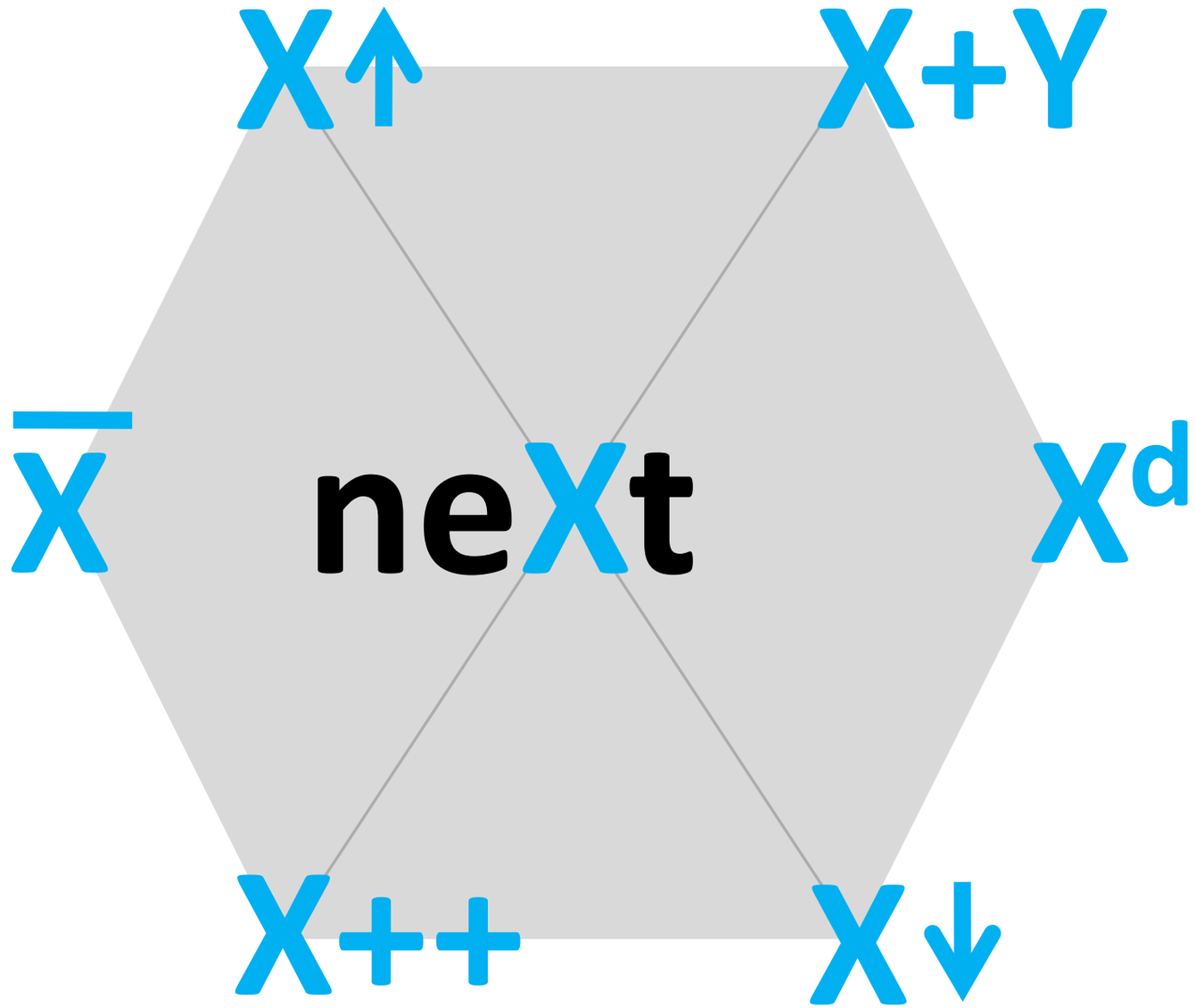

Invention Iterators

6.S063 Engineering Interaction Technologies

Prof. Stefanie Mueller | HCI Engineering Group

how to invent future interactive tech?

how about user centered design?

- interview potential users
- find something that is hard to do or hard to use…
- e.g. via heuristic evaluation (5 experts list usability issues)

we did user-centered design in
6.813 / 6.831 User Interface Design and Implementation

do you think any of the cool stuff
I showed in the last weeks came out of this?

nope.

challenge:

we have it pretty good already.
the current world offers most
of what the current world needs

going with **immediate needs -> small steps**

Usability Evaluation Considered Harmful (Some of the Time)

Saul Greenberg
Department of Computer Science
University of Calgary
Calgary, Alberta, T2N 1N4, Canada
saul.greenberg@ucalgary.ca

Bill Buxton
Principle Researcher
Microsoft Research
Redmond, WA, USA
bibuxton@microsoft.com

ABSTRACT
Current practice in Human Computer Interaction as encouraged by educational institutes, academic review processes, and institutions with usability groups advocate usability evaluation as a critical part of every design process. This is for good reason: usability evaluation has a significant role to play when conditions warrant it. Yet evaluation can be ineffective and even harmful if naively done 'by rule' rather than 'by thought'. If done during early stage design, it can mute creative ideas that do not conform to current interface norms. If done to test radical innovations, the many interface issues that would likely arise from an immature technology can quash what could have been an inspired vision. If done to validate an academic prototype, it may incorrectly suggest a design's scientific worthiness rather than offer a meaningful critique of how it would be adopted and used in everyday practice. If done without regard to how cultures adopt technology over time, then today's reluctant reactions by users will forestall tomorrow's eager acceptance. The choice of evaluation methodology – if any – must arise from and be appropriate for the actual problem or research question under consideration.

Author Keywords

INTRODUCTION
Usability evaluation is one of the major cornerstones of user interface design. This is for good reason. As Dix et al., remind us, such evaluation helps us "assess our designs and test our systems to ensure that they actually behave as we expect and meet the requirements of the user" [7]. This is typically done by using an evaluation method to measure or predict how effective, efficient and/or satisfied people would be when using the interface to perform one or more tasks. As commonly practiced, these usability evaluation methods range from laboratory-based user observations, controlled user studies, and/or inspection techniques [7,22,1]. The scope of this paper concerns these methods.

The purpose behind usability evaluation, regardless of the actual method, can vary considerably in different contexts. Within product groups, practitioners typically evaluate products under development for 'usability bugs', where developers are expected to correct the significant problems found (i.e., iterative development). Usability evaluation can also form part of an acceptance test, where human performance while using the system is measured quantitatively to see if it falls within an acceptable criteria (e.g., time to complete a task, error rate, relative satisfaction). Or if the team is considering purchasing one

but if user-centered design won’t work here
how do you do it, how to make **big steps into the future?**

<30sec brainstorming>

but if user-centered design won’t work here
how do you do it, how to make big steps into the future?

anticipate the future using **what-if questions**

what-if questions

The Mother of All Demos, presented by Douglas Engelbart (1968)

565,601 views

5K 30 SHARE

first time the world saw:
the mouse, interactive editing, hyperlinks…
-> his **main contribution was not these technologies,** but…

Douglas Engelbart

SRI, Bootstrap Institute
human-computer interaction - interactive computing
No verified email
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Citation indices

	All	Since 2009
Citations	3887	776
h-index	21	12
i10-index	29	12

Citations to my articles

Show: 20 **1-20** Next >

Augmenting human intellect: a conceptual framework (1962)
DC Engelbart
PACKER, Randall and JORDAN, Ken. Multimedia. From Wagner to Virtual Reality ... — 737 — 2001

A research center for augmenting human intellect
DC Engelbart, WK English
Proceedings of the December 9-11, 1968, fall joint computer conference, part ... — 713 — 1968

Conceptual Framework for the Augmentation of Man\'s Intellect
DC Engelbart
Spartan Books — 606 — 1963

The augmented knowledge workshop
DC Engelbart, RW Watson, JC Norton — 231 * — 1973

this question:

‘How can we augment human intellect using computing?’

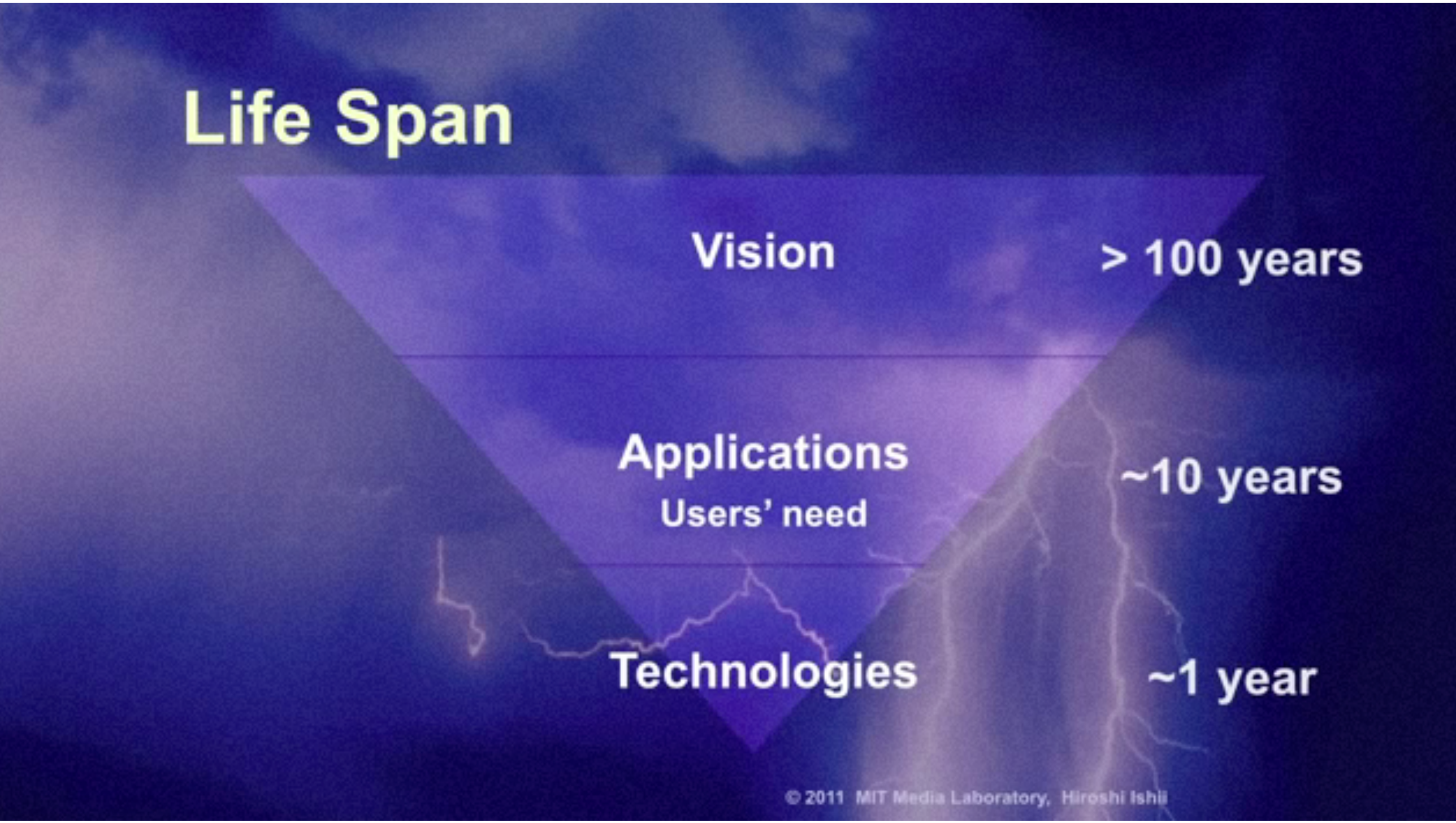
keep in mind
that he asked this at a time when it **sounded absurd:**

this was the time of mainframes & time sharing systems
no one had personal access to a computer;
there were no tools for intellectual workers

(also, he could have been wrong. computer prices could have stayed high; his work would never have become relevant)

Turing Award

		contributions to program and systems verification.
1997	Douglas Engelbart	For an inspiring vision of the future of interactive computing and the invention of key technologies to help realize this vision.
1998	Jim Gray	For seminal contributions to database and transaction processing research and technical leadership in



why **what-if vision questions are more important**
than individual tech contributions

How would you like to be remembered by the people who will live in 2200?

What would you leave for them?

2200

Hiroshi Ishii, Keynote at TEI 2008, Bonn Germany, 18.02.2008

how to **choose** a what-if question?

the visionaries

you

here’s what most people do, don’t do it:

(1) wait for wave

(2) start paddling

you: a visionary

everyone else

better:

(1) look far out, on horizon locate wave, estimate motion

(2) paddle towards extrapolated point

(3) prepare, when it arrives hop on

what-if question

= a wild extrapolation of what we see today

(and maybe there's nothing, but at least you tried to be the first!)

better:

(1) look far out, on horizon locate wave, estimate motion

(2) paddle towards extrapolated point

(3) prepare, when it arrives hop on

some more selected **what-if questions…**

ubiquitous computing (1991):

what if a user had multiple computers/CPUs available?

The Computer for the 21st Century

Mark Weiser 1991

The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.

Consider writing, perhaps the first information technology: The ability to capture a symbolic representation of spoken language for long-term storage freed information from the limits of individual memory. Today this technology is ubiquitous in industrialized countries. Not only do books, magazines and newspapers convey written information, but so do street signs, billboards, shop signs and even graffiti. Candy wrappers are covered in writing. The constant background presence of these products of "literacy technology" does not require active attention, but the information to be conveyed is ready for use at a glance. It is difficult to imagine modern life otherwise.

Silicon-based information technology, in contrast, is far from having become part of the environment. More than 50 million personal computers have been sold, and nonetheless the computer remains largely in a world of its own. It is approachable only through complex jargon that has nothing to do with the tasks for which which people actually use computers. The state of the art is perhaps analogous to the period when scribes had to know as much about making ink or baking clay as they did about writing.

size, price

number

1960’s

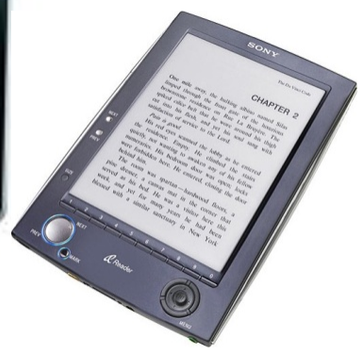
1 computer : n users

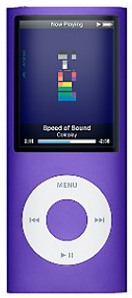
1980’s

1 computer :: 1 user

2000’s

n computers :: 1 user





ubiquitous computing: the obvious answer

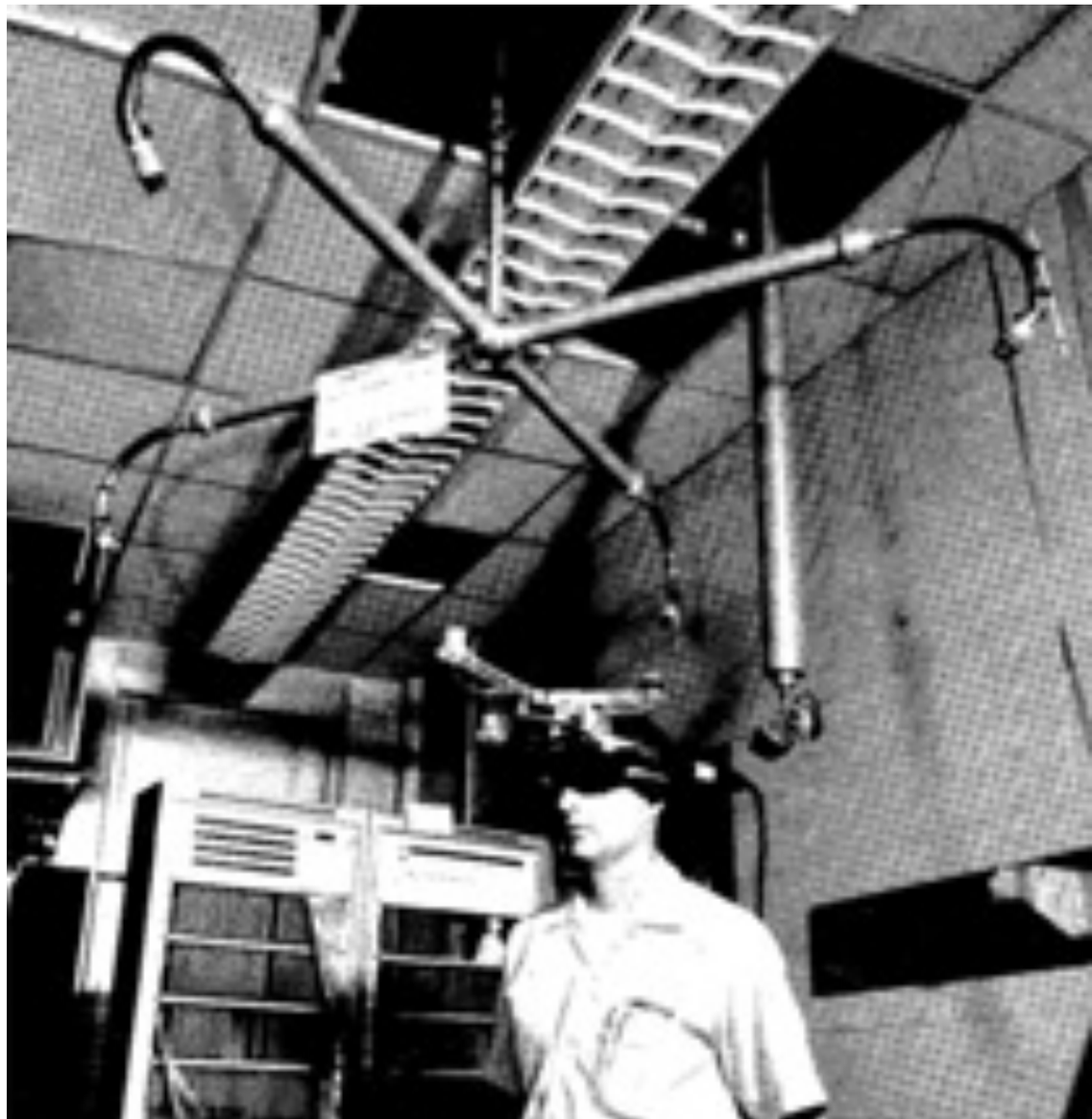
ubiquitous computing: the **less obvious answer..**

99 micro-controllers in a 2003 BMW

ubiquitous computing: computers start to disappear

augmented reality (1968):

what if there was the perfect display everywhere I look



tangible computing (1997):

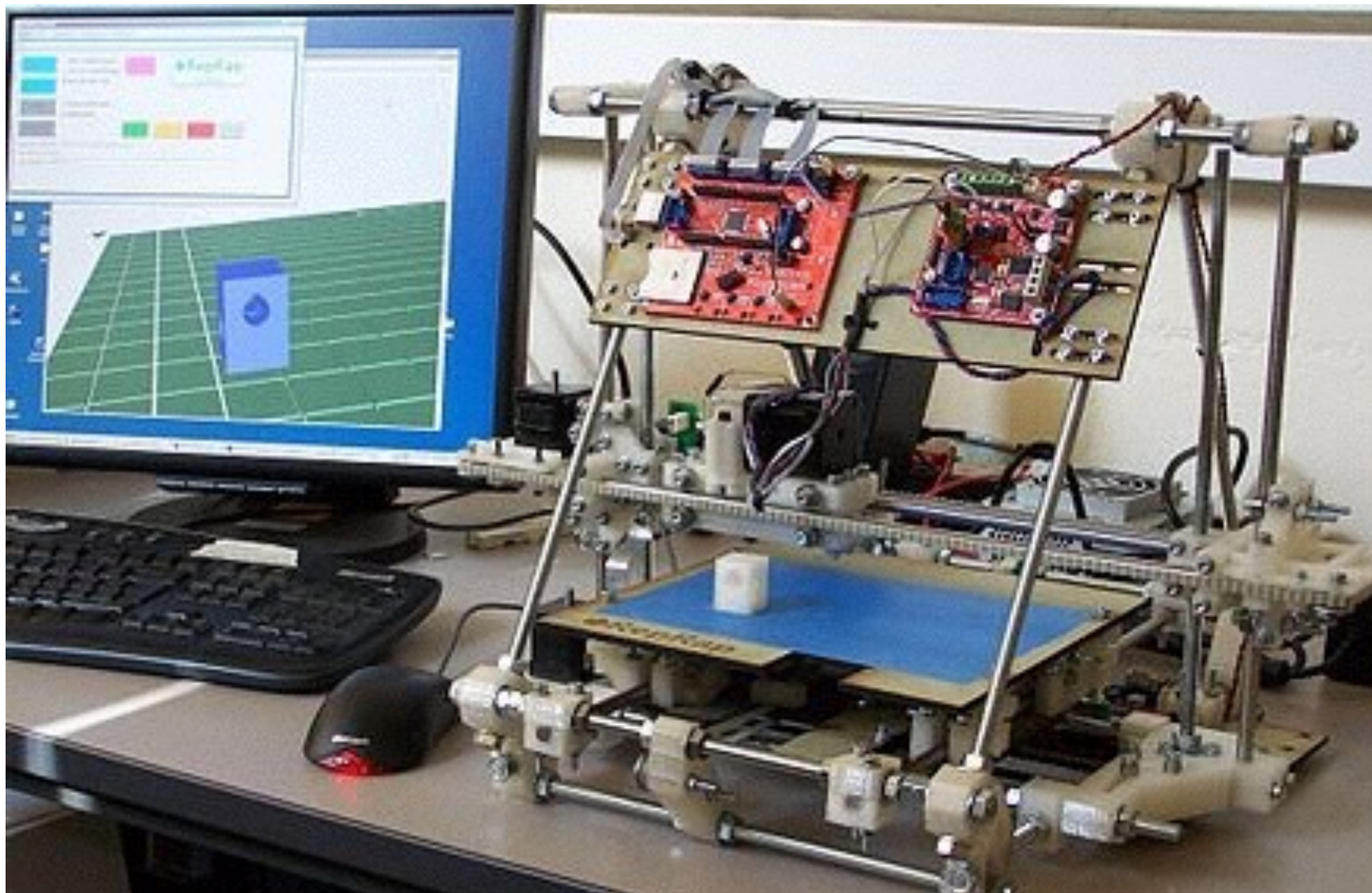
what if I operated stuff in the world not via a computer,
but by actually **manipulating it?**

natural user interfaces (1985):

what if we could **process camera images**
at interactive rates

personal fabrication (2005):

what if **fabrication machinery is available**
in every office and/or every household?



wearable (1961):

what if **technology shrank past mobile?**

brain-computer interfaces (1961):

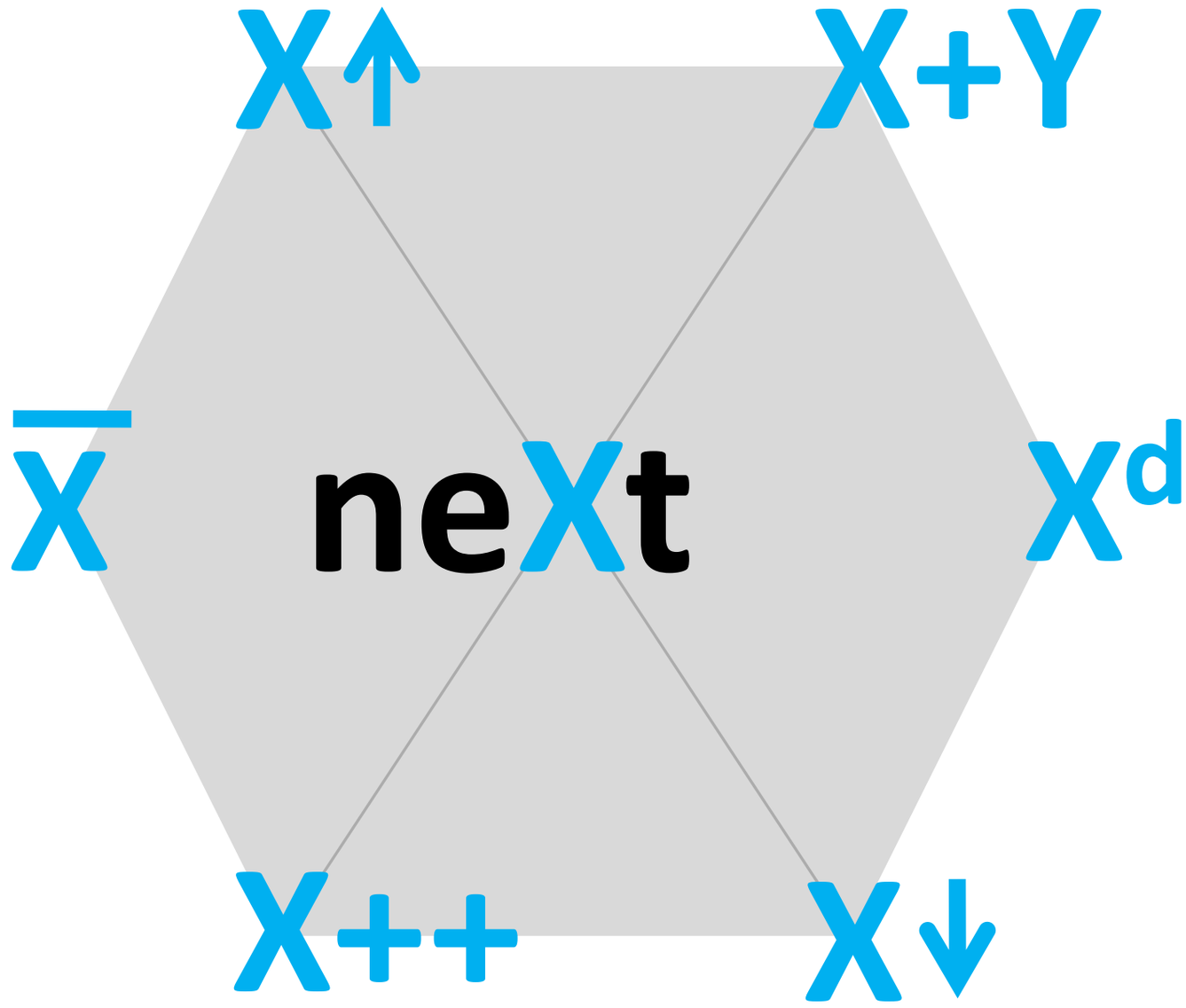
what if computers could read (and write) thoughts?

looking back through the history of HCI,
we see that **quantum leaps have rarely resulted from studies on user needs or market research;**

they have come from people
asking **visionary what-if questions!**

another way to extrapolate into the future is to use **invention iterators…**

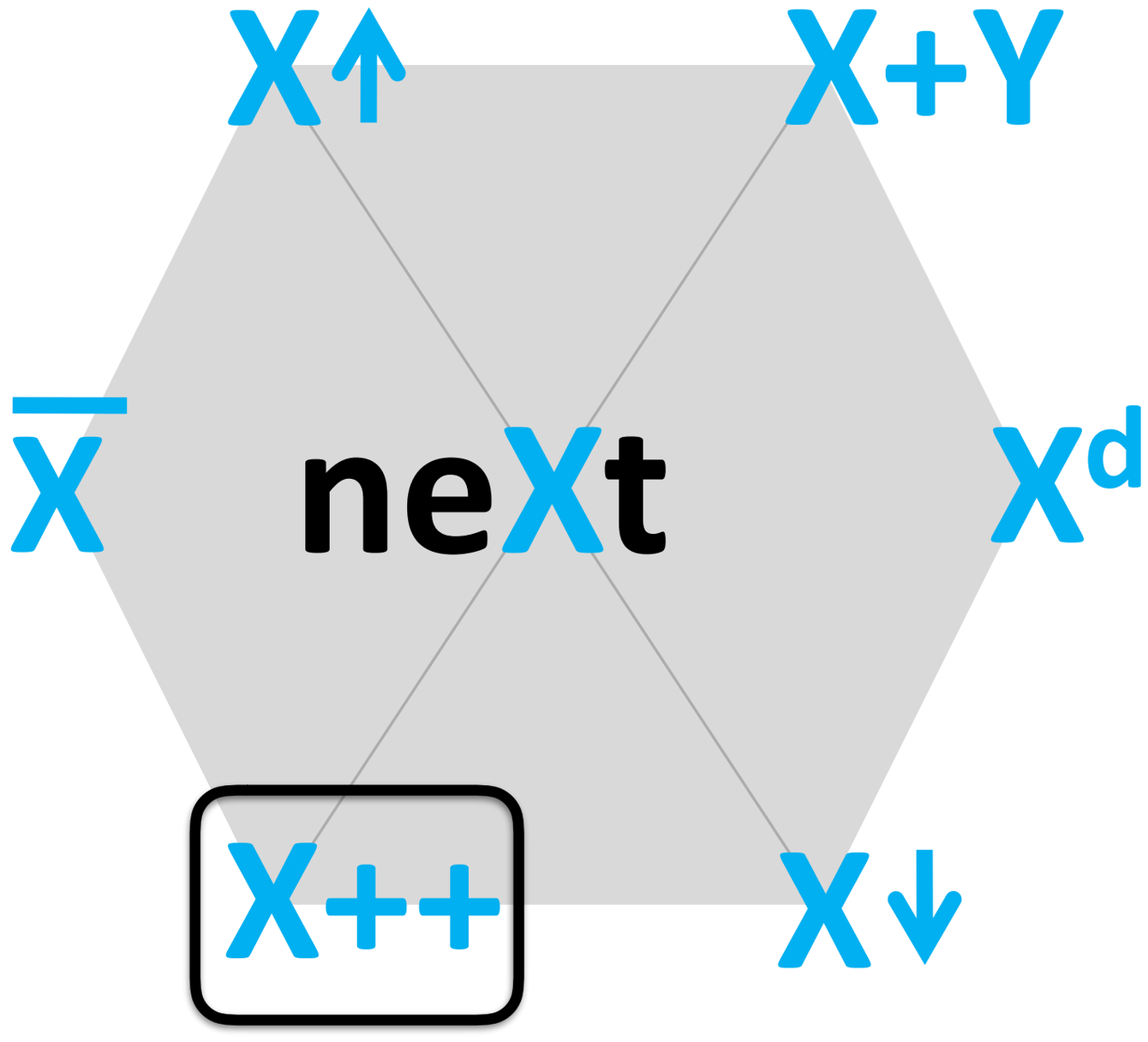
after X, what is neXt?



[Ramesh Raskar]

X =

idea you just heard
concept
patent
new product
product feature
design
art
algorithm


X↑
X+Y
X̄
neXt
Xd
X++
X↓

X++

increment

(make it faster, better, cheaper)

the first iPhone was a huge leap forward…
everything else is mainly **incremental**

								
	iPhone	**iPhone 3G**	**iPhone 3GS**	**iPhone 4**	**iPhone 4S**	**iPhone 5**	**iPhone 5c**	**iPhone 5s**
Code Name	M68	N82	N88	N90	N94	N41	N48	N51
Model Name	iPhone 1,1	iPhone 1,2	iPhone 2,1	iPhone 3,1	iPhone 4,1	iPhone 5,1	iPhone 5,3	iPhone 6,1
OS	iPhone OS 1.0	iPhone OS 2.0	iPhone OS 3.0	iOS 4	iOS 5	iOS 6	iOS 7	iOS 7
Screen Size	3.5-inch 480x320 at 163ppi	3.5-inch 480x320 at 163ppi	3.5-inch 480x320 at 163ppi	3.5-inch IPS 960x640 at 326ppi	3.5-inch IPS 960x640 at 326ppi	4-inch 1136x640 in-cell IPS LCD at 326ppi	4-inch 1136x640 in-cell IPS LCD at 326ppi	4-inch 1136x640 in-cell IPS LCD at 326ppi
System-on-chip	Samsung S5L8900	Samsung S5L8900	Samsung APL0298C05	Apple A4	Apple A5	Apple A6	Apple A6	64-bit Apple A7, M7 motion c-processor
CPU	ARM 1176JZ(F)-S	ARM 1176JZ(F)-S	600MHz ARM Cortex A8	800MHz ARM Cortex A8	800MHz dual-core ARM Cortex A9	1.3GHz dual-core Swift (ARM v7s)	1.3GHz dual-core Swift (ARM v7s)	1.3GHz dual-core Cyclone (ARM v8)
GPU	Power VR MBX Lite 3D	Power VR MBX Lite 3D	PowerVR SGX535	PowerVR SGX535	PowerVR dual-core SGX543MP4	PowerVR triple-core SGX543MP3	PowerVR triple-core SGX543MP3	PowerVR G6430
RAM	128MB	128MB	256MB	512MB	512MB	1GB	1GB	1GB DDR3
Storage	4GB/8GB (16GB later)	8GB/16GB	16GB/32GB	16GB/32GB	16GB/32GB/64GB	16GB/32GB/64GB	16GB/32GB	16GB/32GB/64GB
Top Data Speed	EDGE	3G 3.6	HSPA 7.2	HSPA 7.2	HSPA 14.4	LTE/DC-HSPA	LTE/DC-HSPA	LTE/DC-HSPA
SIM	Mini	Mini	Mini	Micro	Micro	Nano	Nano	Nano
Rear Camera	2MP	2MP	3MP/480p	5MP/720p, f2.8, 1.75μ	8MP/1080p, f2.4, BSI, 1.4μ	8MP/1080p, f2.4, BSI, 1.4μ	8MP/1080p, f2.4, BSI, 1.4μ	8MP/1080p, f2.2, BSI, 1.5μ
Front Camera	None	None	None	VGA	VGA	1.2MP/720p, BSI	1.2MP/720p, BSI	1.2MP/720p, BSI
Bluetooth	Bluetooth 2.0 + EDR	Bluetooth 2.0 + EDR	Bluetooth 2.1 + EDR	Bluetooth 2.1 + EDR	Bluetooth 4.0	Bluetooth 4.0	Bluetooth 4.0	Bluetooth 4.0
WiFi	802.11 b/g	802.11 b/g	802.11 b/g	802.11 b/g/n (2.4GHz)	802.11 b/g/n (2.4GHz)	802.11 b/g/n (2.4 and 5GHz)	802.11 b/g/n (2.4 and 5GHz)	802.11 b/g/n (2.4 and 5GHz)
GPS	None	aGPS	aGPS	aGPS	aGPS, GLONASS	aGPS, GLONASS	aGPS, GLONASS	aGPS, GLONASS
Sensors	Light, accelerometer, proximity	Light, accelerometer, proximity	Light, accelerometer, proximity, compass	Light, accelerometer, proximity, compass, gyroscope	Light, accelerometer, proximity, compass, gyroscope, infrared	Light, accelerometer, proximity, compass, gyroscope, infrared	Light, accelerometer, proximity, compass, gyroscope, infrared	Light, accelerometer, proximity, compass, gyroscope, infrared, fingerprint identity

screen size becomes a bit bigger..
camera resolution becomes a bit higher…
harddrive can store a bit more data…

better
= pick your favorite adjective:

- more context aware
- more adaptive
- more (temporally) coherent,
- more progressive
- more efficient
- more parallelized
- more distributed
- more personalized/customized
- more democratized

least innovative

X++ is a sign that the **field or tech is “maturing”**

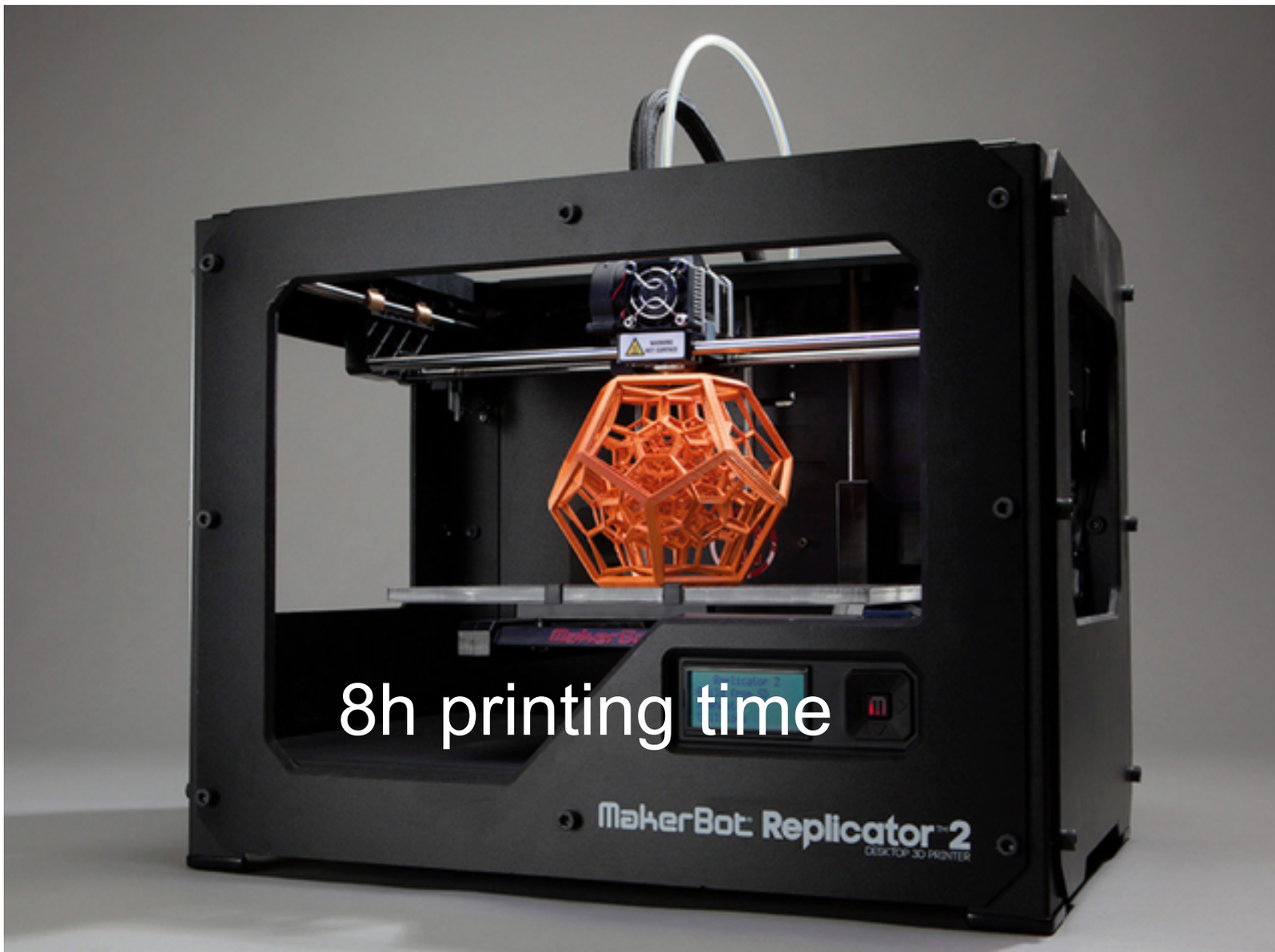
increments get smaller, less ground-breaking

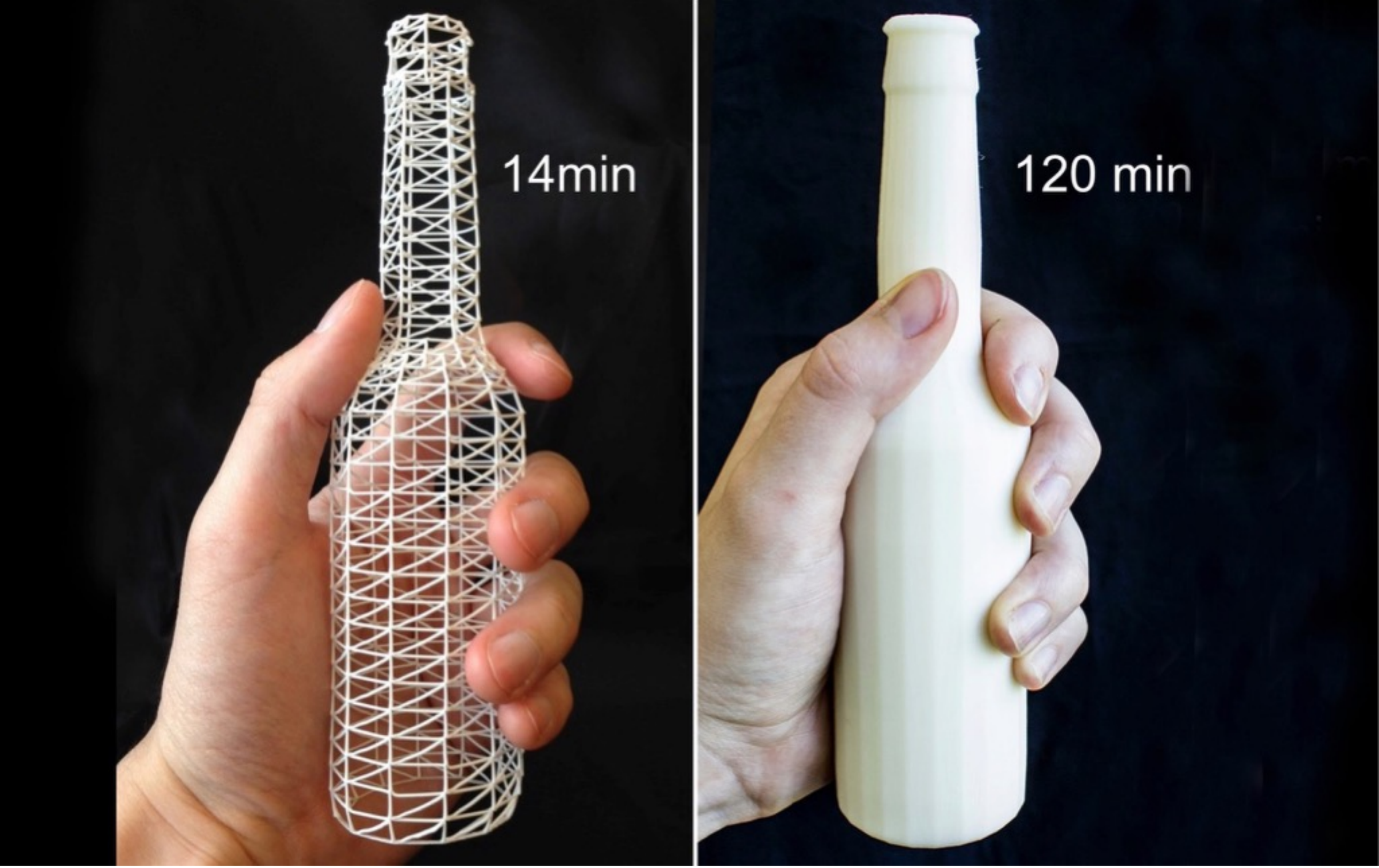
given a nail

find all the hammers

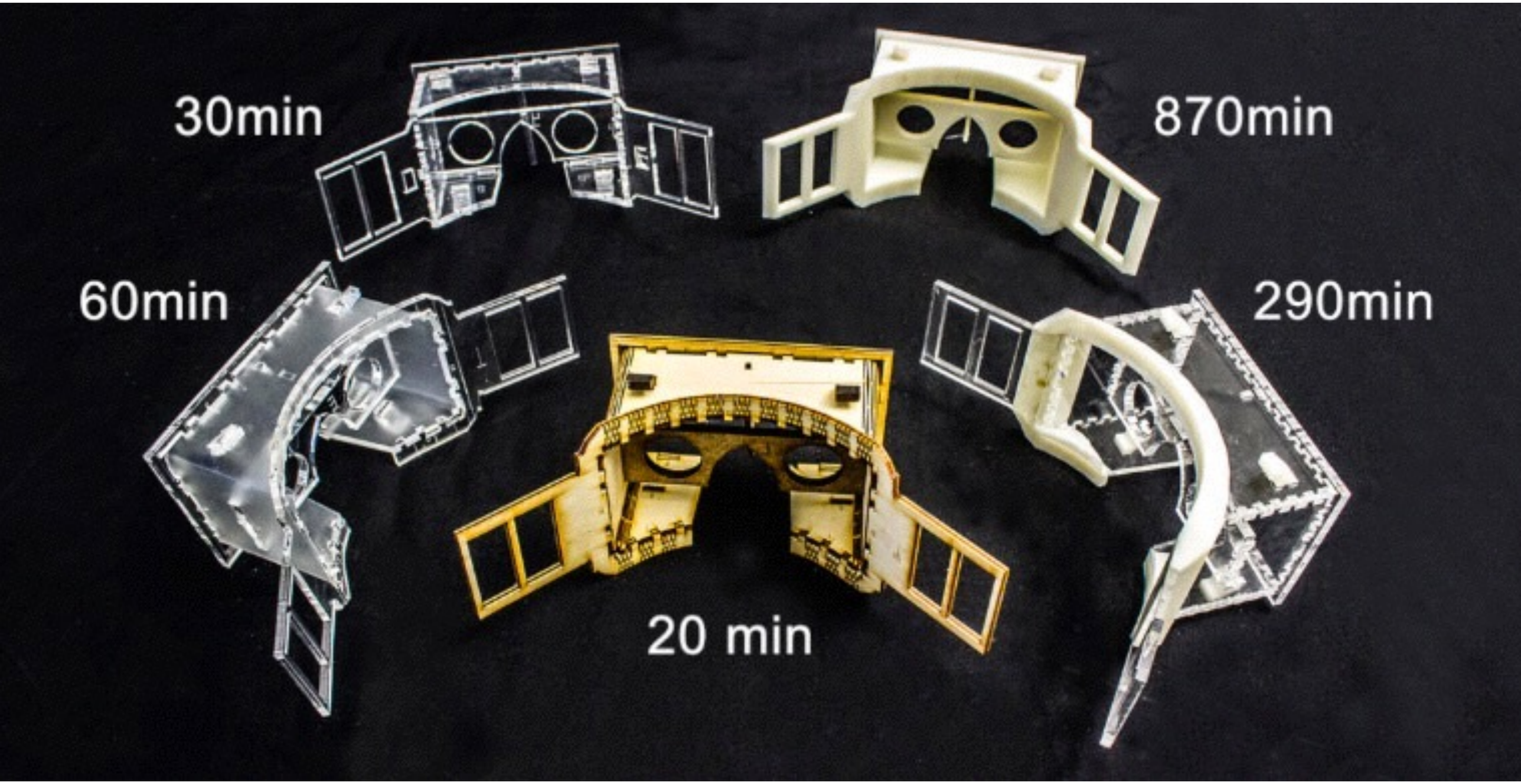
given a problem,
find all solutions…

e.g. 3D Printing is so slow

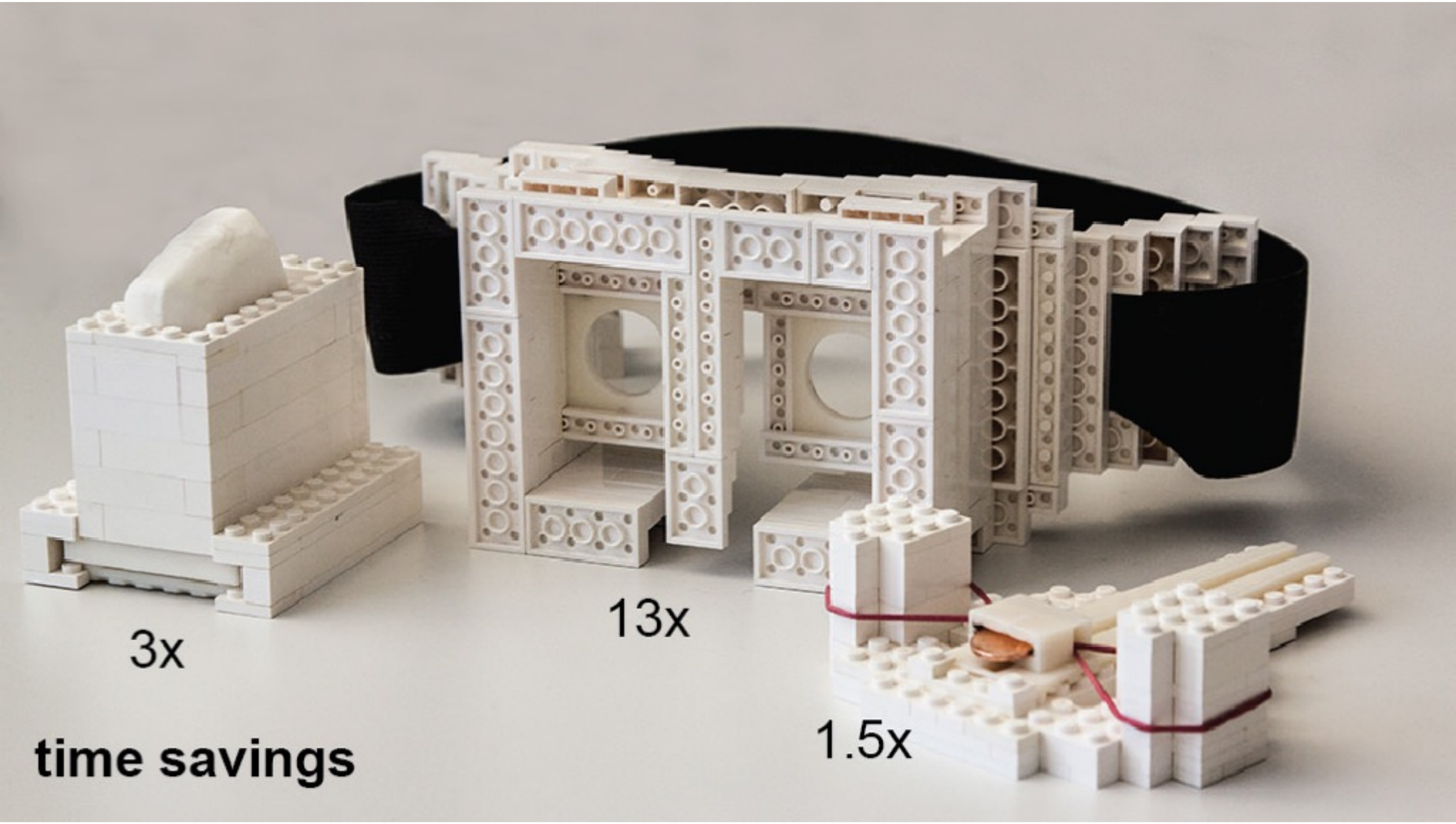




solution 1: print as wireframes



solution 2: convert to laser cut plates



solution 3: combine with existing building blocks

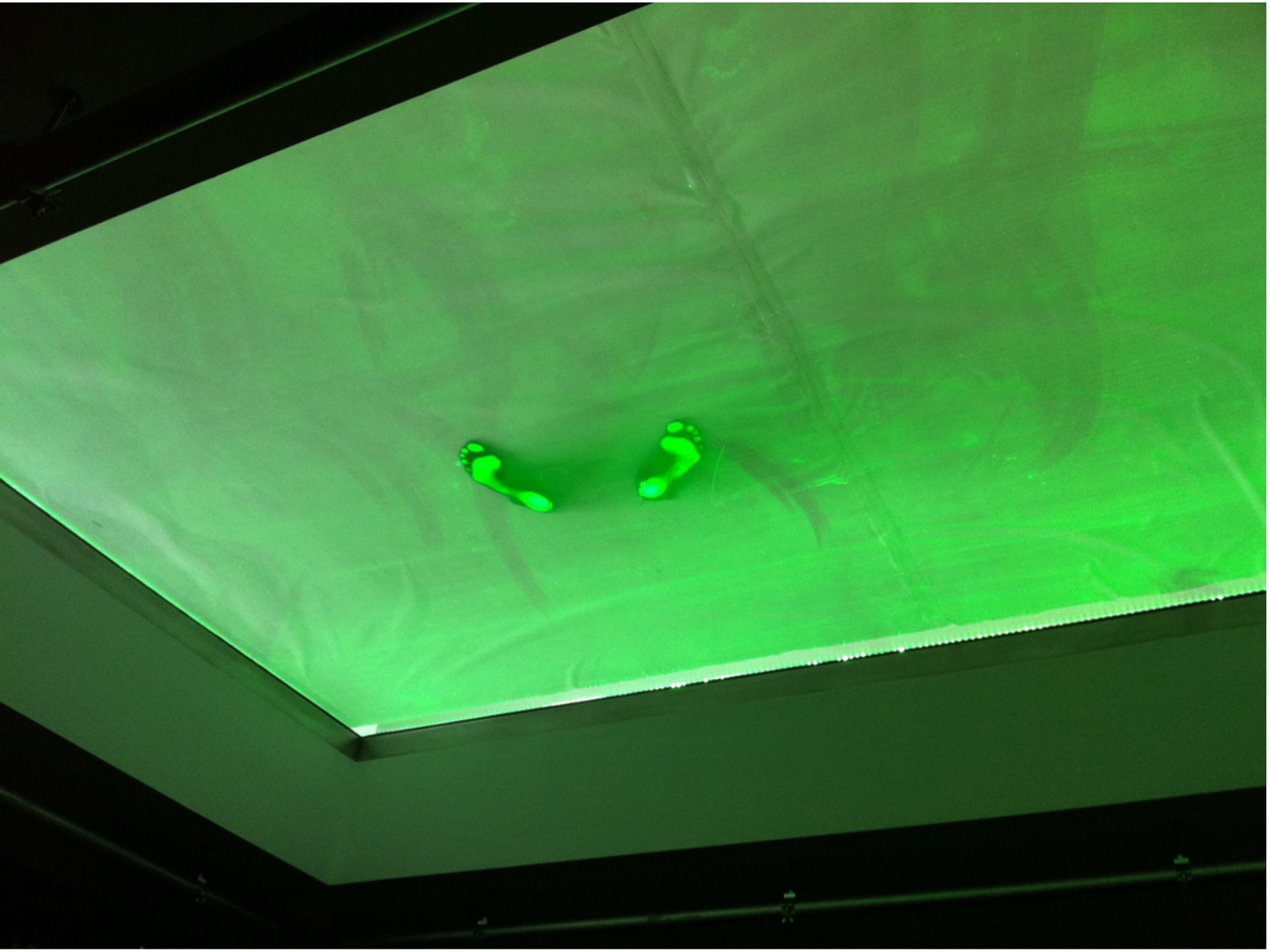
low in innovation power
— dance around the same problem

given a hammer

find all the nails

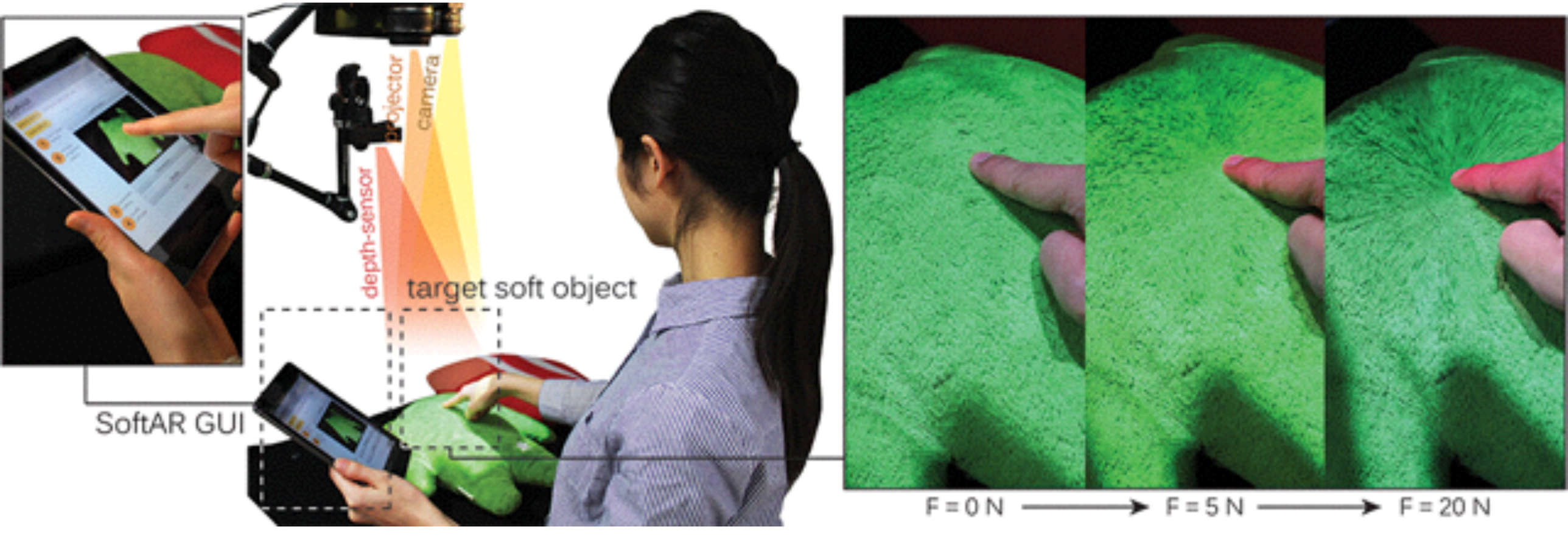
given a cool solution find other problems

-> high inventive power



multitouch:

for hands -> multitouch for feet



perception research:
applied to haptics, applied to eating habits

look back at your career
what could be **your hammer?**

<something you know a lot about but others know little>

<30sec brainstorming>

Xd

extend it
to the next dimension

flickr -> youtube
text, audio (speech), image, video -> physical objects

visible images -> infrared
sound -> ultrasound -> electromagnetic spectrum

macro scale -> micro scale
airbag for car -> airbag for .. ?

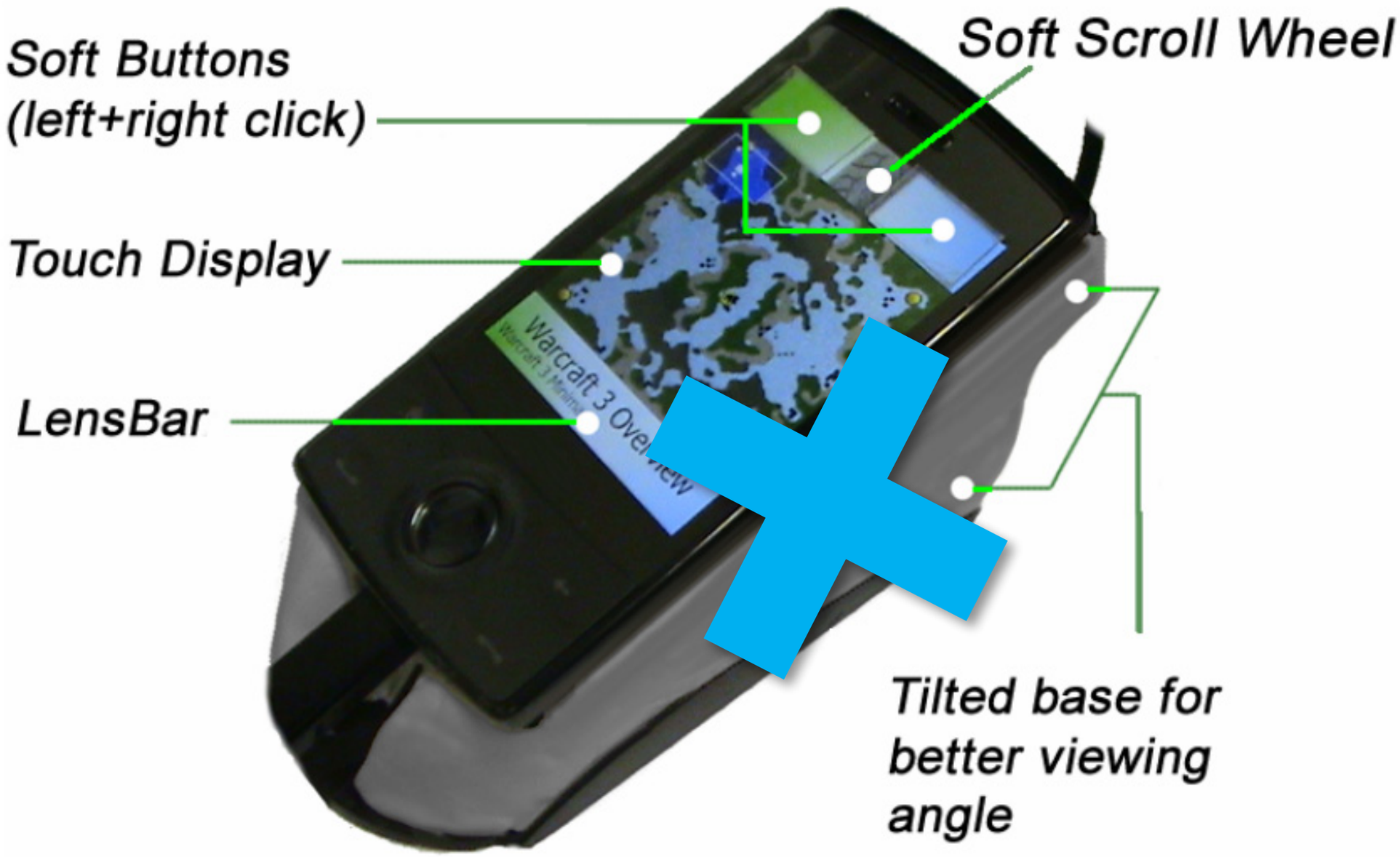
= generalize the concept (common in patent applications)

variation for hammer re-use, but more **actionable**
(extend solution to next dimension)

X+Y

fusion of the dissimilar

X+Y only good if **emergent effect**
value(X+Y) > value(X)+value(Y)



negative example:
mounting touchscreen on mouse offers
exactly the same value as mouse & touchscreen seperate

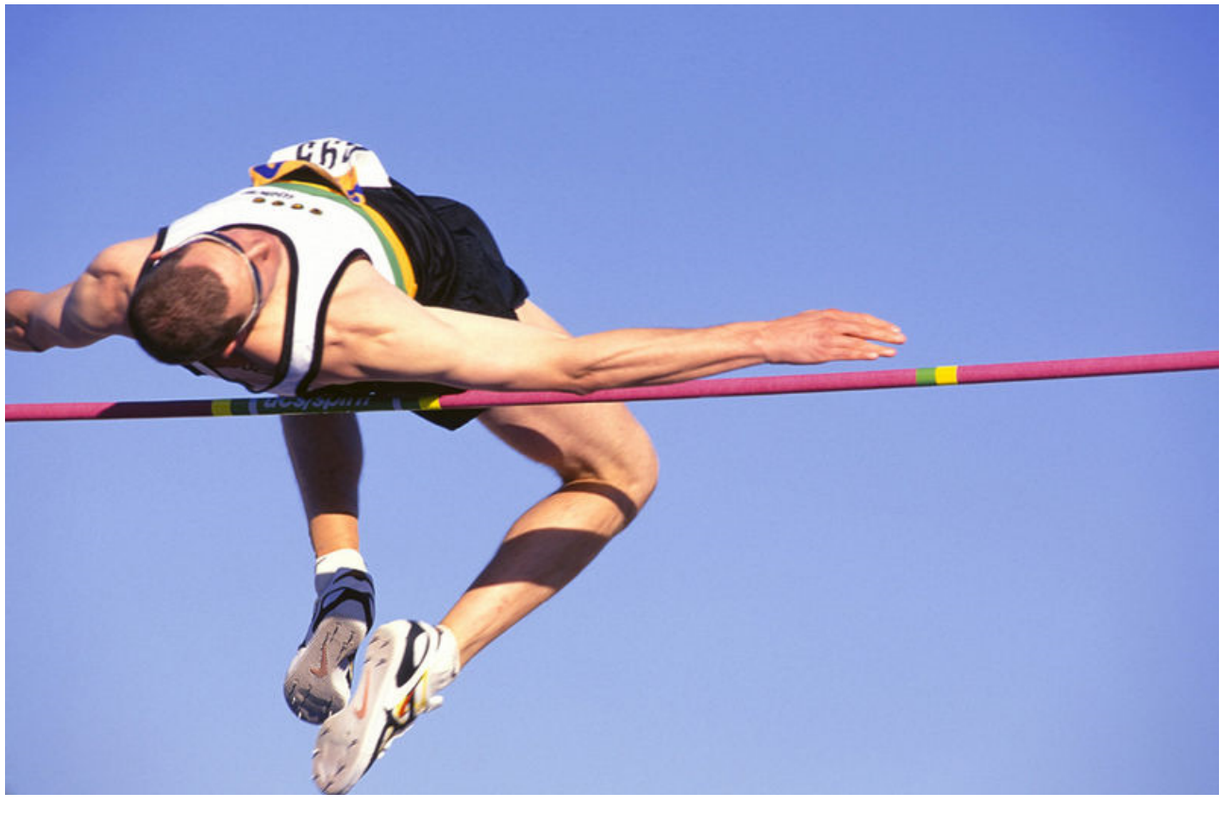
good example:
glass fibers + diffuse illumination touch screen -> Fiberio

good example: food printing + perception:
maybe automation can feed some new insight back into perception research

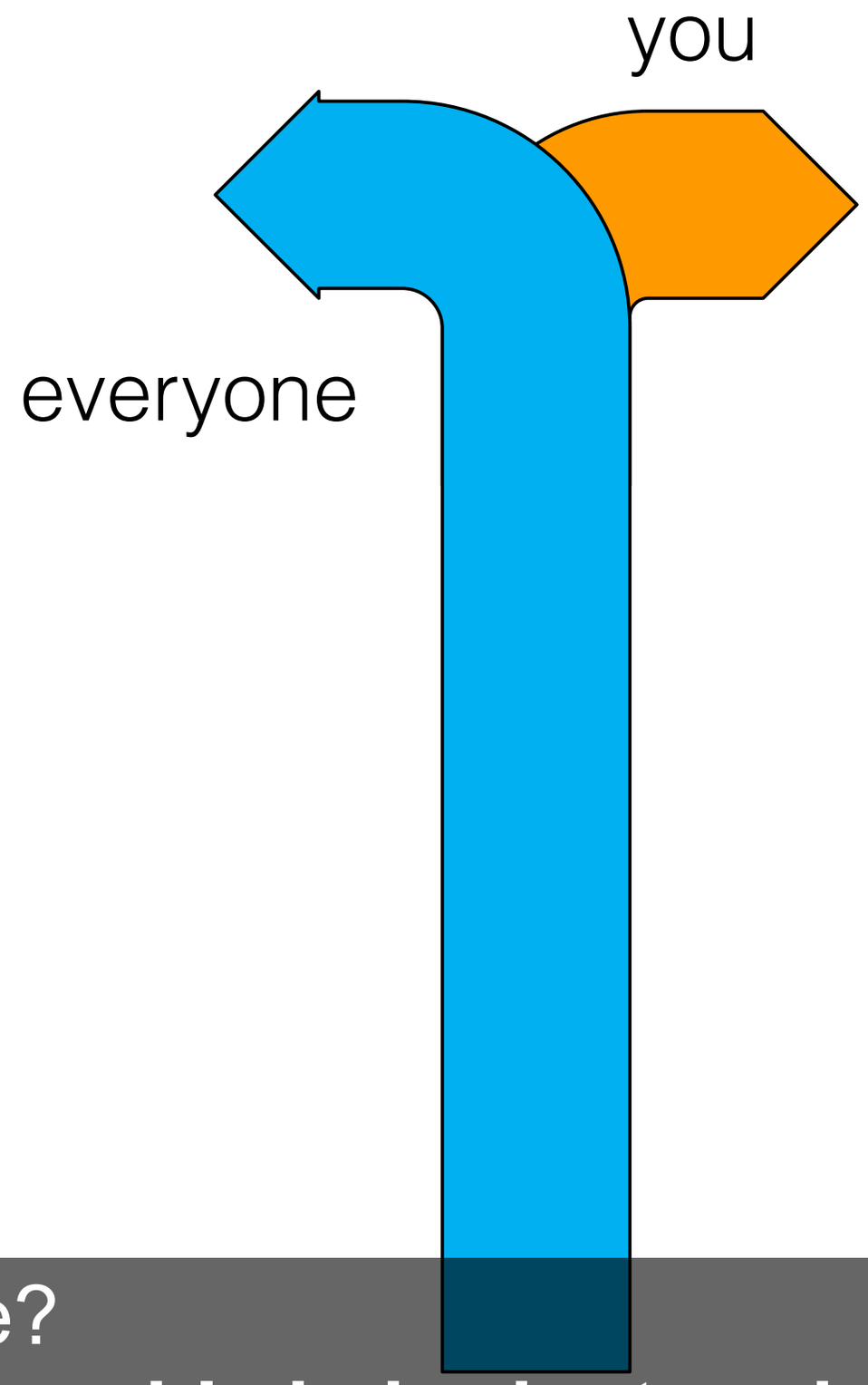
high innovative power, but not very actionable because for a given X the search space of all Y is large and unstructured

do the opposite

Straddle Method for High Jump

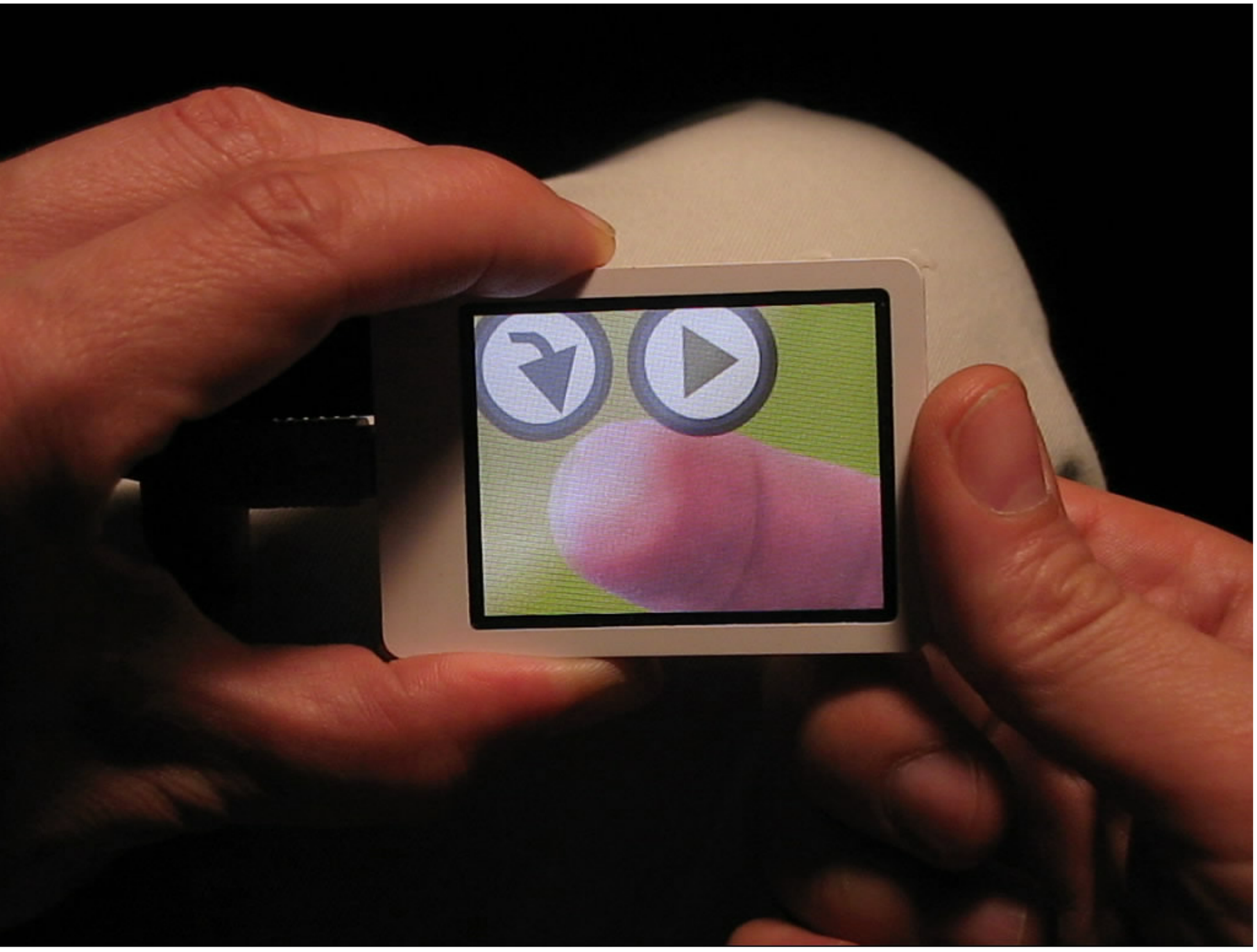


1968 Olympics: “Fosbury Flop”

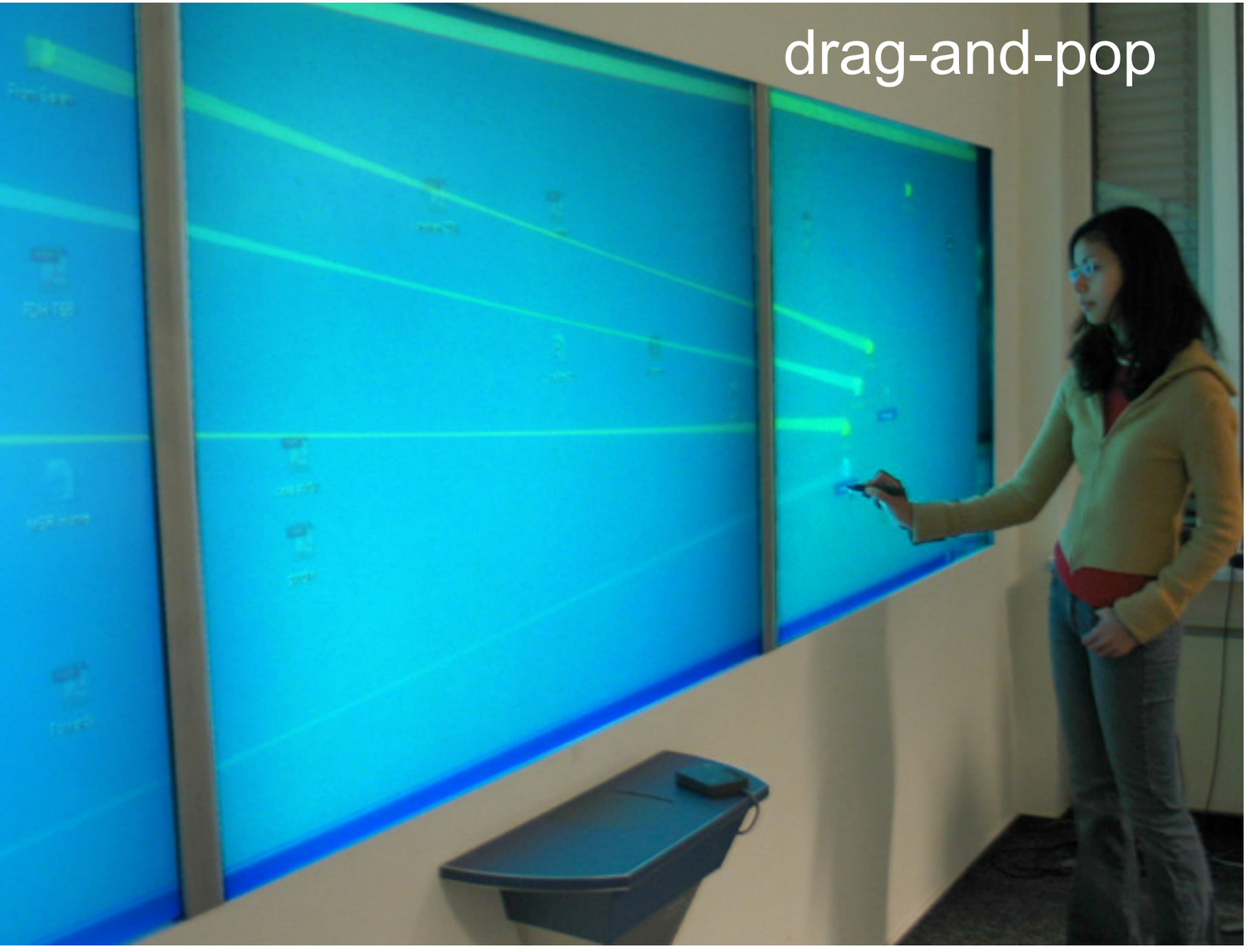


find the opposite?

strong and actionable in brainstorming

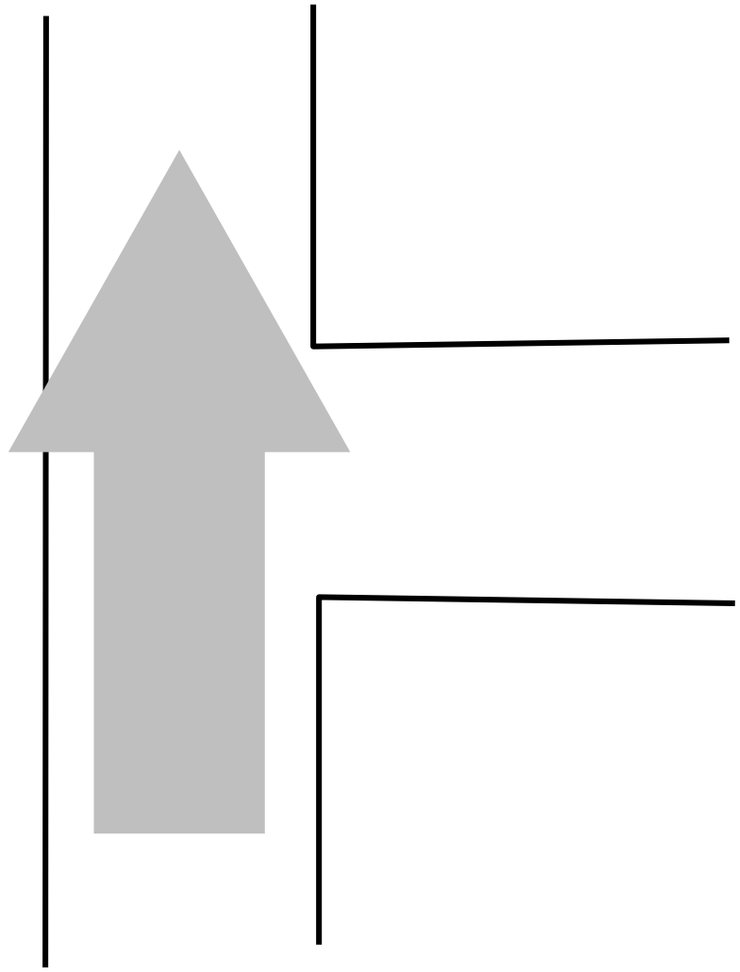


everyone adds touch screens to the front,
instead add it on the back

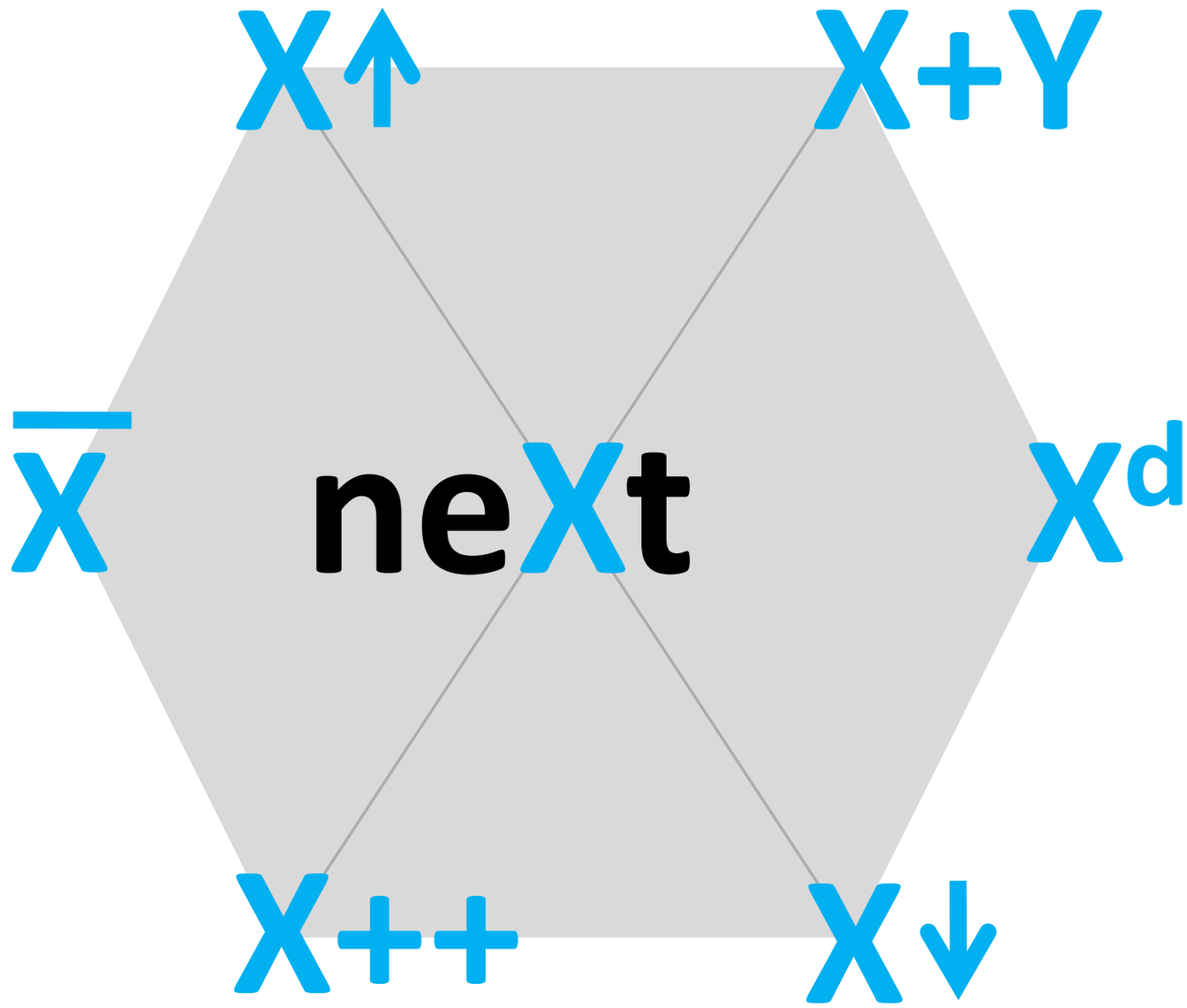


how can user reach contents?
how can contents get to the user?

process:
look at existing designs.
find point(s) where everyone made the same decision



finding X



these were the 6 iterators…

X =

idea you just heard
concept
patent
new product
product feature
design
art
algorithm

but how to **find the right X to start** out with?

stand a the edge of the ‘known world’ to find new land

awards (best paper, best product, researchers)

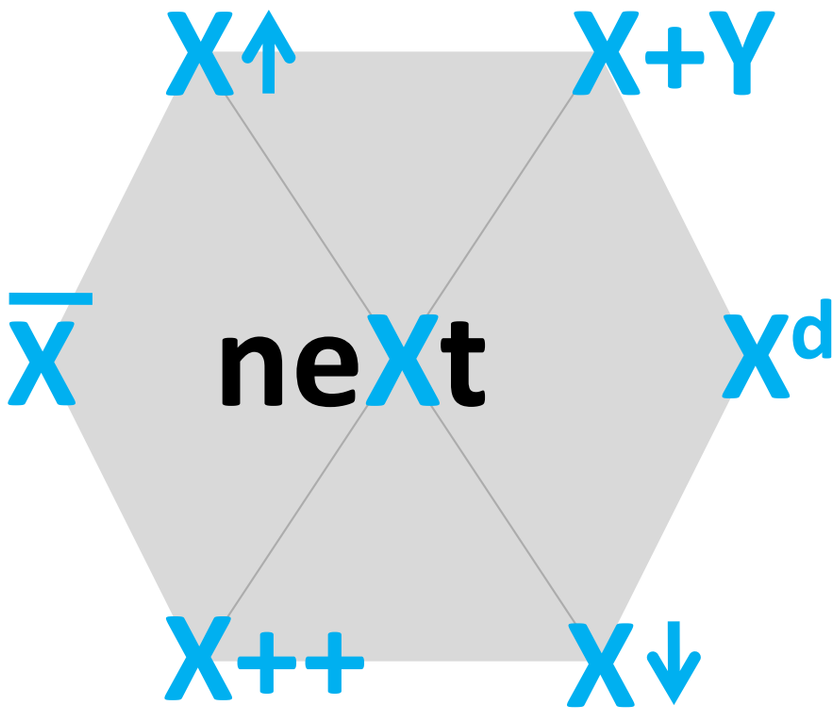
network and talk to people:
avoid small-talk .. ask ‘what is the latest x’

patents (but searching them is time-consuming)

(DIY community ca. 10-15 years behind research.)

do not follow the hype

too much competition



any template will produce the same ideas
as everyone else who uses the same templates

address this by
1. using a wilder set of iterators than others
2. make your very own iterators

conclusions

“so many people get **stuck in incremental research:**
‘my double click mouse is better
than your double click mouse’”

“do what I call **vision-driven research…**”

[Ishii at UIST’11]

great project:

1. **novel =** not done

2. **important =** future people will say “this matters to us”

3. **something you can do =** you have/can aquire the skills

end.