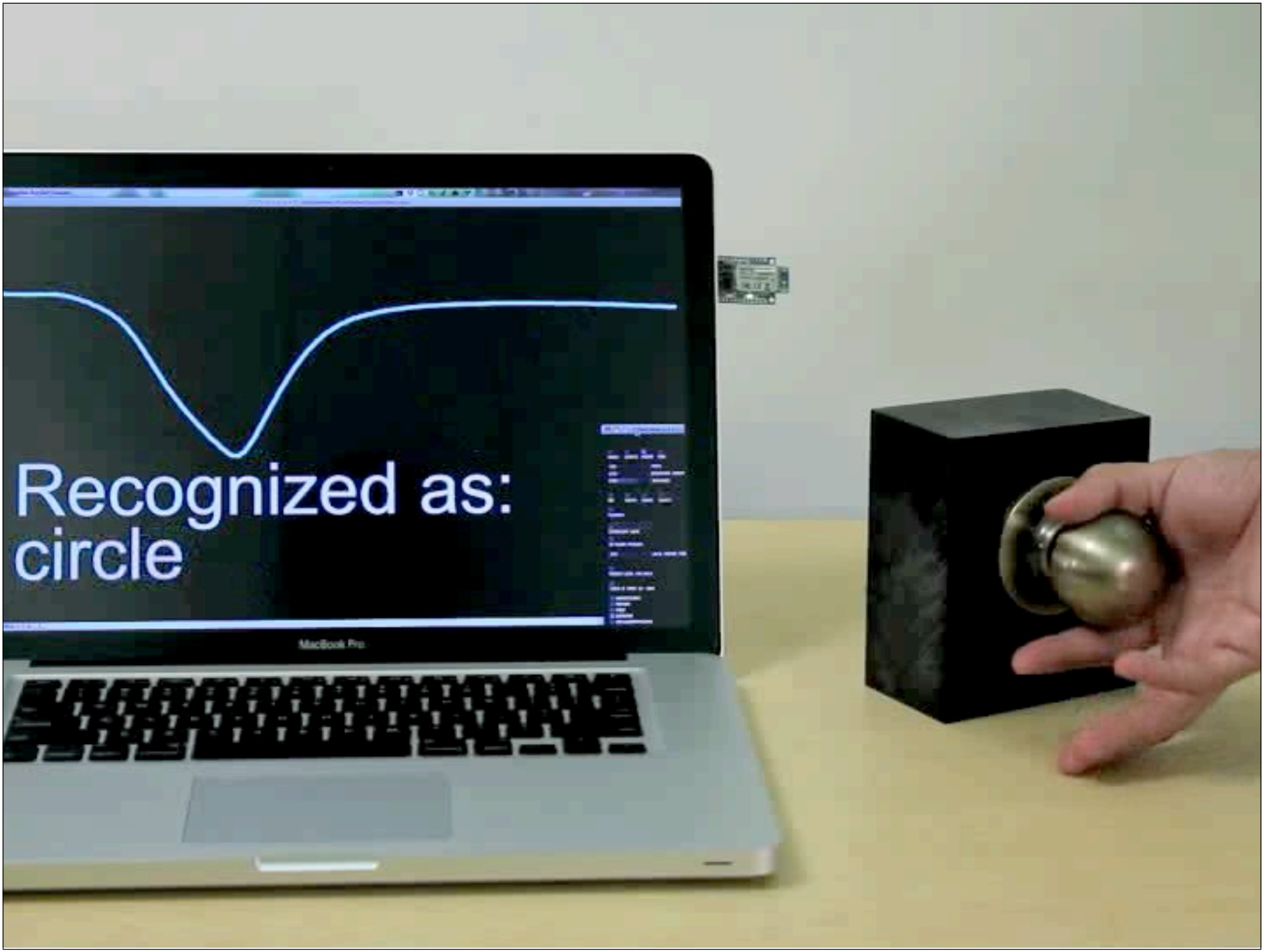
Touché (CHI 2012)

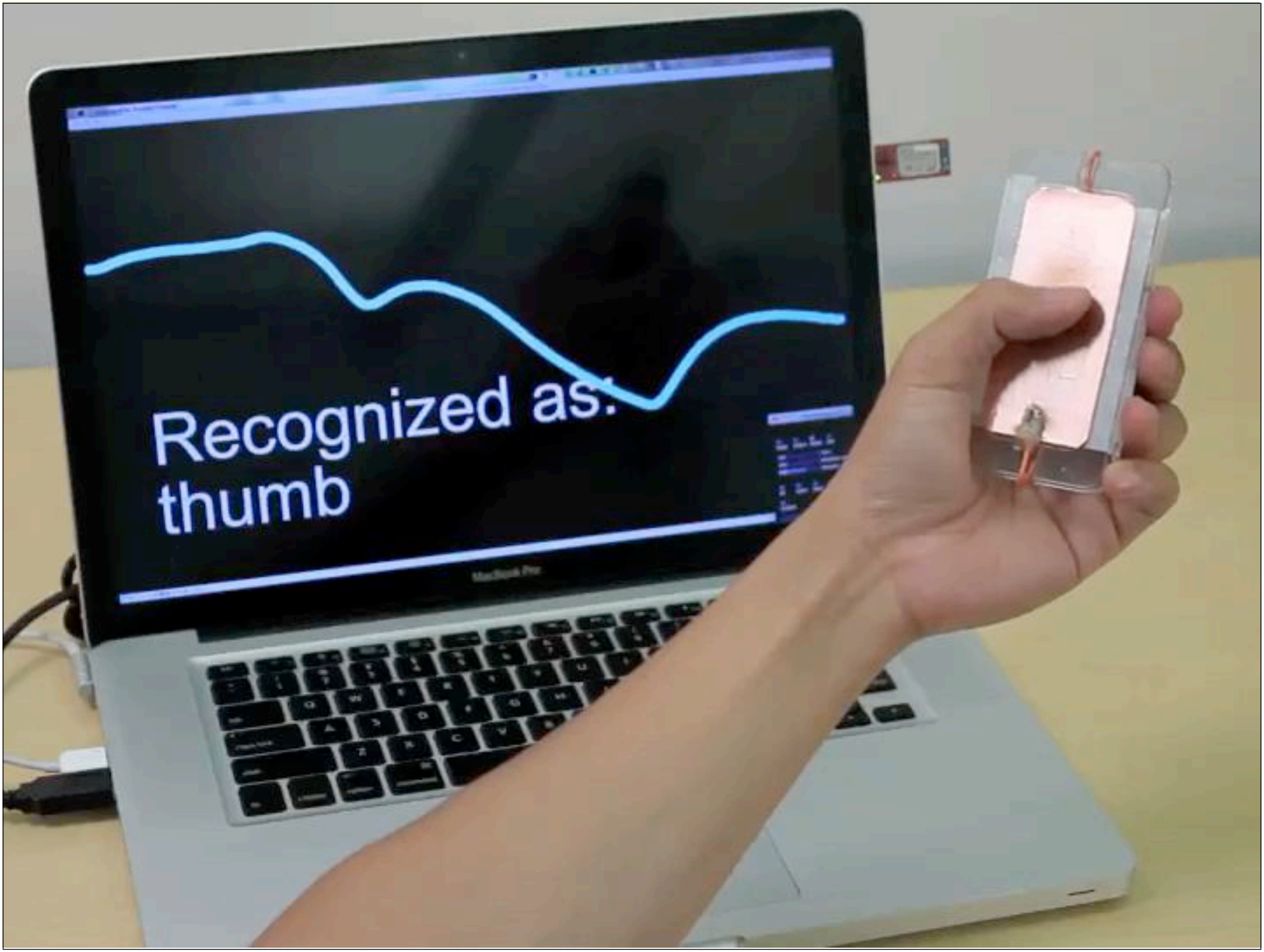
Munehiko Sato Ivan Poupyrev Chris Harrison

Disney Research Pittsburgh



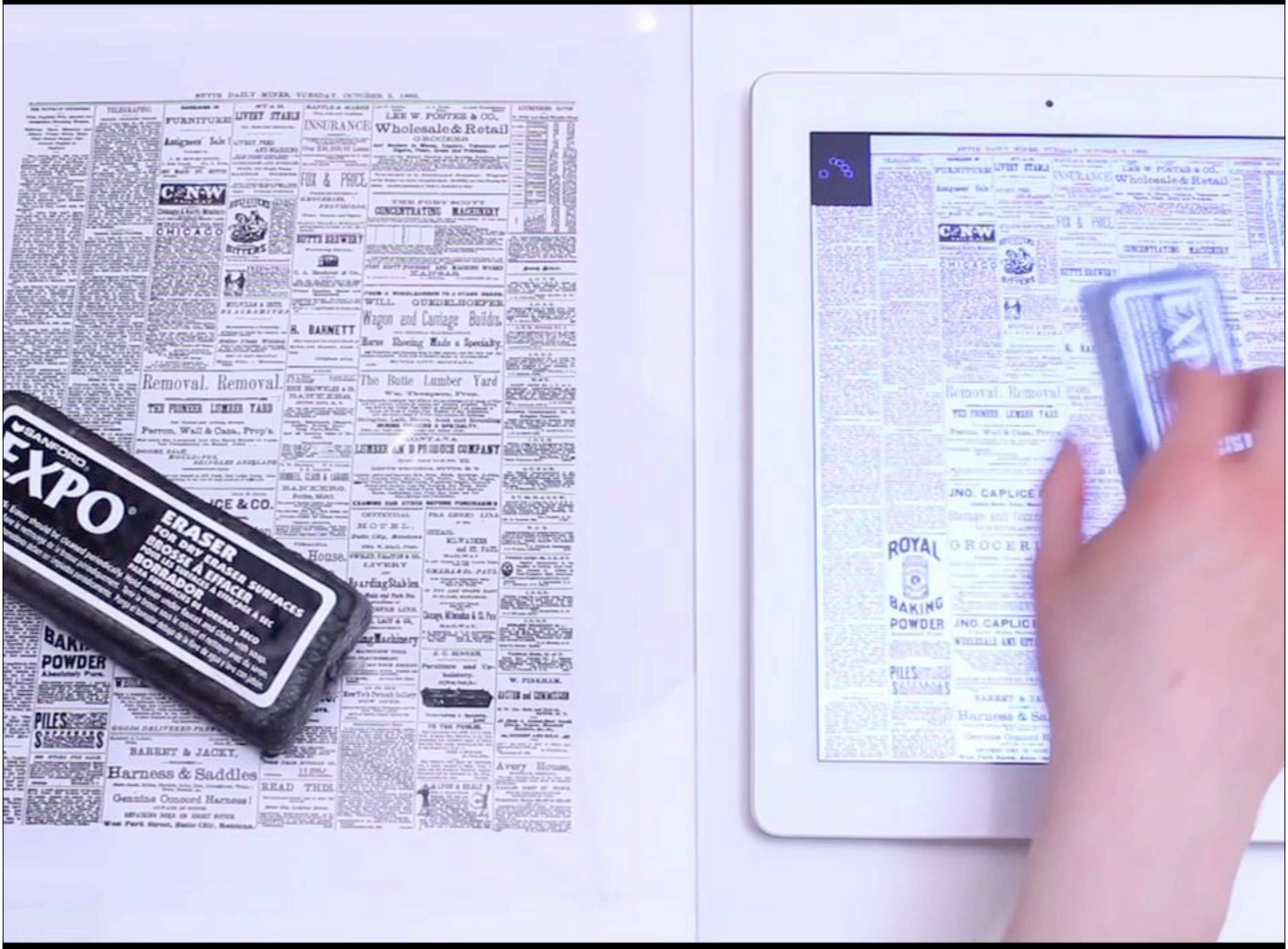
American Sign Language Alphabet

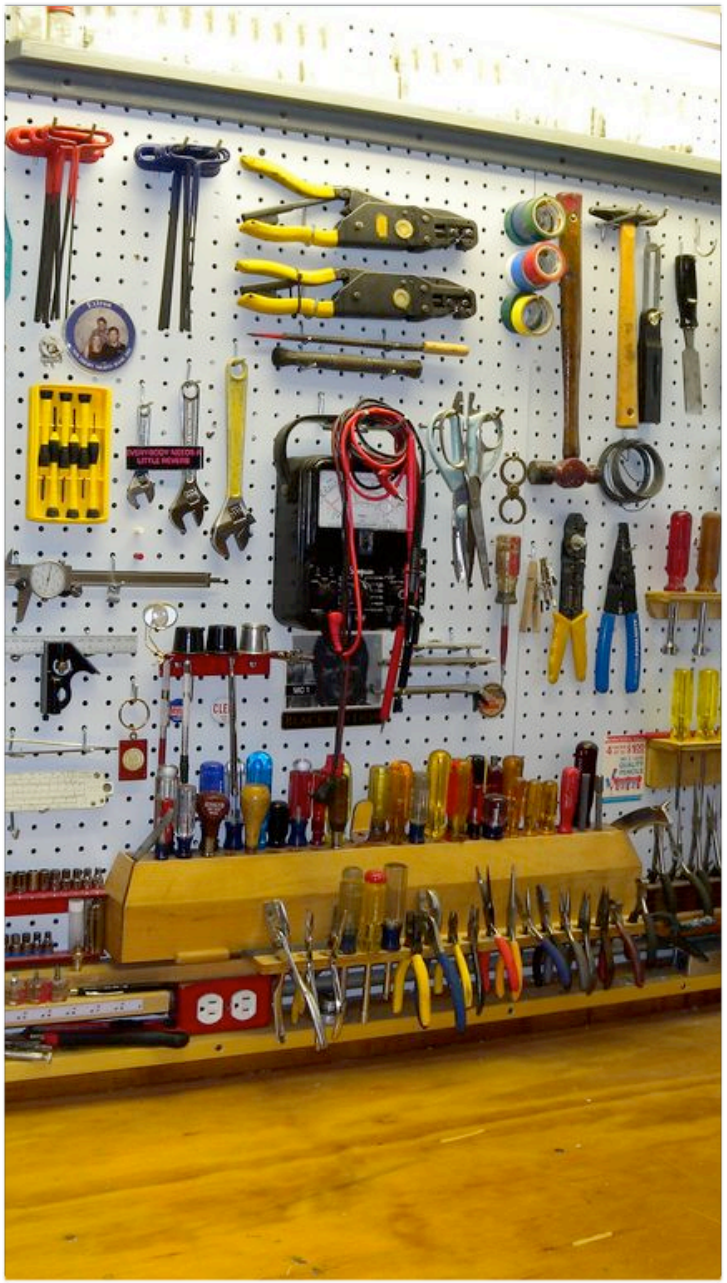

Recognized as:
circle
MacBook Pro

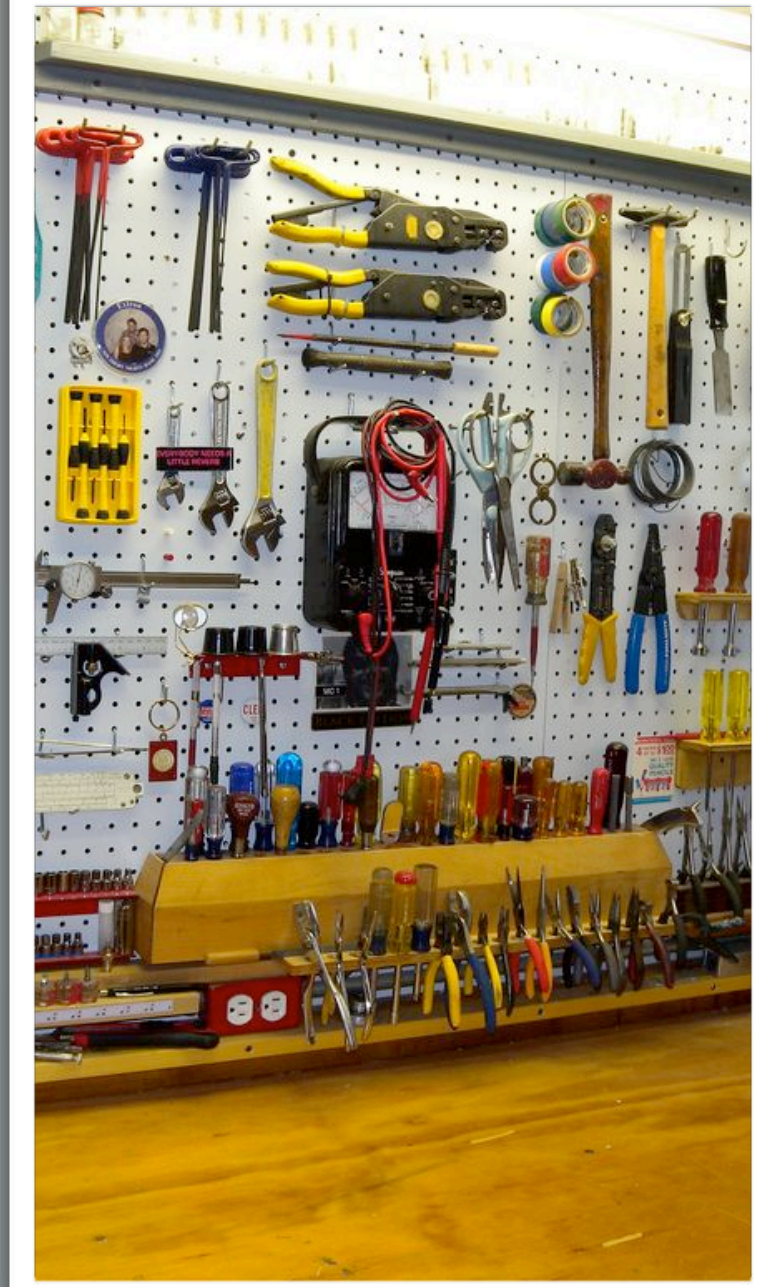

Recognized as:
thumb

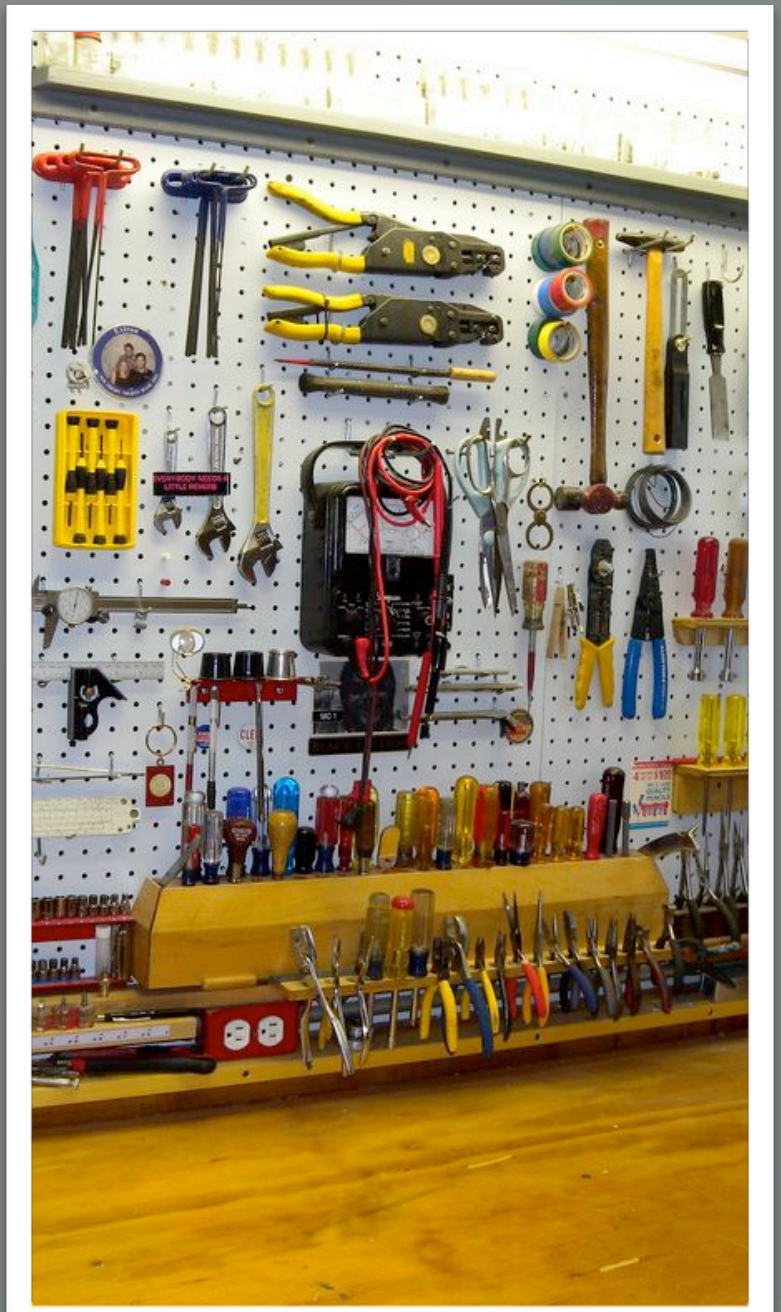
Hand Grasp

TouchTools (CHI 2014)
Chris Harrison Robert Xiao Julia Schwarz Scott Hudson


SANFORD
EXPO
ERASER
FOR DRY ERASER SURFACES
BROSSE À EFFACER
BORRADOR
FURNITURE
LIVERY STABLE
INSURANCE
LEE W. POSTER & CO.
Wholesale & Retail
FOX & PRICE
CONCENTRATING MACHINERY
CHICAGO
BUTTE BREWERY
WILL GUEDELHOEFER
Wagon and Carriage Builds.
Horse Shoeing Made a Specialty.
H. BARNETT
Removal. Removal.
THE PIONEER LUMBER YARD
Perron, Wall & Cass, Prop's.
The Butte Lumber Yard
LUMBER AND PRODUCE COMPANY
BANKERS
CONTINENTAL HOTEL
LIVERY
Boarding Stables
Machinery
BARRET & JACKY,
Harness & Saddles
Genuine Concord Harness!
READ THIS
Avery House
PILES
POWDER
ROYAL
BAKING
POWDER
JNO. CAPLICE
GROCERI
Harness & Sa







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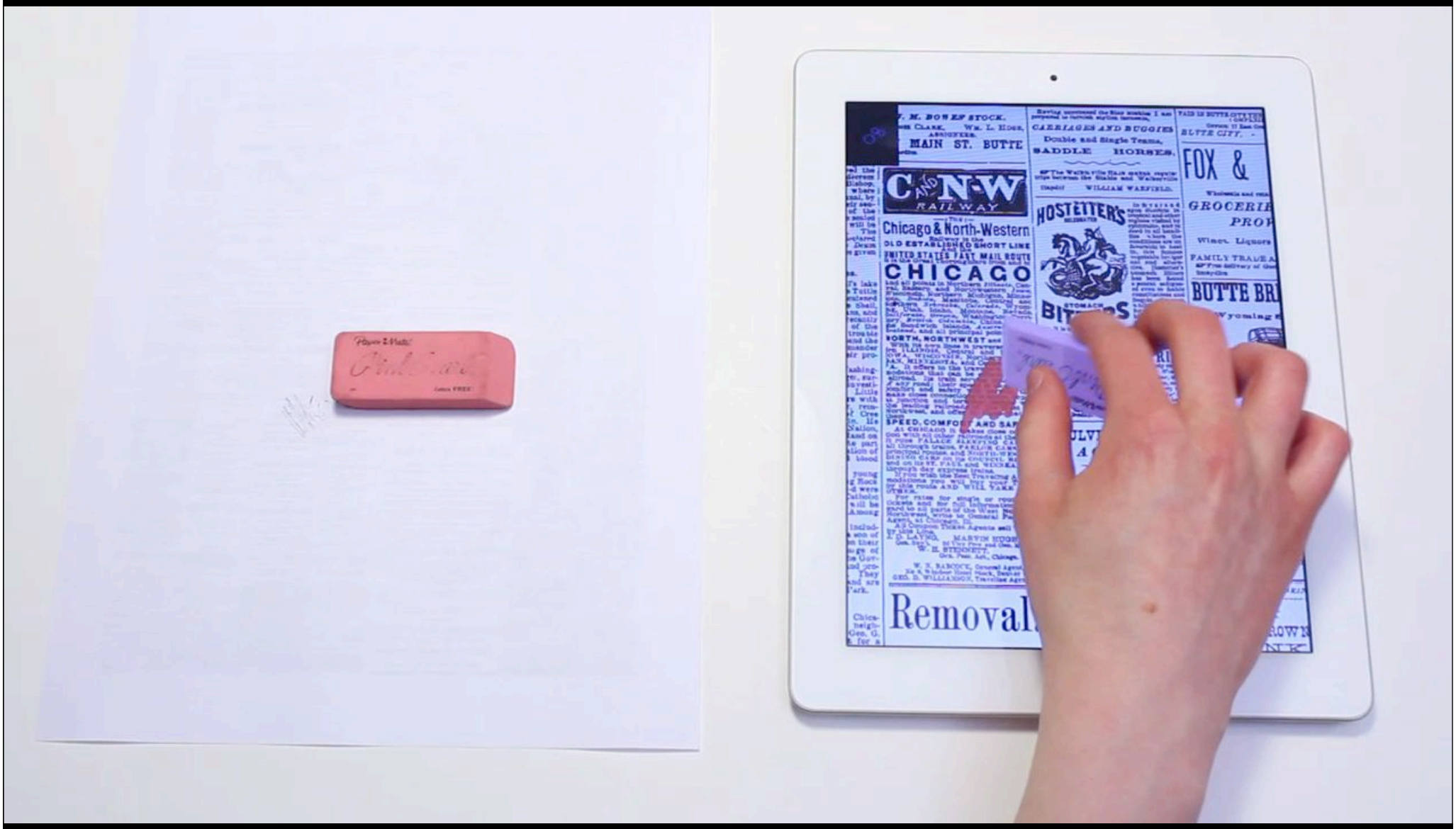
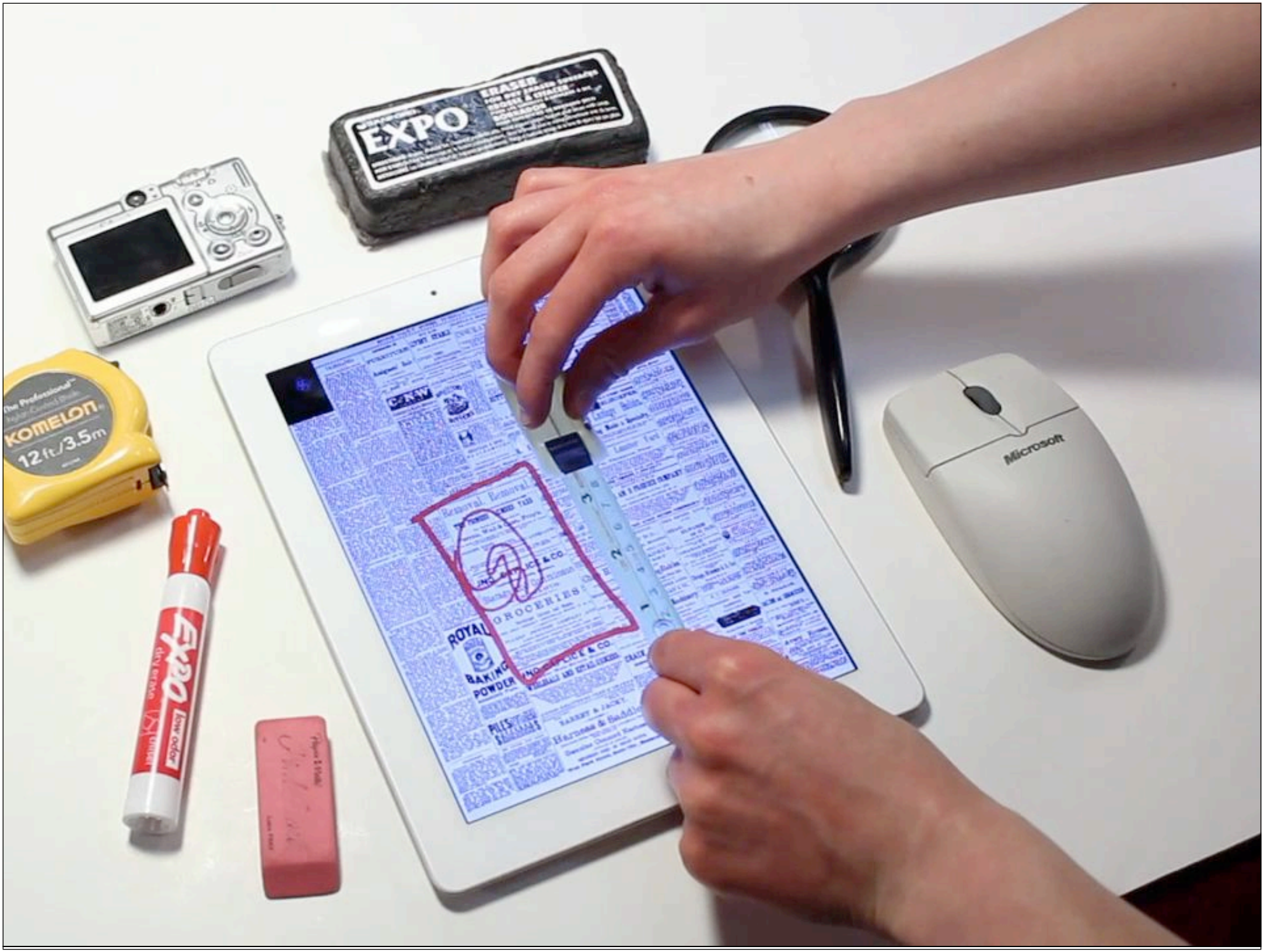
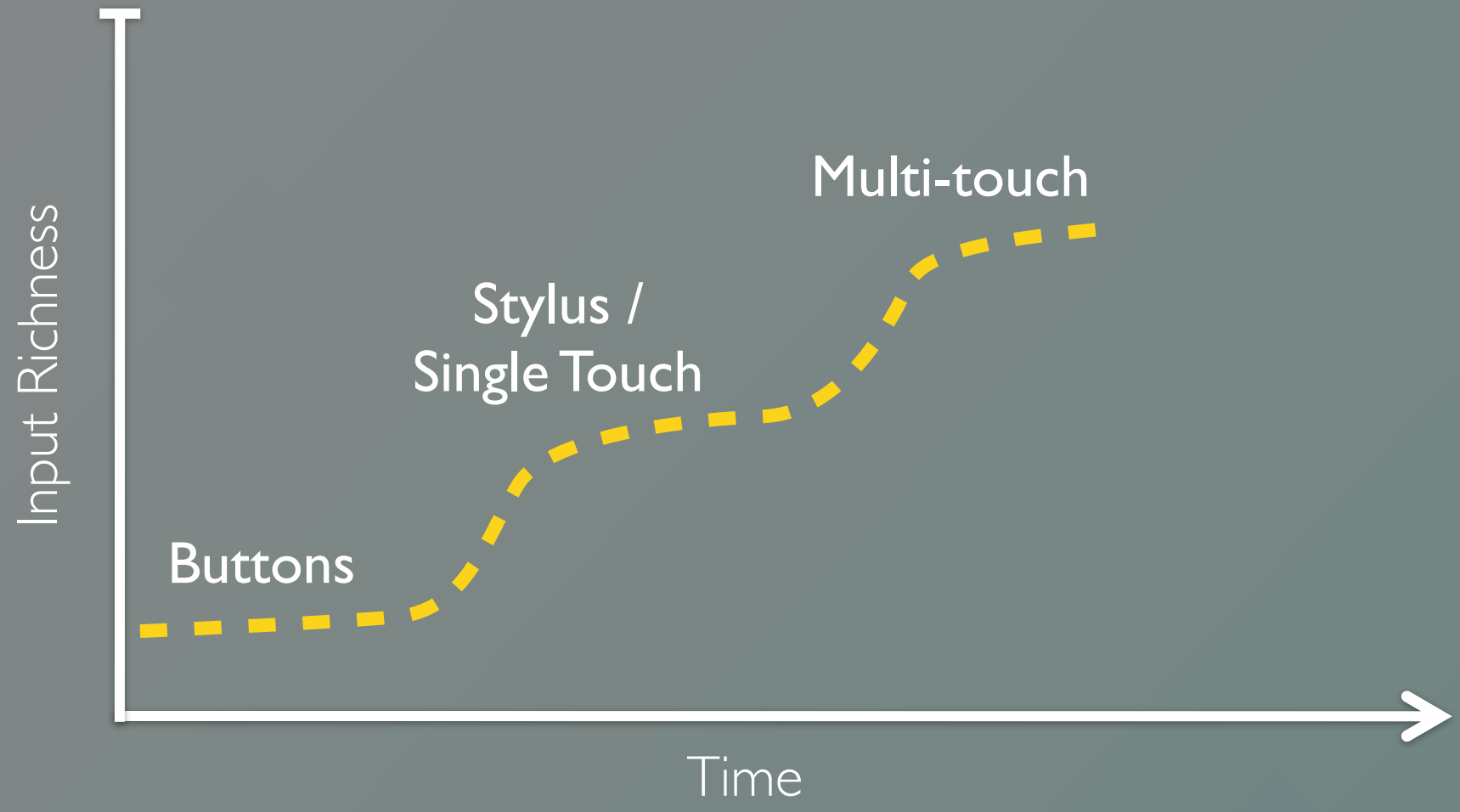

MAIN ST. BUTTE
CARRIAGES AND BUGGIES
Double and Single Teams,
SADDLE HORSES.
C AND N-W RAILWAY
Chicago & North-Western
CHICAGO
HOSTETTER'S
FOX &
BUTTE BR
Removal

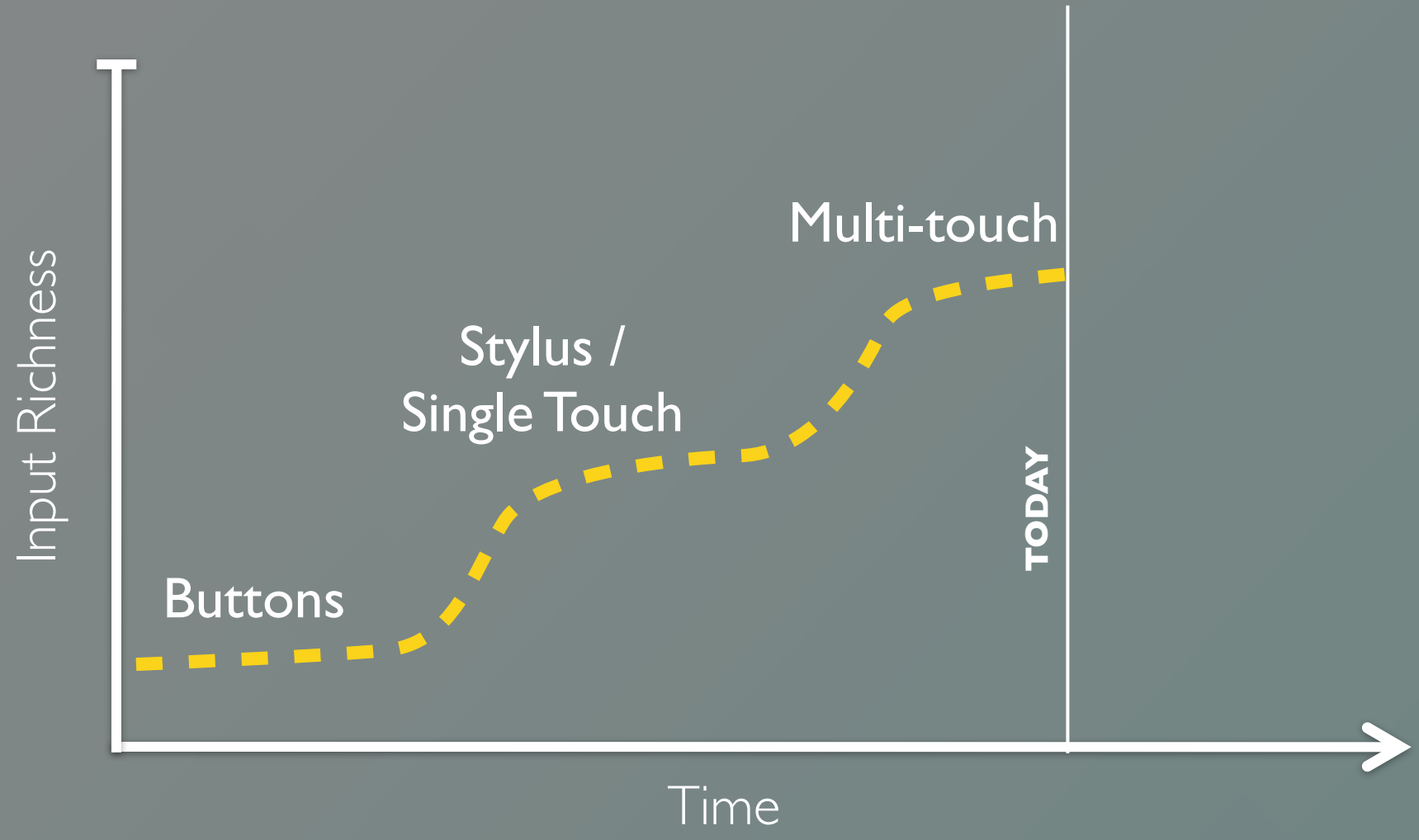

EXPO
ERASER
KOMELON
12 ft./3.5m
Microsoft
GROCERIES
ROYAL
BAKING
POWDER
EXPO
low odor

- Finger chording [Elias '07, Freeman '08, ..]
- Touch type [Paradiso '05, Lopes '11, ..]
- Impact force [Lopes '11, Hinckey '11, ..]
- Shear [Herot '78, Minsky '84, Heo '11, Lee '12, ..]
- Pressure [Ramos '04, Stewart '10, Heo '12, Hwang '13, ..]
- Torque [Heo '11, Hinckey '11, ..]
- Pitch [Wang '09, Roudaut '09, Rogers '10, Holz '10, ..]
- Yaw [Wang '09, Rogers '10, Holz '10, ..]
- Contact area [Benko '06, Wilson 08, Wang '09, Schmidt '10, Holz '10, ..]
- Contact shape [Rekimoto '02, Wu '03, Epps '06, Cao '08, Wilson '08, Wigdor '11]
- Who is touching [Dietz '01, Marquardt '11, Ramakers '12, Holz '13, ..]
- Which finger [Holz '10, Marquardt '11, Kung '12, Ewerling '12, ..]
- Grasp pose [Schmidt '10, Marquardt '11, Ewerling '12, Murugappan '12, ..]
- …

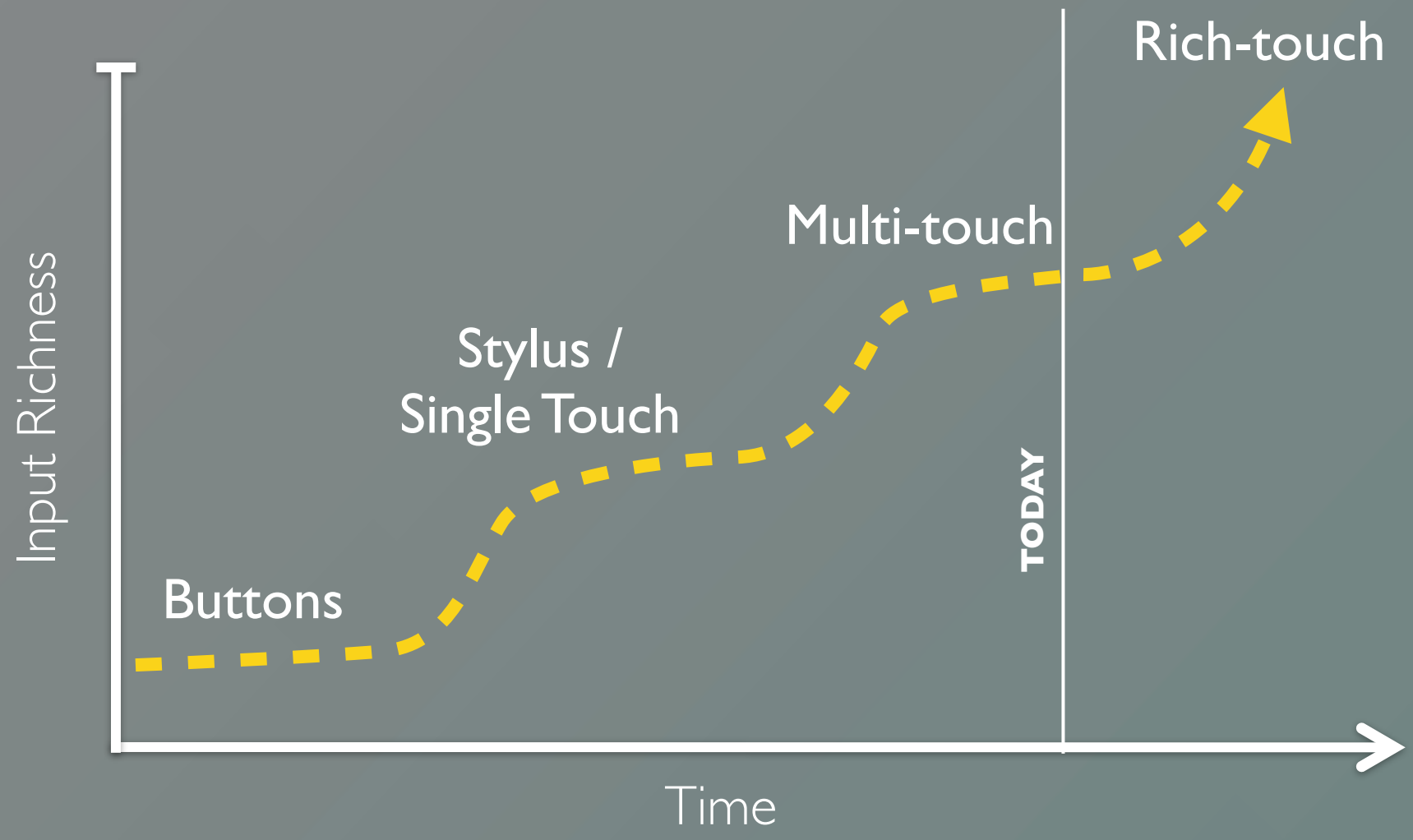
Evolution of Mobile Input



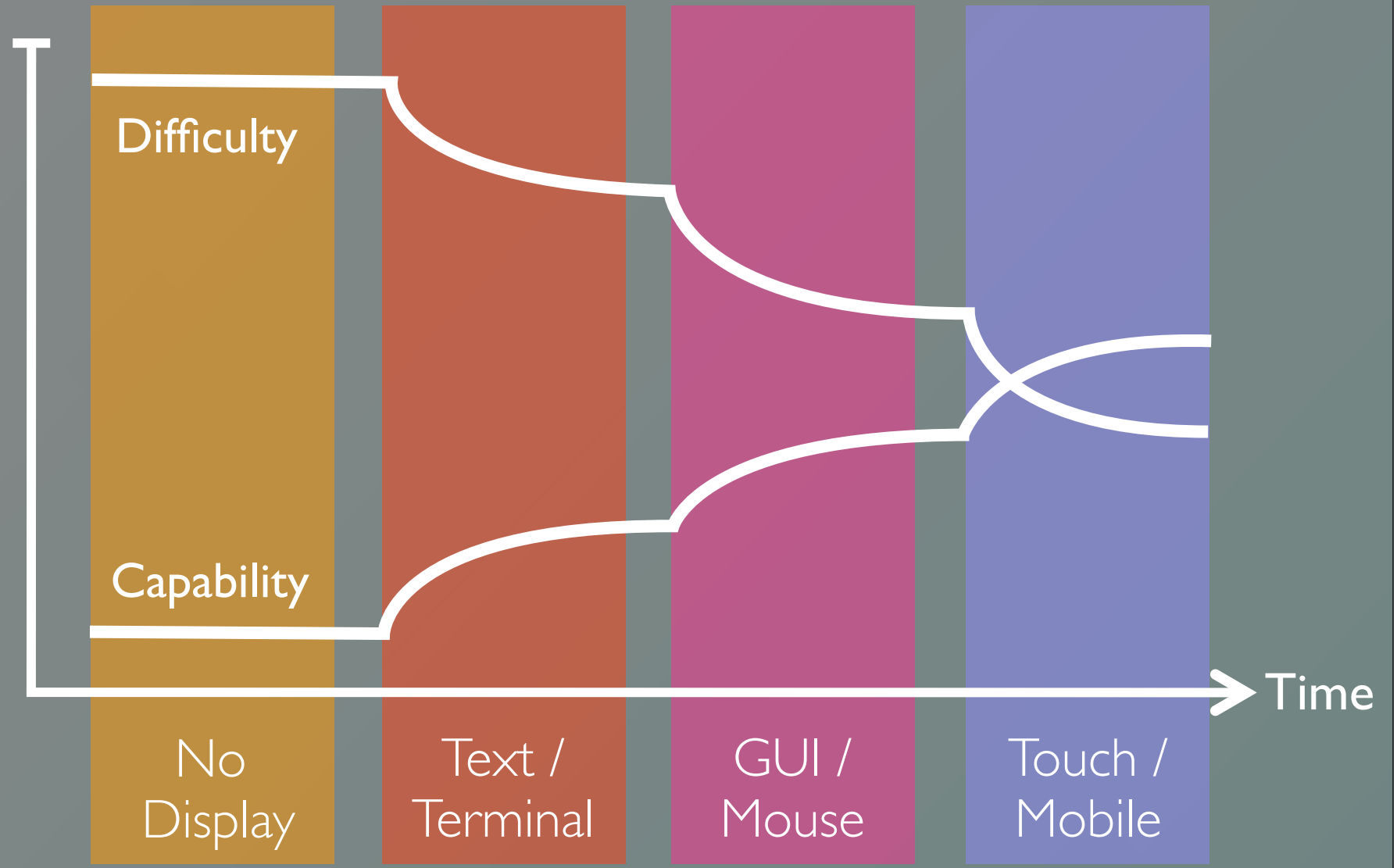
Evolution of Mobile Input



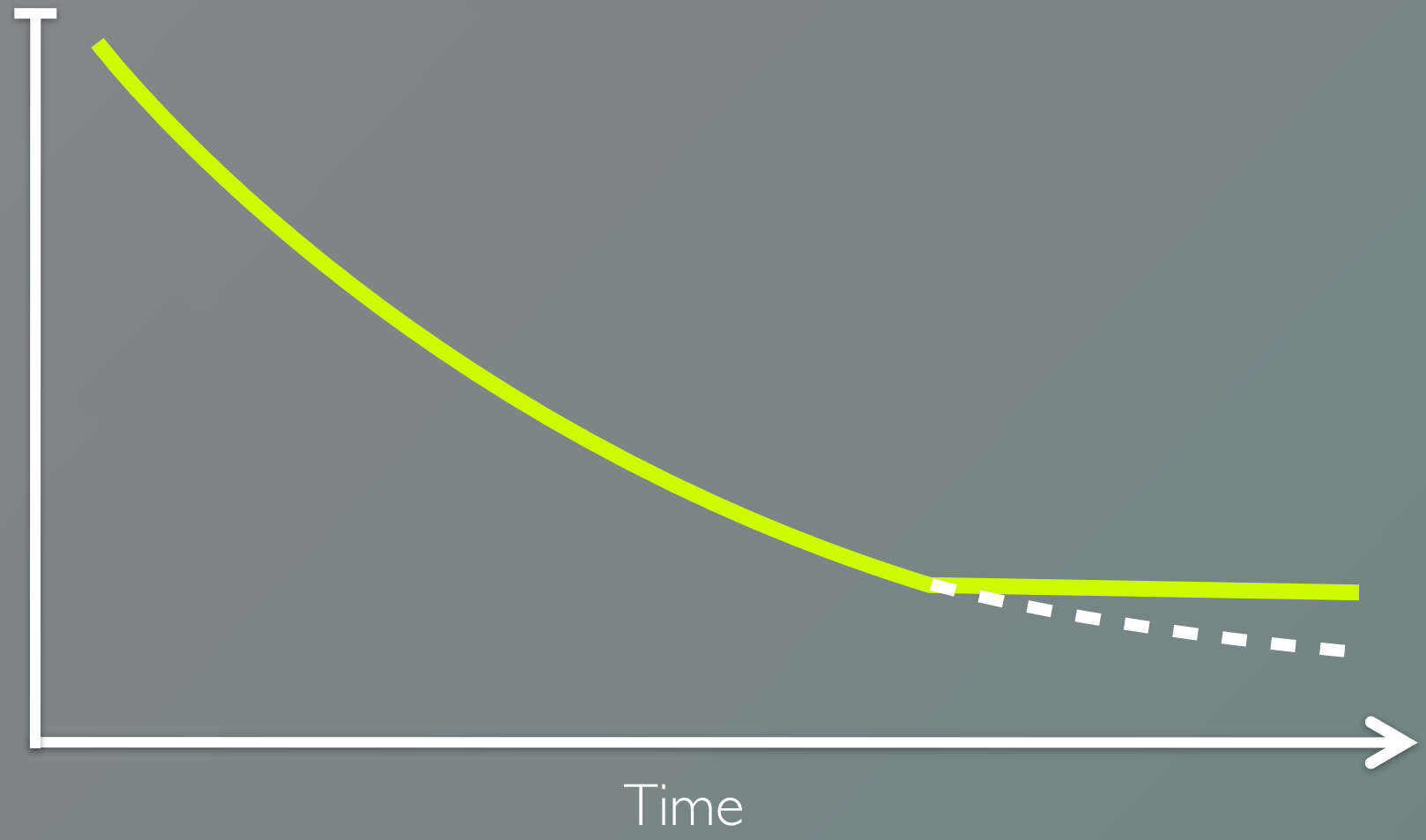
Evolution of Mobile Input



Evolution of Interfaces



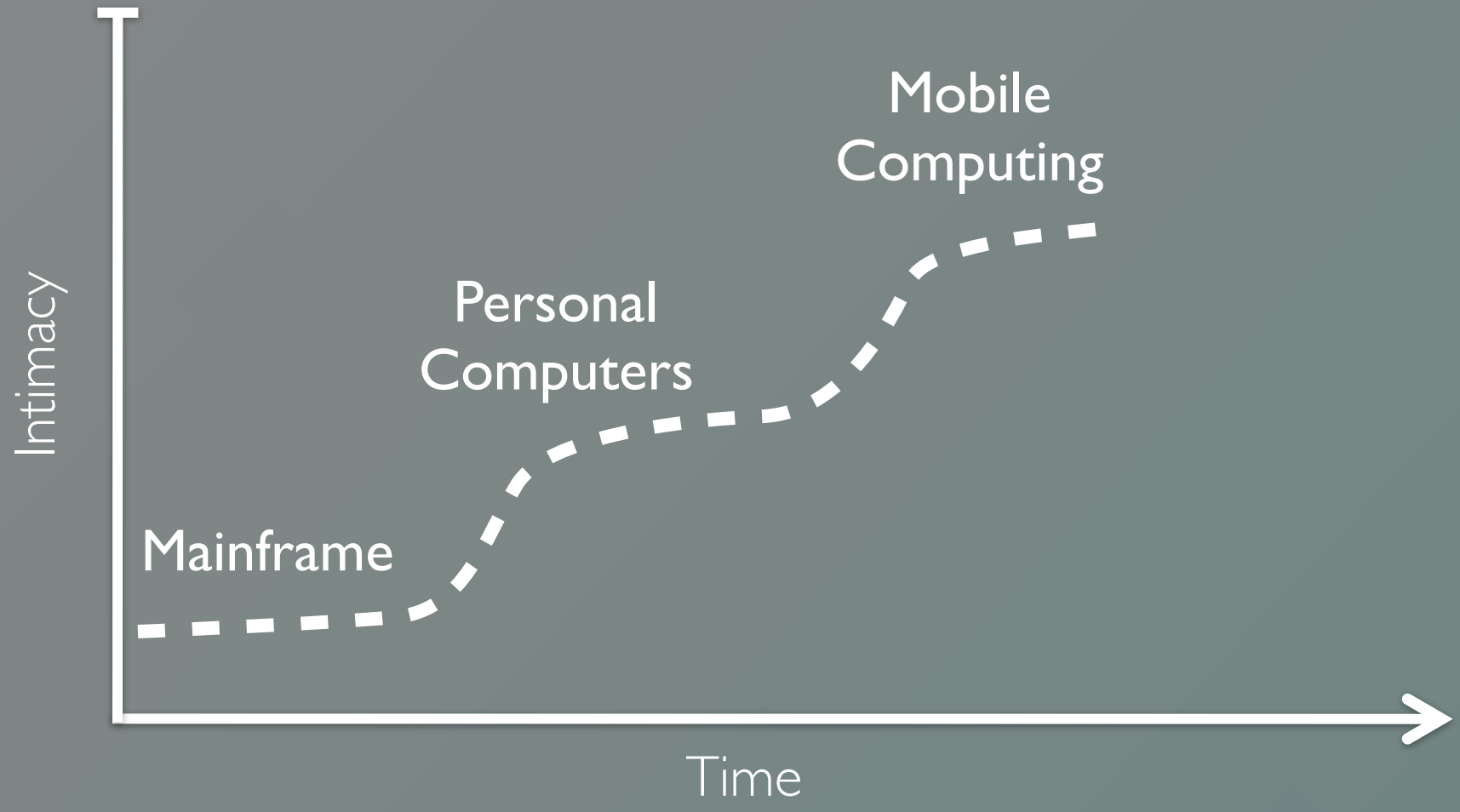
Size of Devices



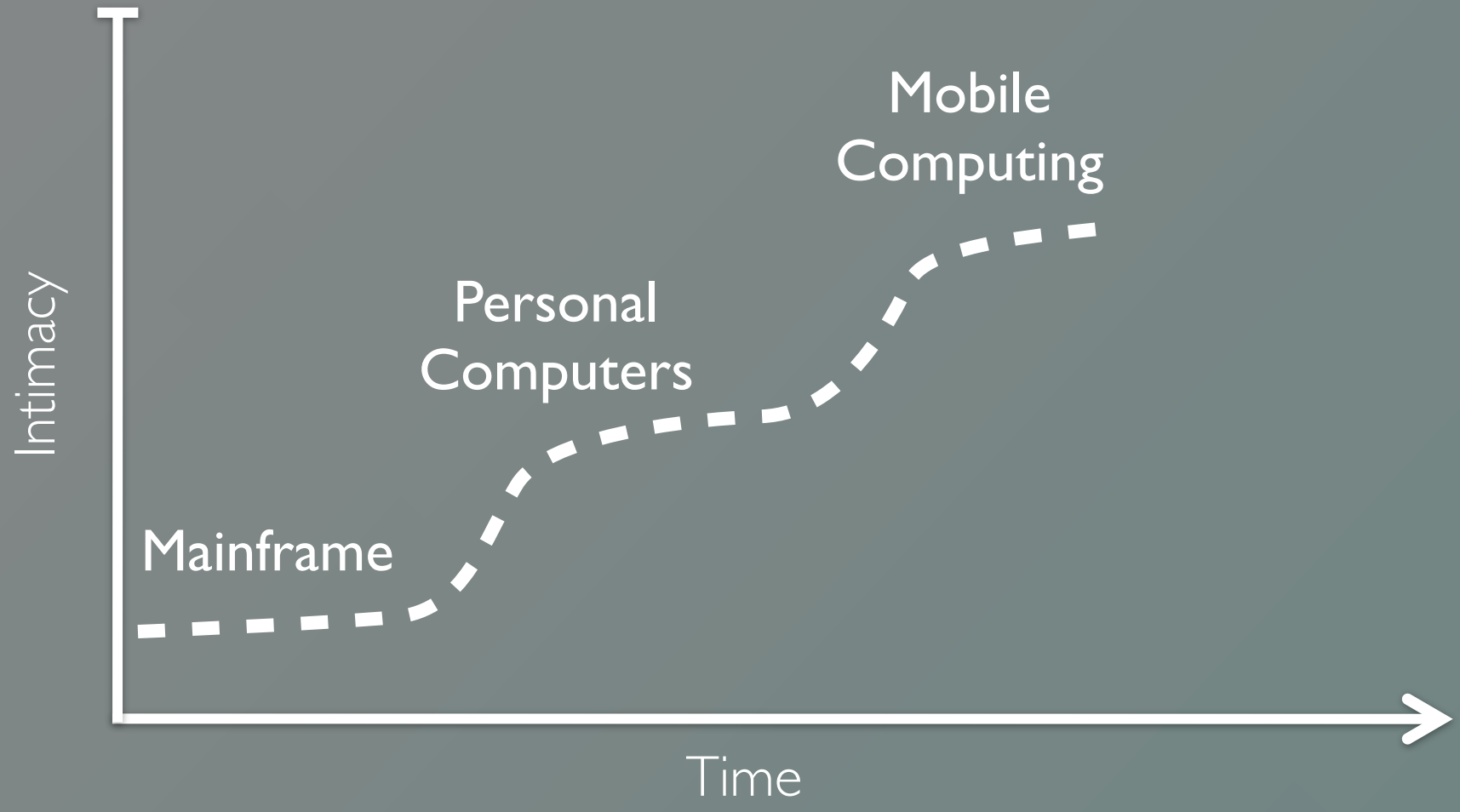
Sony Smartwatch
2013

Computational Intimacy

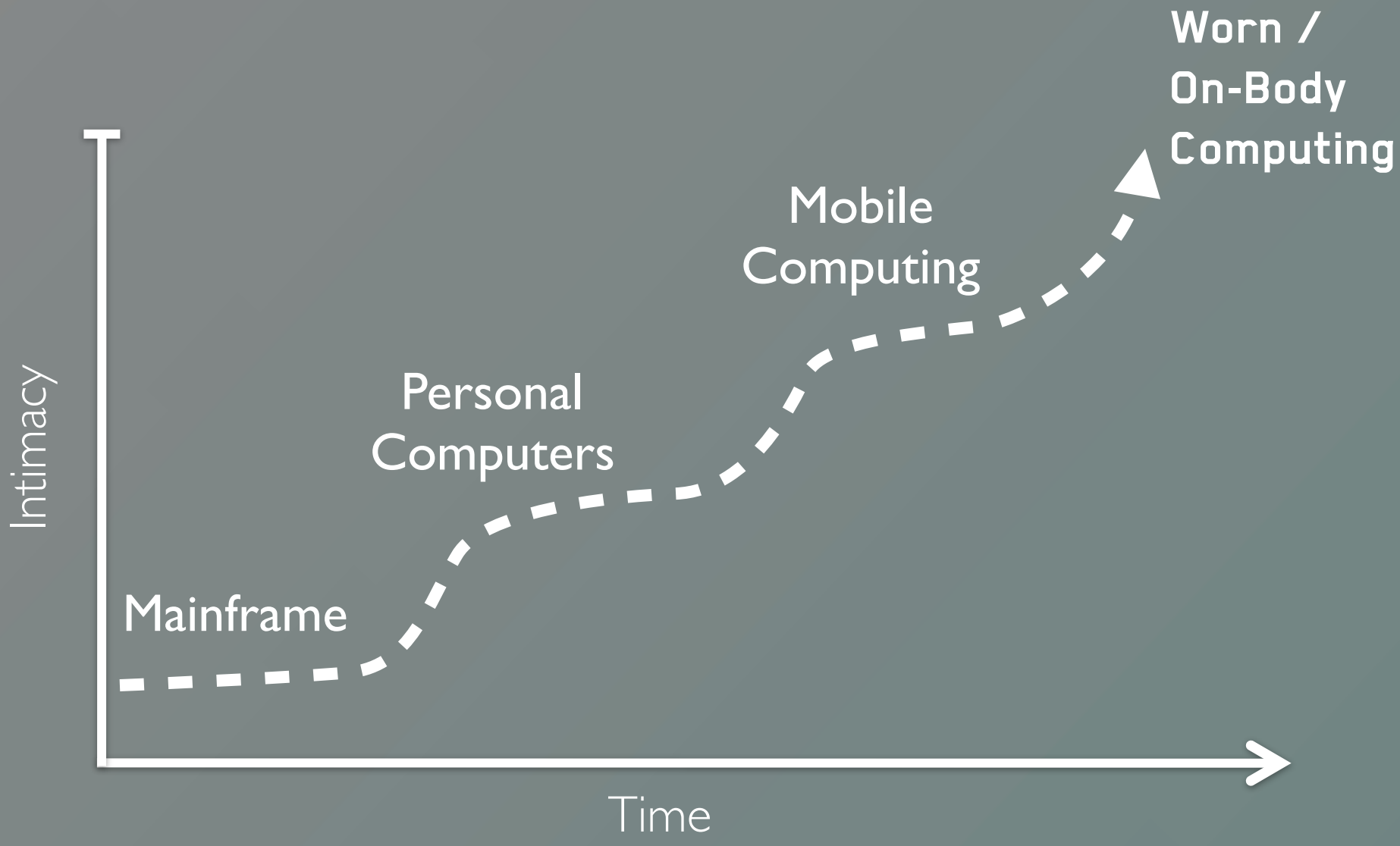
Computational Intimacy



Computational Intimacy



Computational Intimacy



> Next came the whole circus routine of noisy bathroom antics: the twisting of the faucet handles, opening and closing of cabinets and shower doors, putting the toilet seat back where it belongs. There were slippery things to play with: soap, brushes, tubes, and little jars with caps and lids to twist or flip open. If you shaved, there was a razor to steer around the nose and over the chin; if you put on makeup, there were pencils, brushes and tubes to bring color to eyelids, cheeks and lips.
>
> - Frank WIlson ("The Hand")

FUTURE INTERFACES GROUP

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Carnegie Mellon University