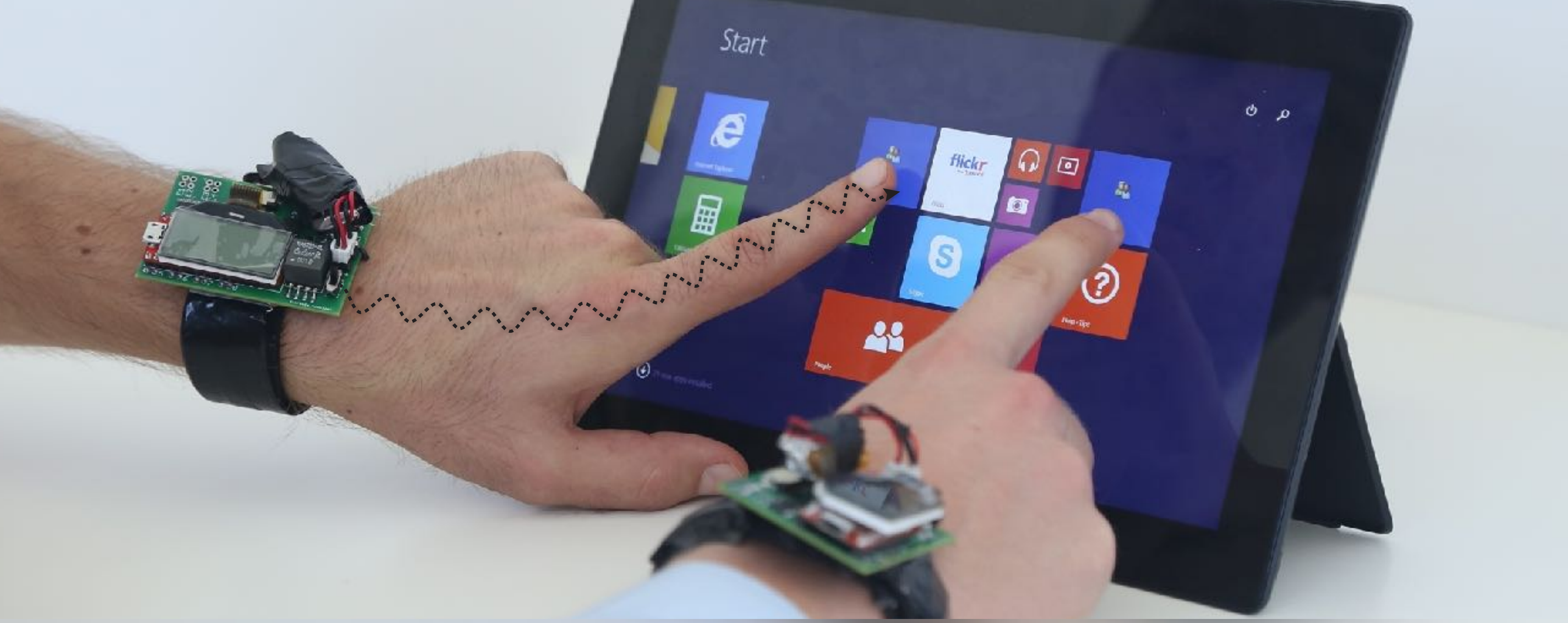
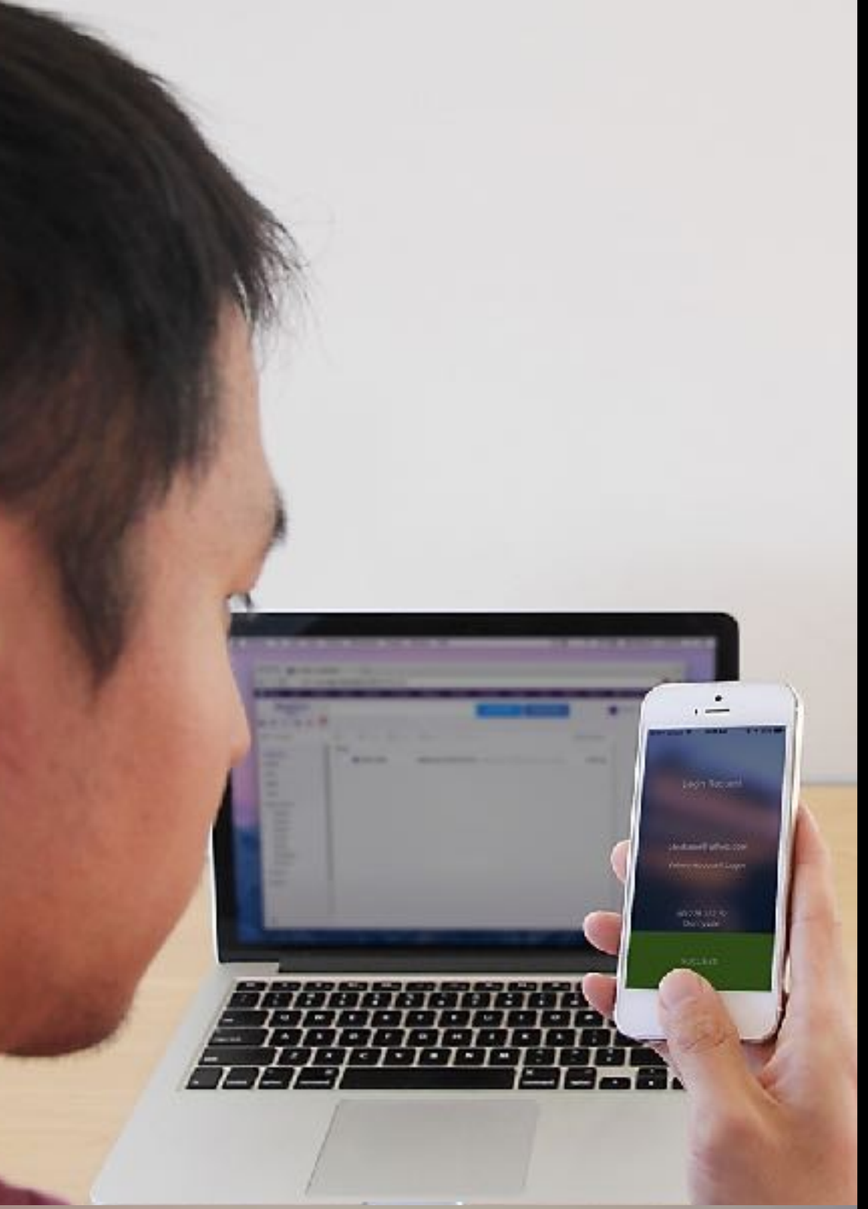


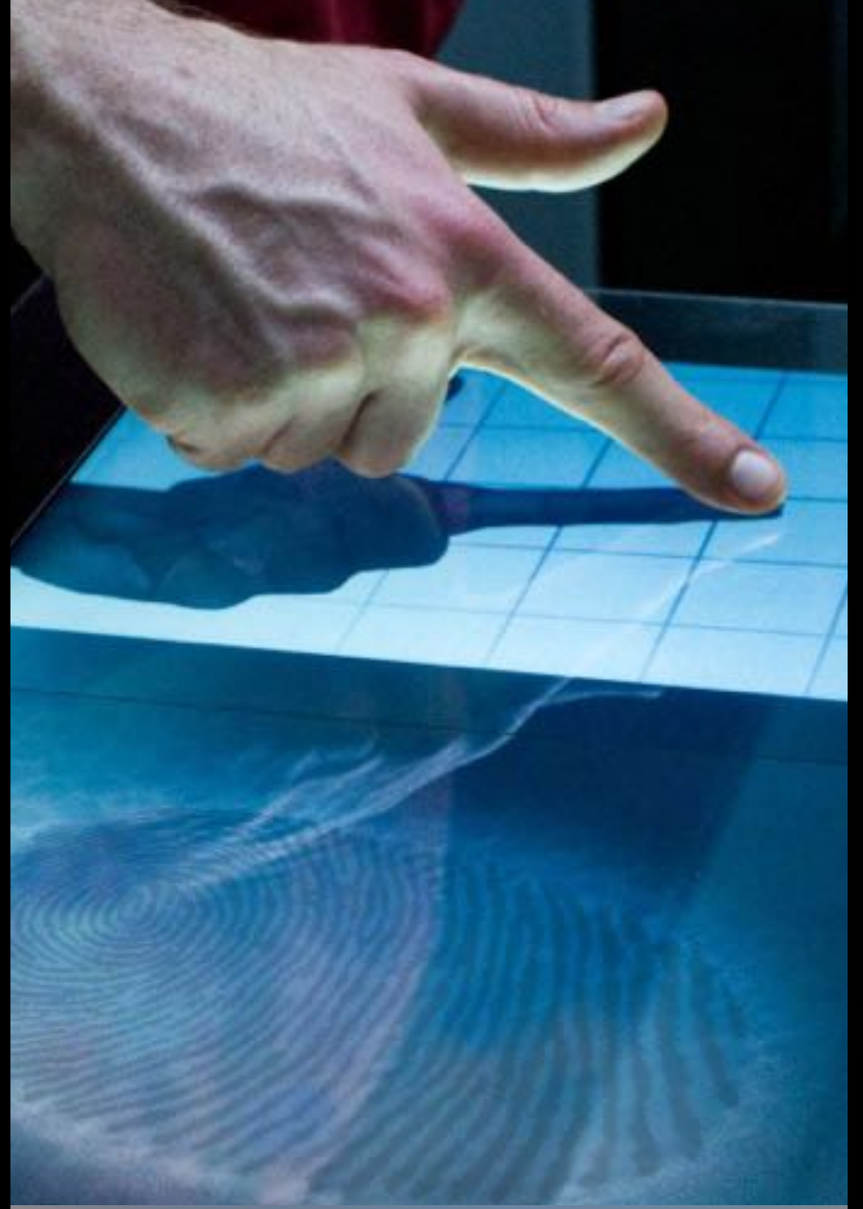
a new perspective on user authentication on touch devices

prof. dr. **christian holz** · department of computer science

ETH zürich
sensing, interaction & perception lab

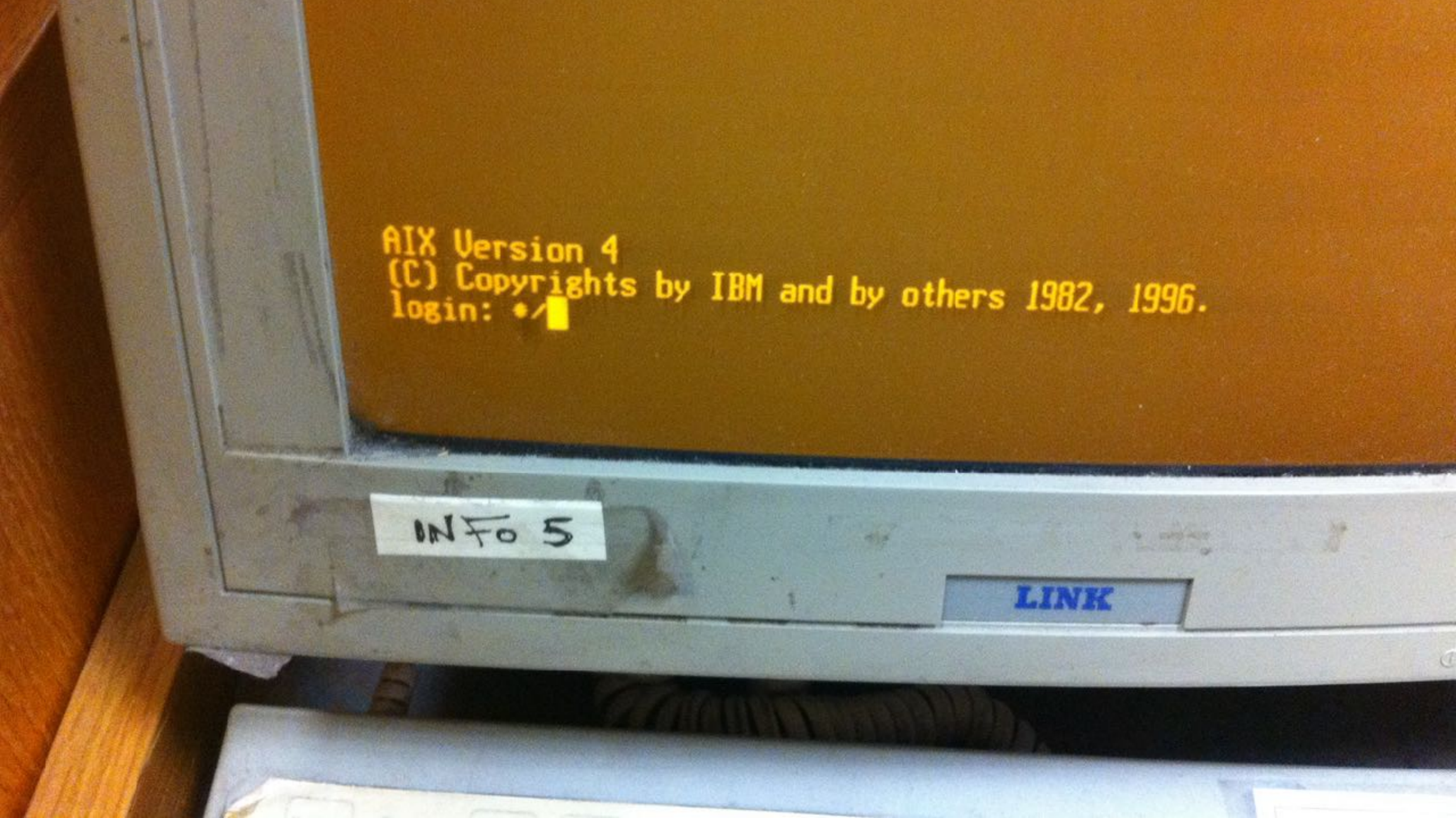


1 two factor authentication



2 touchscreens and fingerprints

3 a new model for authentication


AIX Version 4
(C) Copyrights by IBM and by others 1982, 1996.
login: */
INFO 5
LINK

1) type in passcode

2) interact (start apps, access emails, …)

typical process

security

user
authentication

convenience

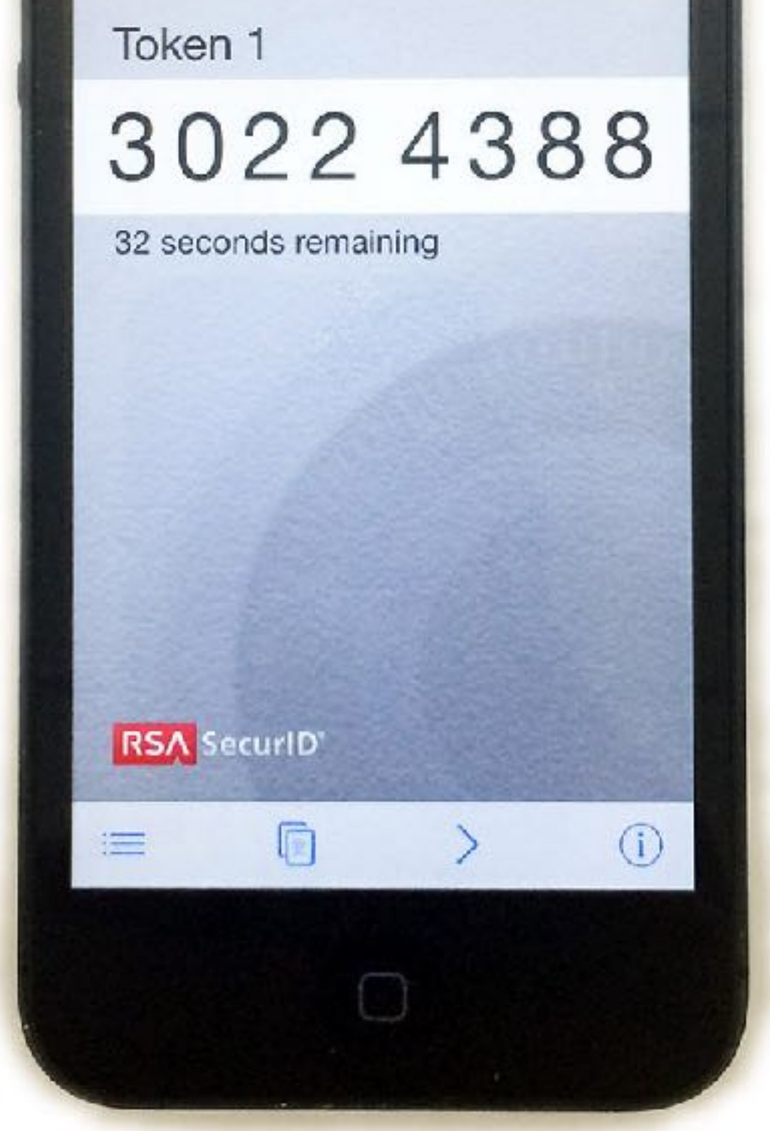
something you know	passwords
something you have	key, access token, …
something you are	biometrics

\+ combinations of these factors

secure authentication

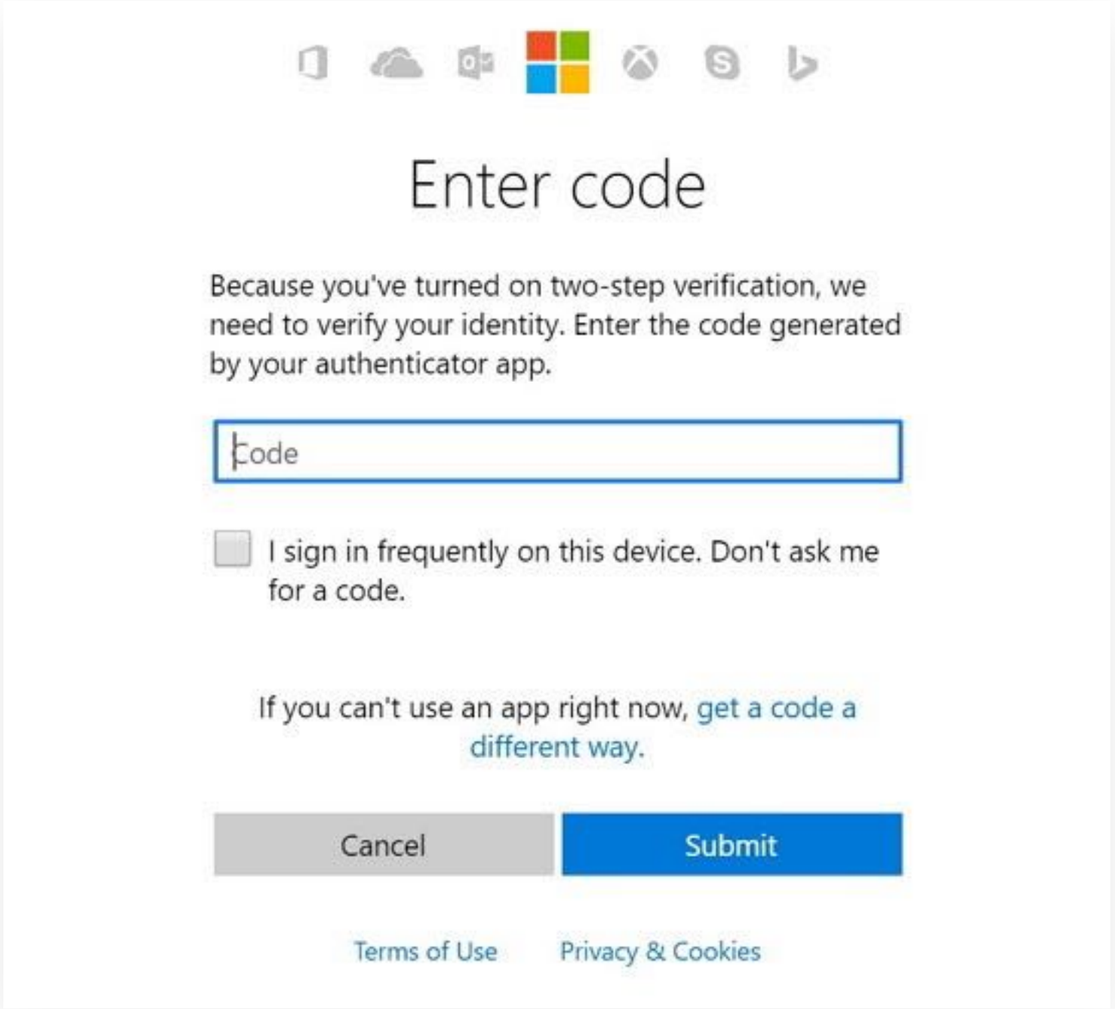
passwords…

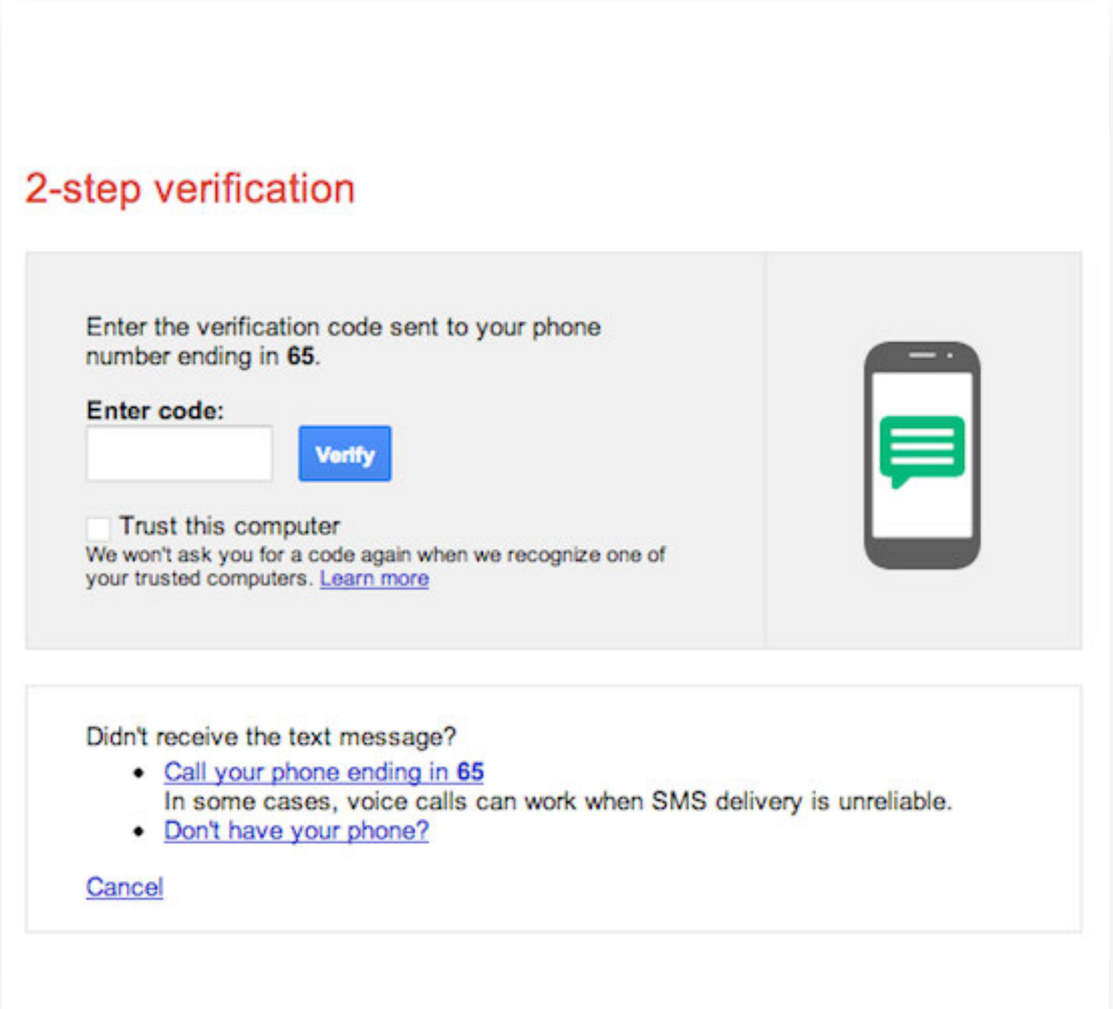
keys and tokens



keys and tokens

two-factor authentication





additional login protection

only 6.4%

two-step verification-enabled Google accounts

of 900 million users

[Petsas et al. 2014]

6.4%

two-step verification-enabled

of 900 million users

2014

10%

two-step verification-enabled

of 1.5 billion users

2018

[Grzegorz Milka, Usenix 2018]

security

user
authentication

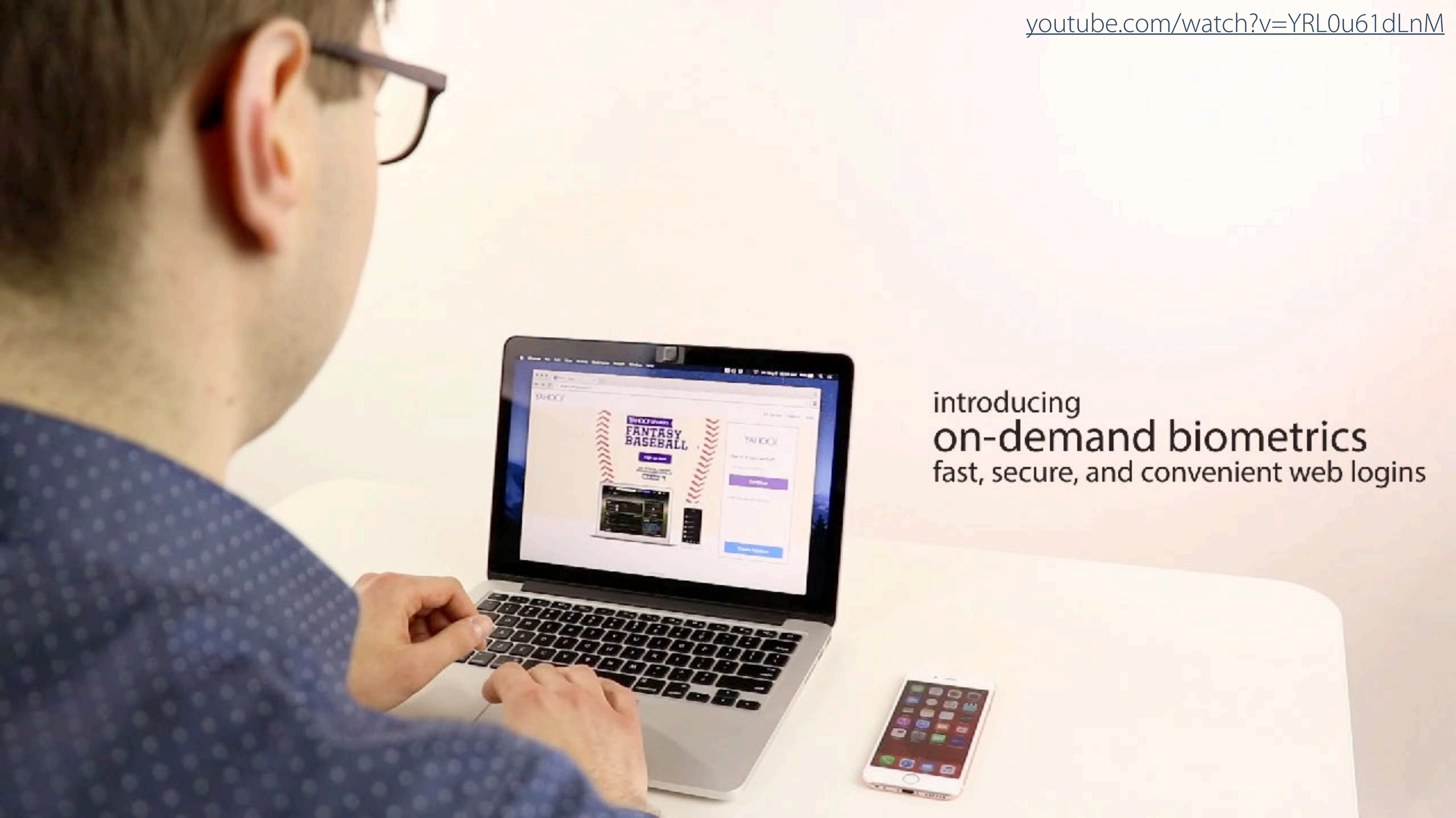
convenience

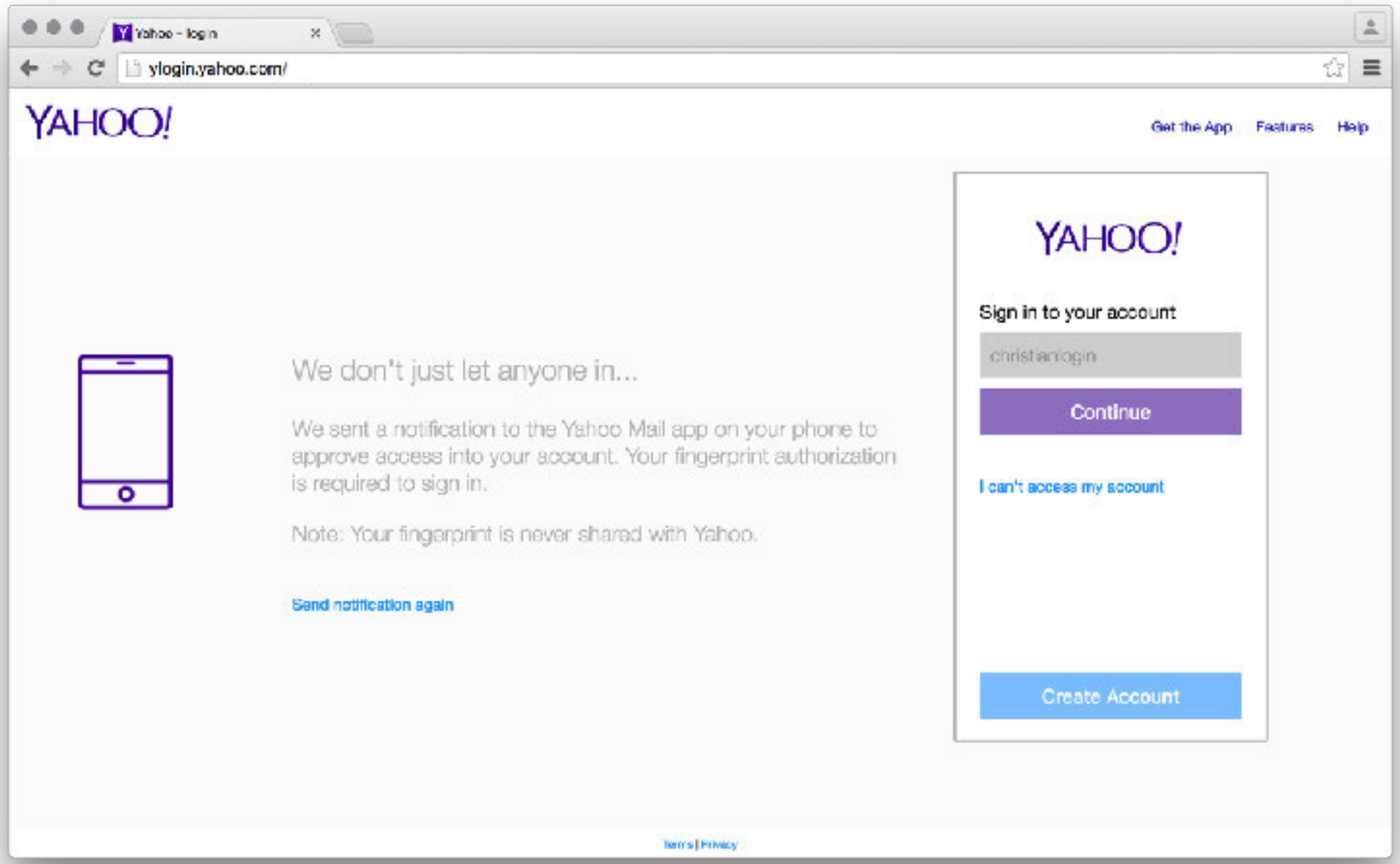
20 seconds

overhead of two-step verification

[Gunson et al. 2014]

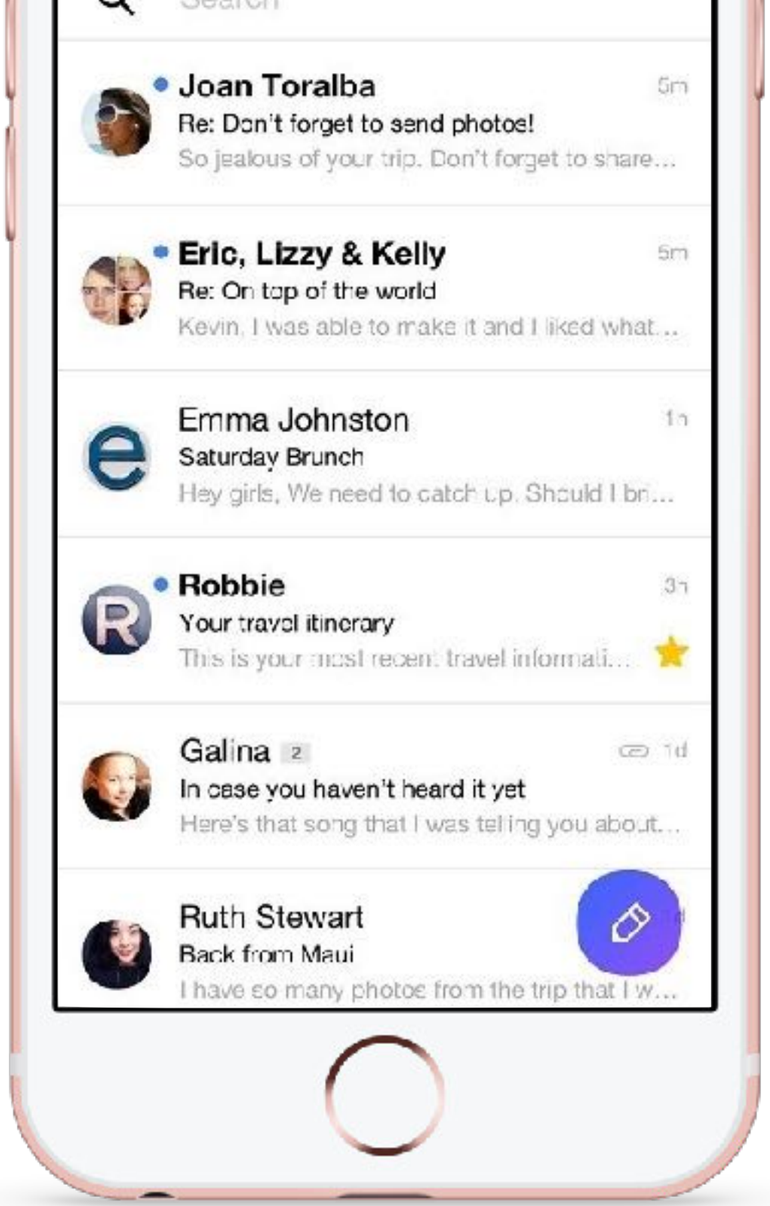
youtube.com/watch?v=YRL0u61dLnM





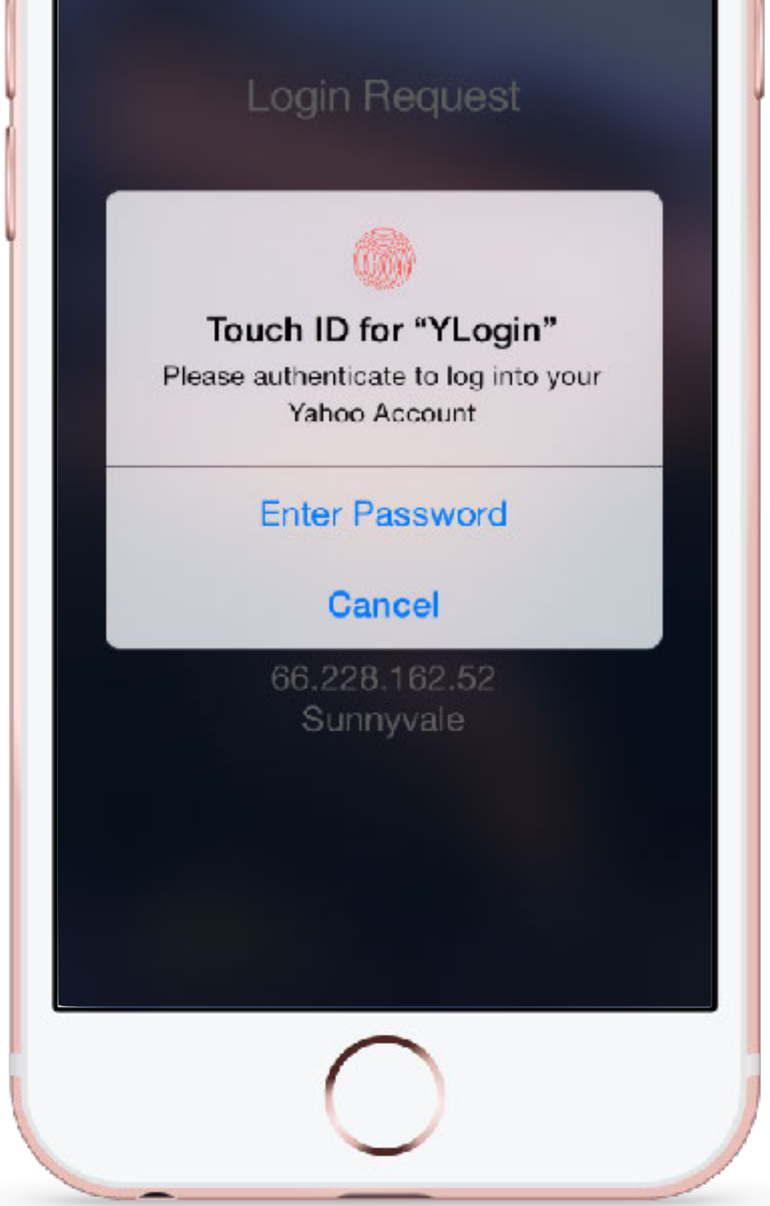
on-demand biometrics

replaced login mechanism
for Yahoo account on the web



on-demand biometrics

authentication integrated into Yahoo Mail on iOS



on-demand biometrics

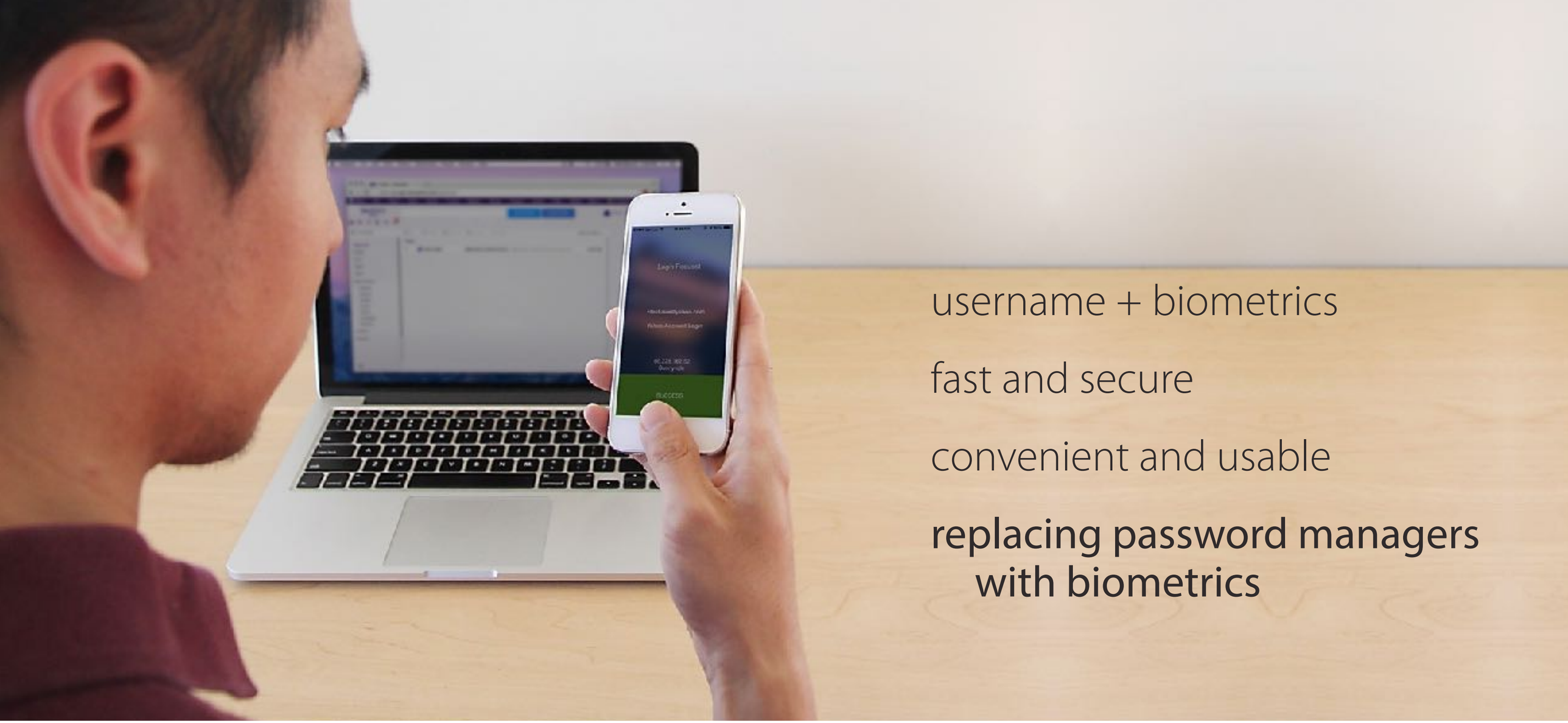
authentication integrated into Yahoo Mail on iOS

email inboxes, social media, content apps contain sensitive data worth protecting

on-demand biometrics

- reduce effort during login
- are simple and convenient
- result in high acceptance and retention

usability evaluation: resulting themes



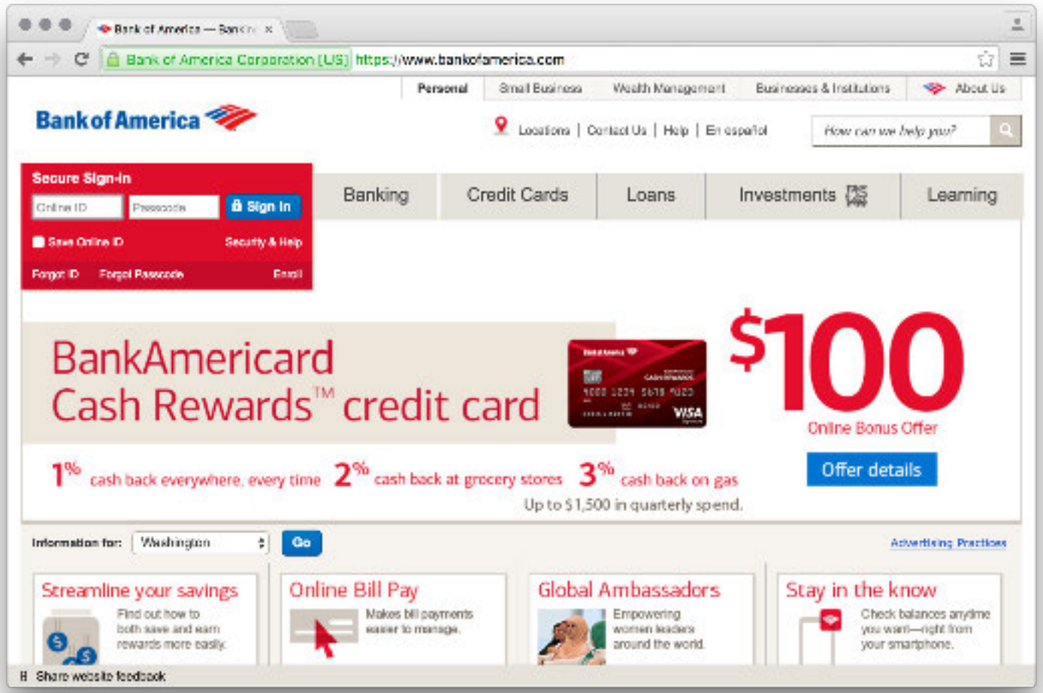
username + biometrics

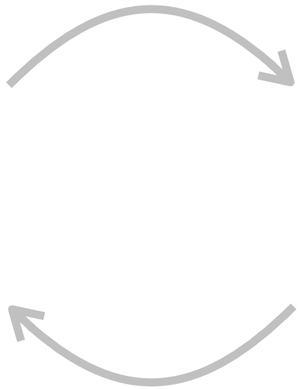
fast and secure

convenient and usable

replacing password managers with biometrics

on-demand biometrics



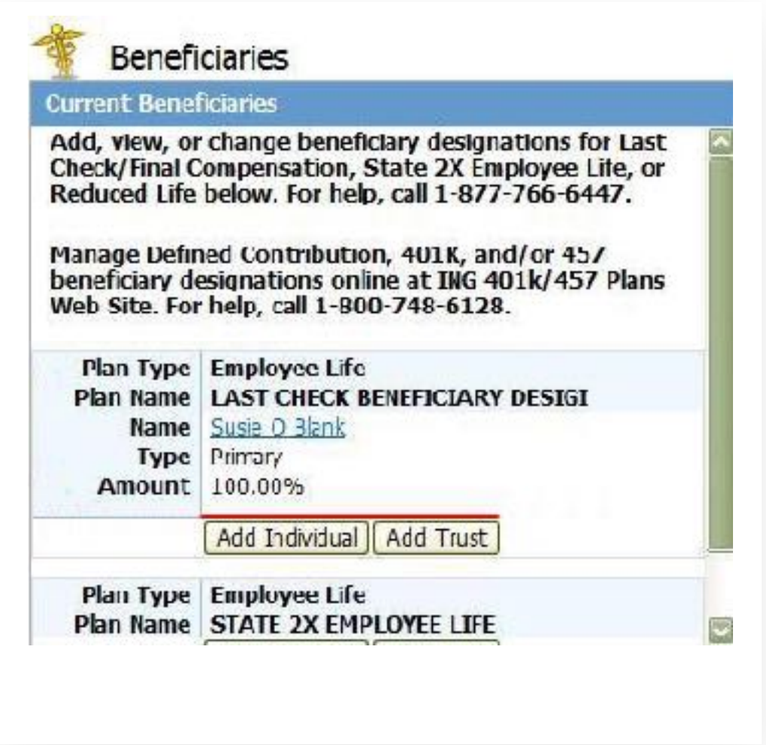


confined web apps
in the browser

powerful sensors
on mobile devices

credit card use

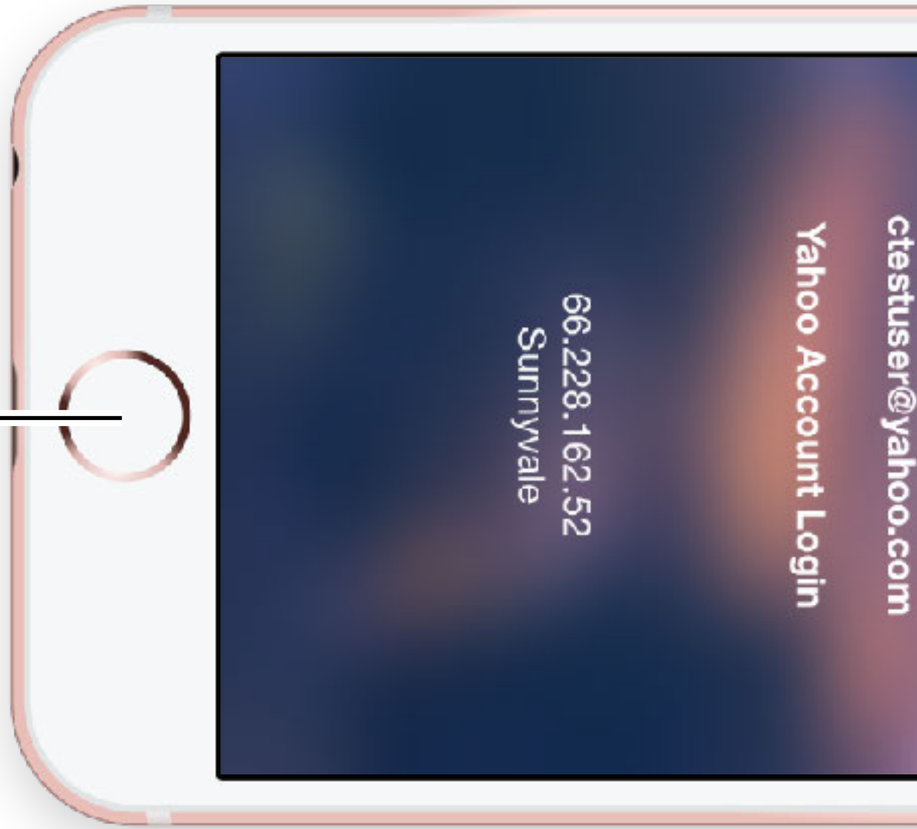
bank transfer



changes to HR details

more granular authentication

fingerprint
scanner



on-demand biometrics

fingerprint
scanner

face
scanner

on-demand biometrics

89%

of iOS users actively use biometrics for authentication

vast potential for adoption

Apple Platform Security 2019: https://support.apple.com/guide/security/welcome/web

~80x

users unlock their devices a day on average

vast potential for adoption

Apple Platform Security 2019: https://support.apple.com/guide/security/welcome/web

1) type in passcode

2) interact (send emails, …)

typical process

1) ~~type in passcode~~

use biometric authentication

2) interact (send emails, …)

typical process

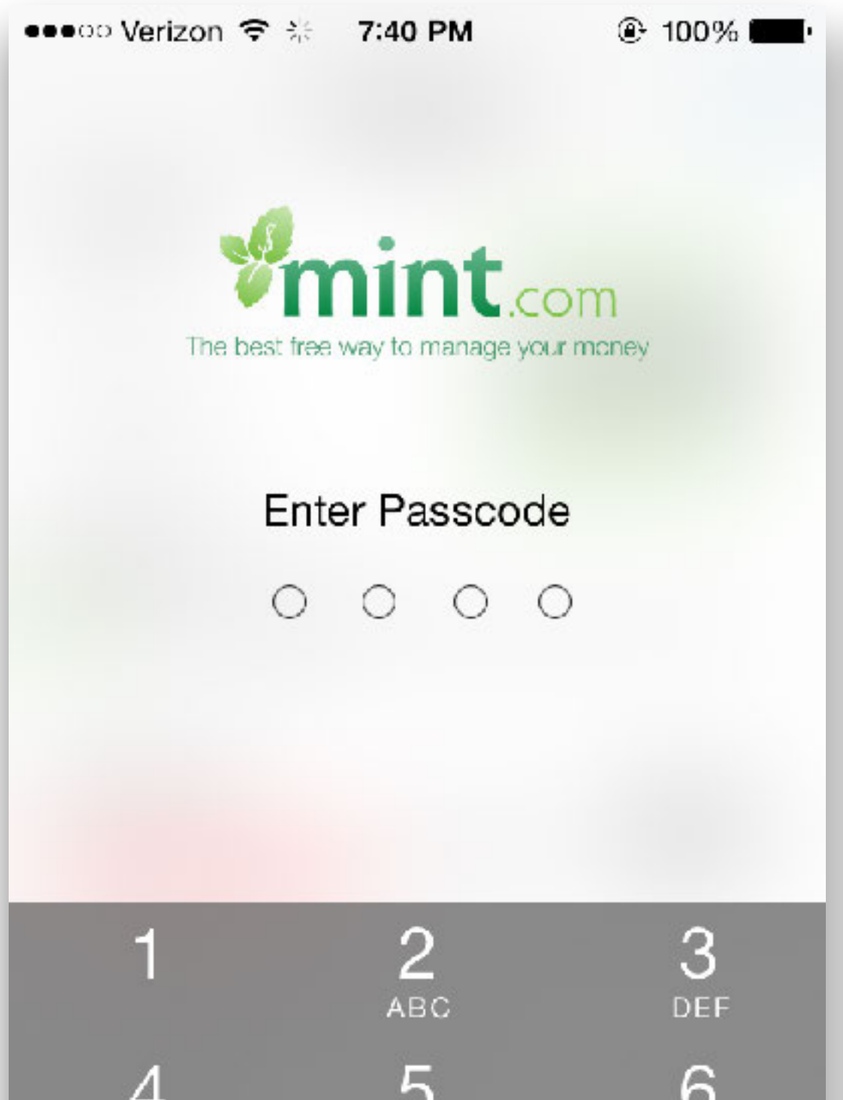
wide-open session

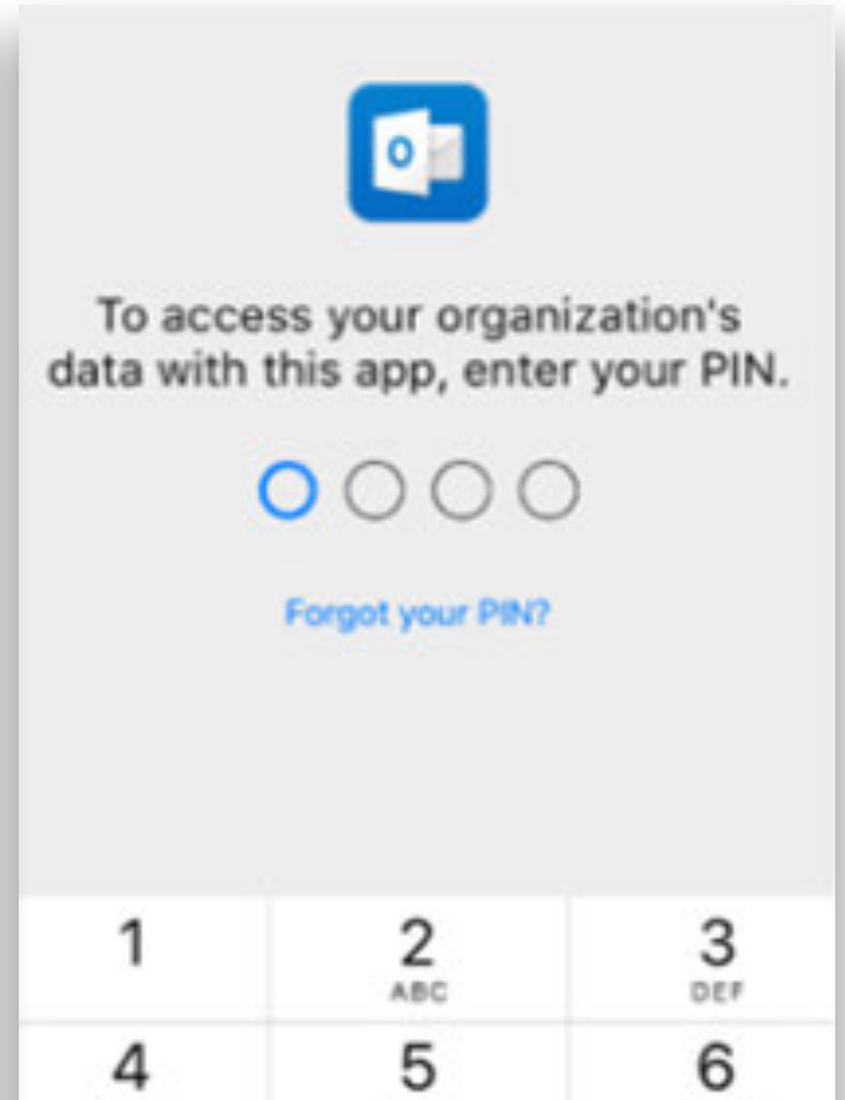
access to all my data

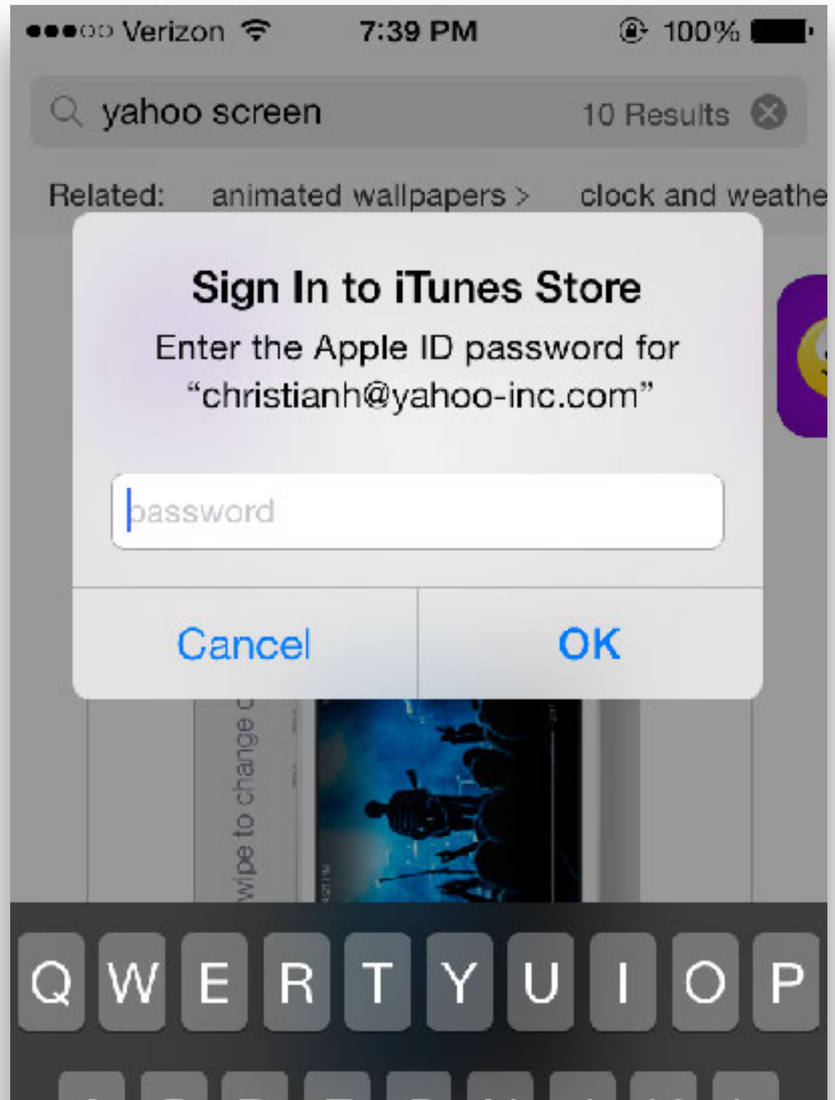
can we trust the user now?

is this secure now?

some have decided “no”



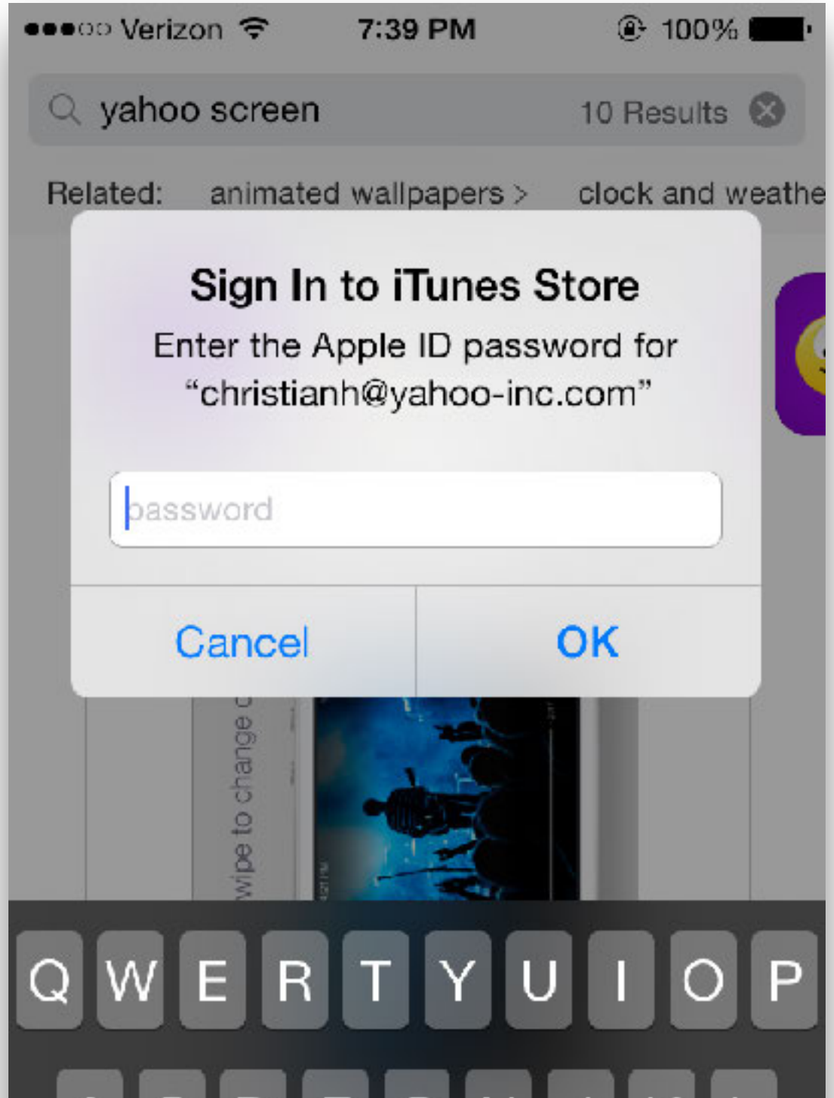




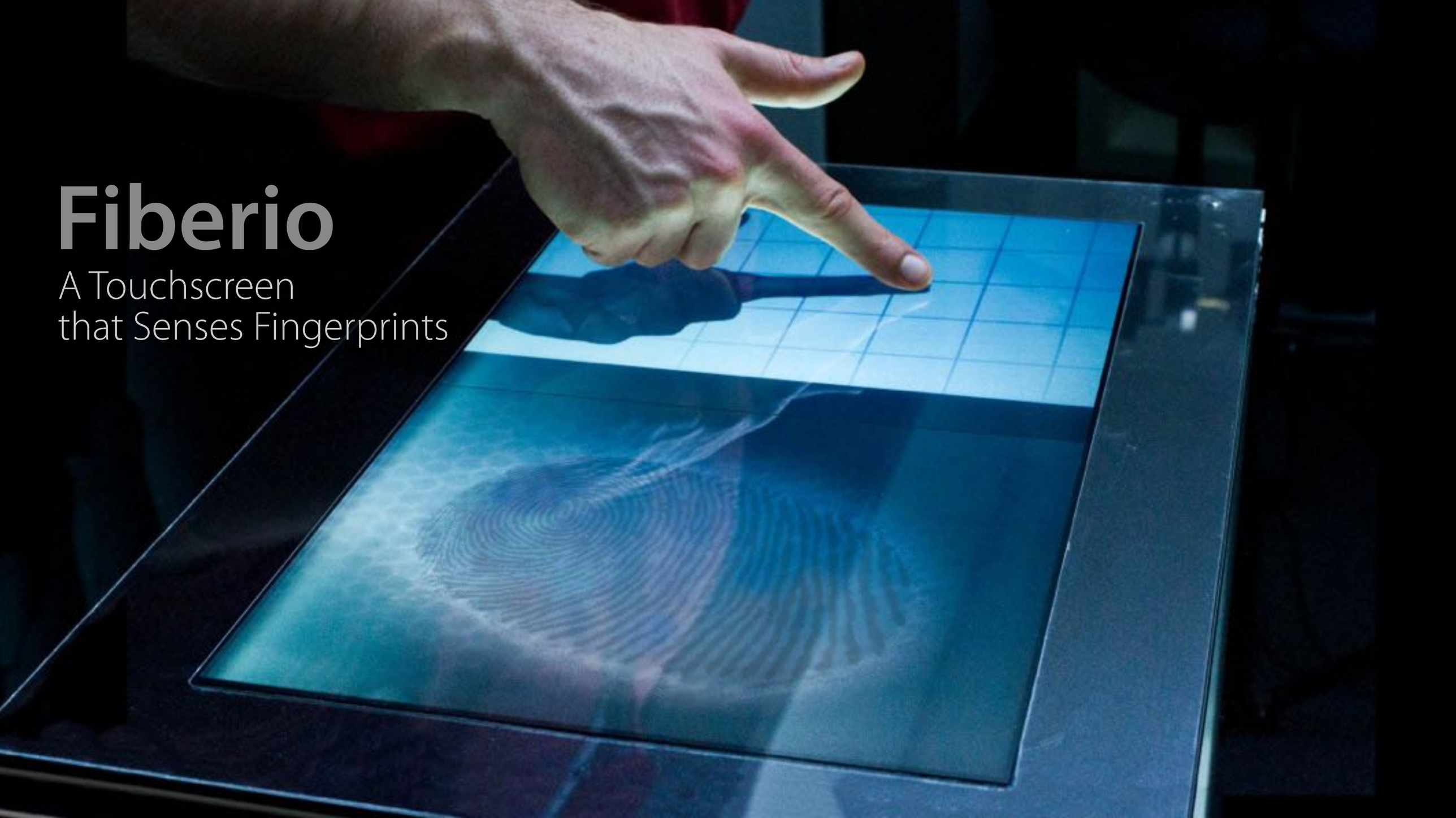
interaction flow

ideally we want this
protection **all the time**

but it **disrupts** interaction



can we make this **part of the interaction?**



Fiberio

A Touchscreen
that Senses Fingerprints

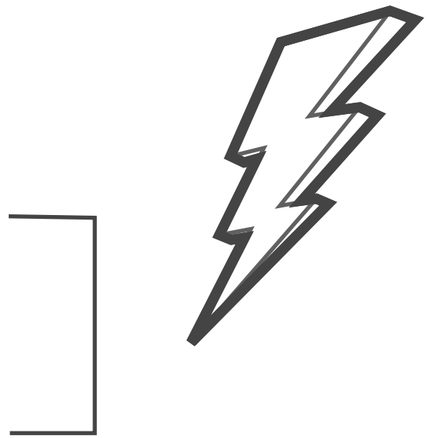

youtube.com/watch?v=p1a5yLzuTqA
Fiberio

challenge

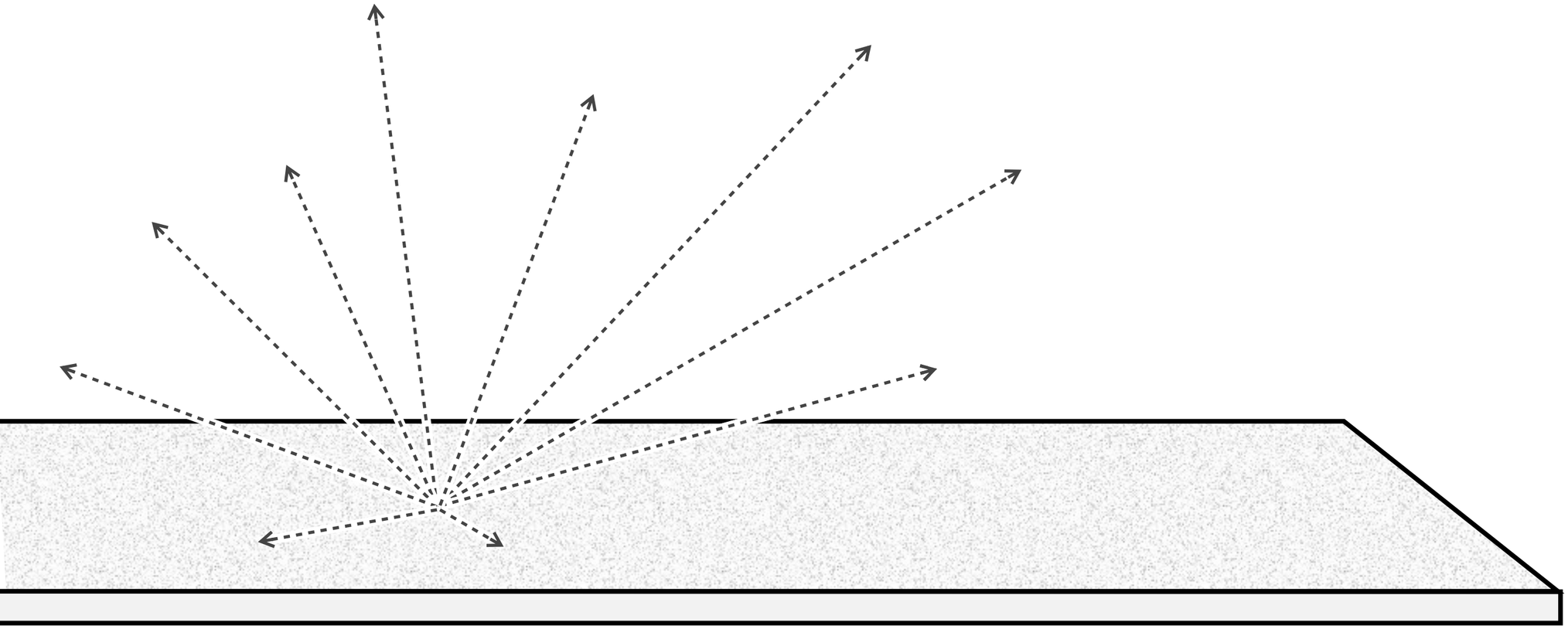
such an touch**screen** device requires

(1) output: display images

(2) input: capture fingerprints



(1) display images

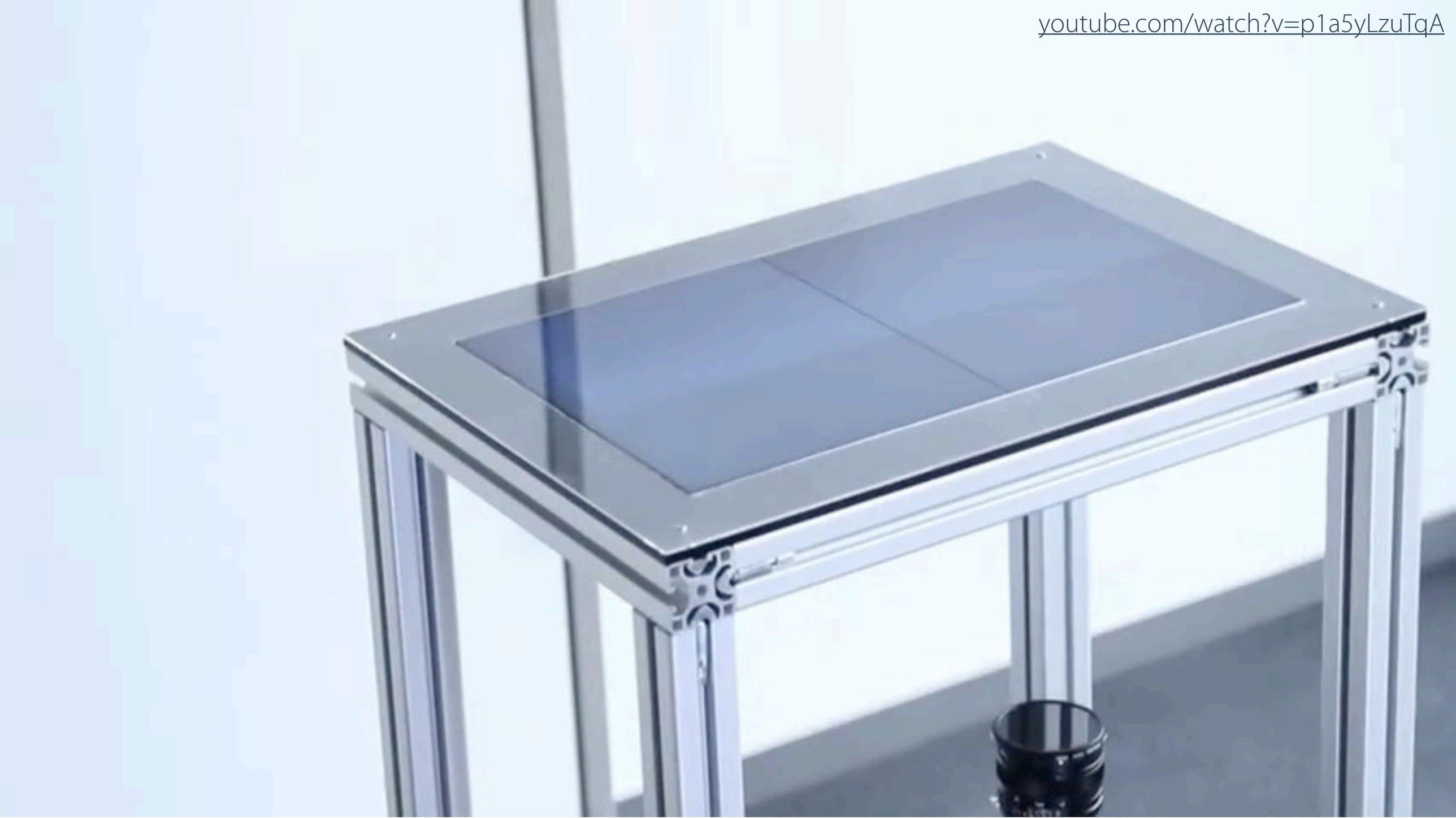


scattered light

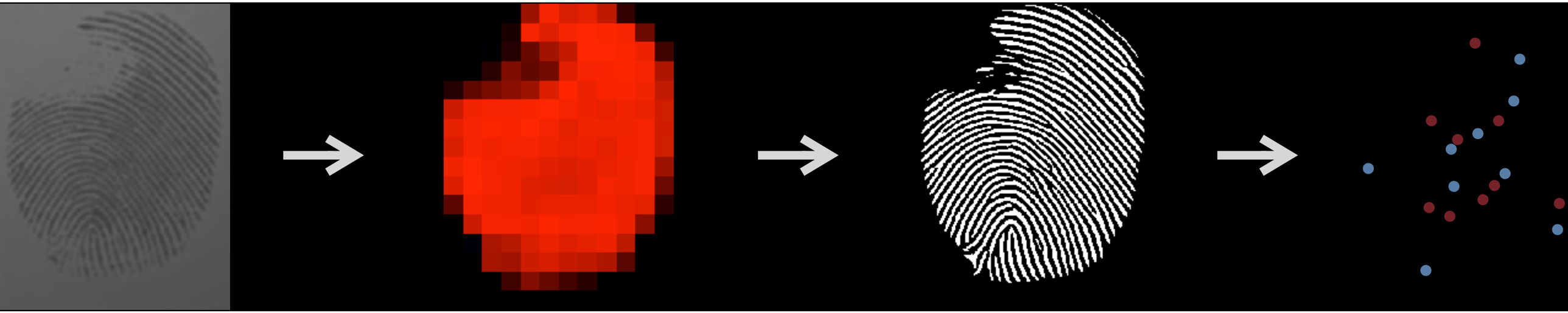
(2) capture fingerprints

high **contrast**
between ridges and valleys

youtube.com/watch?v=p1a5yLzuTqA



fingerprint processing pipeline

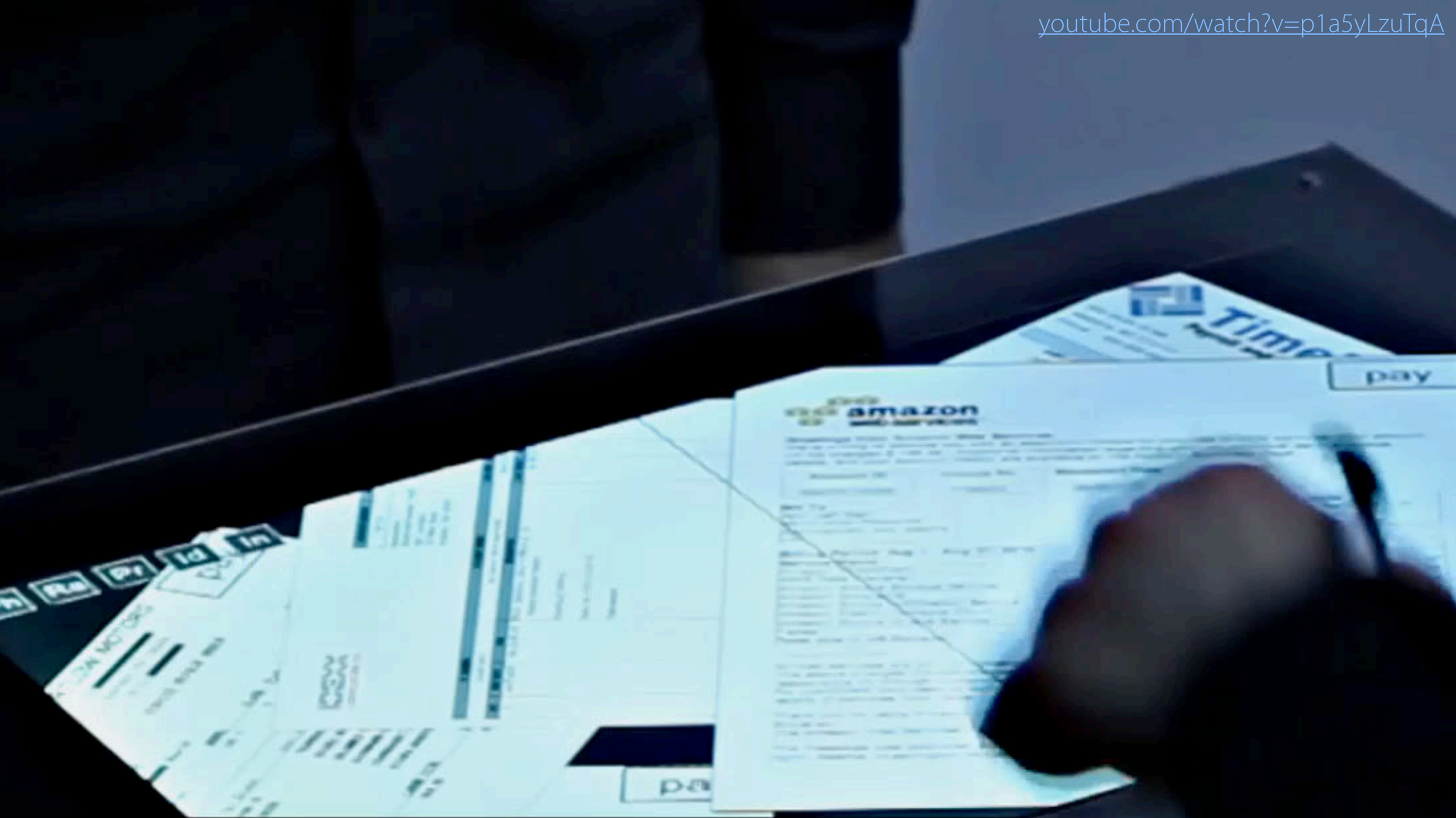


raw
image

locate
fingerprints

augment &
extract features

match
users


youtube.com/watch?v=p1a5yLzuTqA
amazon
pay

user authentication
for **each** input event

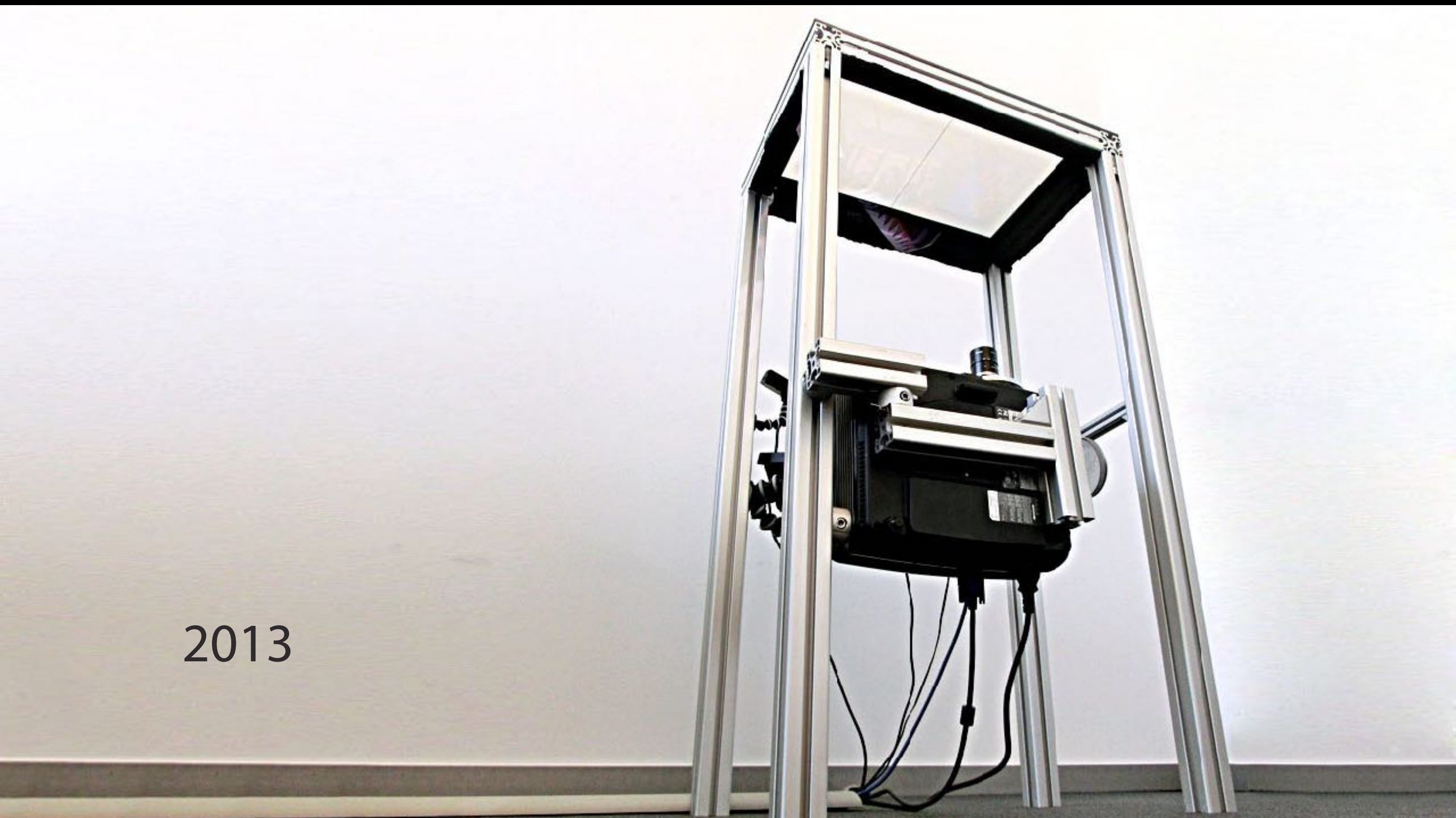
realtime operation
for **interactive** behavior

…integrating authentication
into **regular** interaction

security

user
authentication

convenience



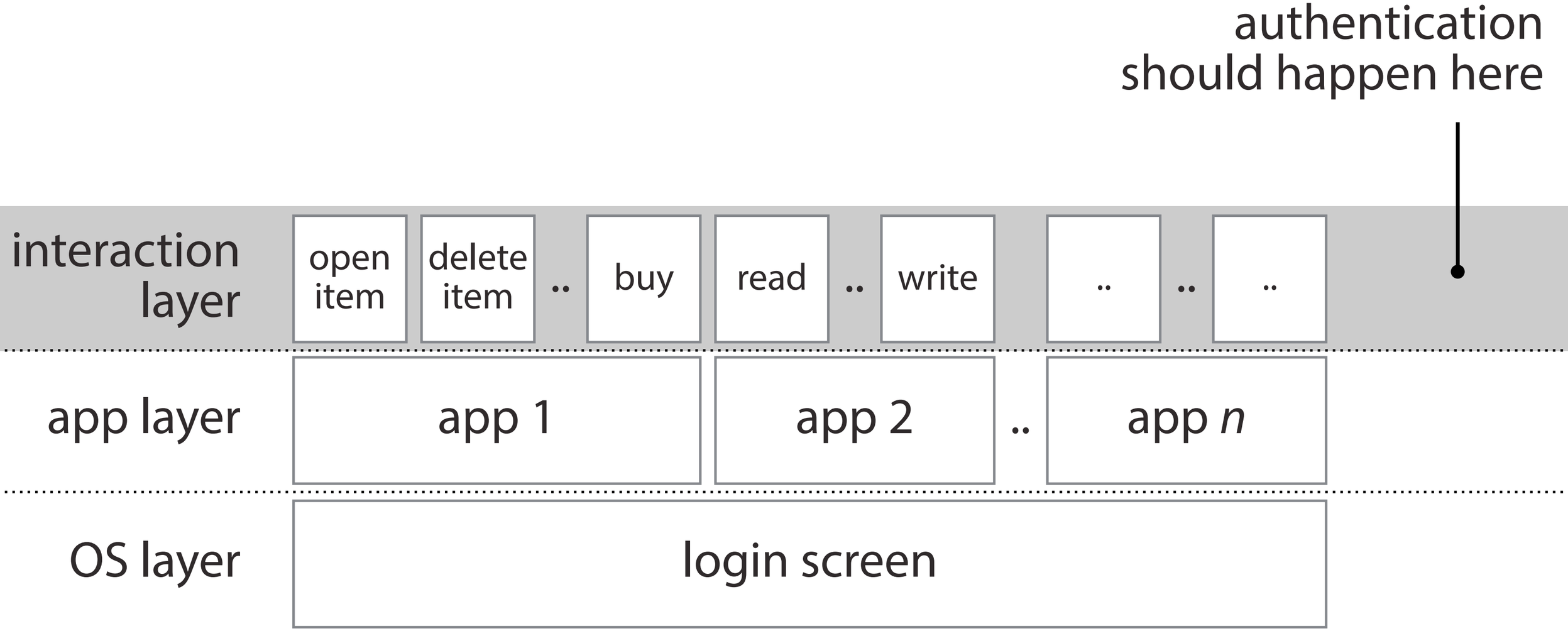
2013

today

Biometric Touch Sensing

a new model for authentication

youtube.com/watch?v=FgnJee0mVgQ



moments of authentication

obtained directly
from the touchscreen

touch event = (*x*, *y*)

session = {
    userID from initial login,
    running apps, …
}

state of the art

touch event = (*x*, *y*, ***userID***)

session = {
    running apps,
    …
}

biometric touch sensing

continuous authentication during each touch

seamlessly integrated into regular interaction

no password prompts interrupt direct interaction

biometric touch sensing

Bioamp

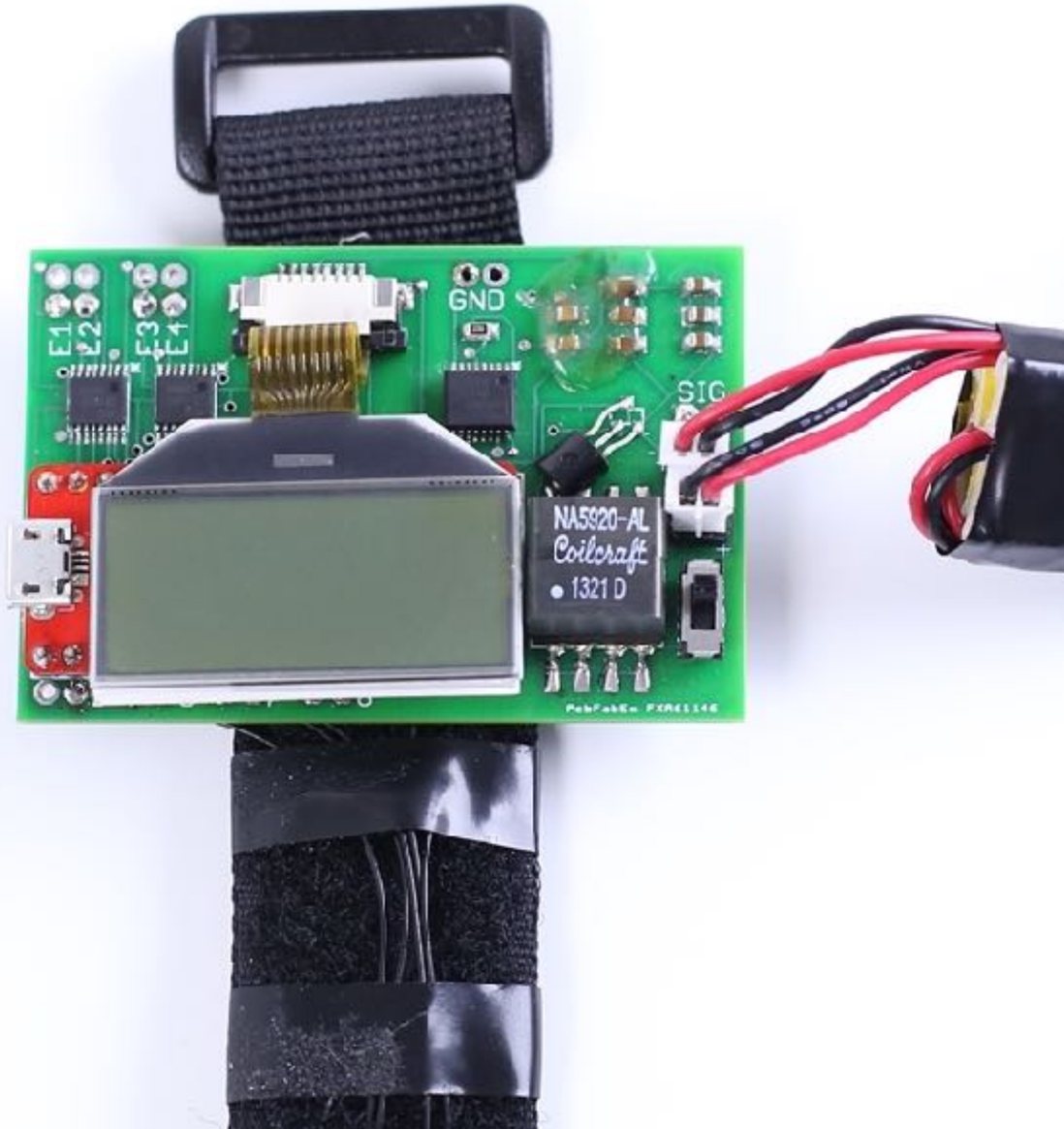
a prototypical helper

Bioamp

“watch” prototype for

1 biometric sensing

2 data transfer to the touchscreen



bioimpedance of the user's wrist as a unique feature

8 electrodes

1 biometric sensing

signal is transmitted
through the body and finger

touchscreen observes it
along with the touch event

no pairing necessary

2 data transfer to the touchscreen

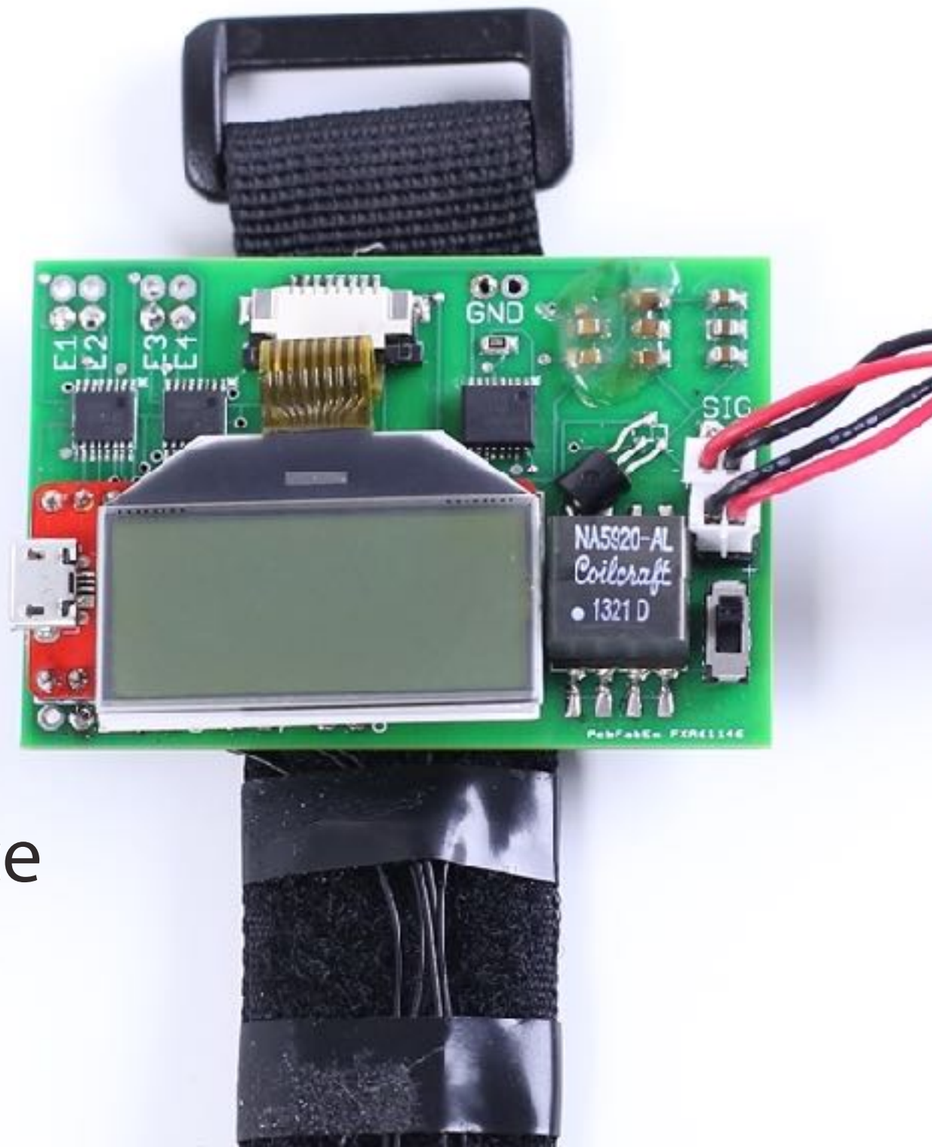
Bioamp

“watch” prototype for

1 biometric sensing

2 data transfer to the touchscreen

3 authentication by the touchscreen device



touch := (x, y, userID)

integrated into the operating system

authentication during input

access control for apps and personal data

youtube.com/watch?v=FgnJee0mVgQ

youtube.com/watch?v=FgnJee0mVgQ

authentication during output

access control for displayed content

youtube.com/watch?v=FgnJee0mVgQ

youtube.com/watch?v=FgnJee0mVgQ

explicit logins

for customized sessions and registration

youtube.com/watch?v=FgnJee0mVgQ

input event := (*x*, *y*, ***userID***)

wrap up

convenience

user
authentication

security

traditional process

1) ~~type in passcode~~

use biometric authentication

---

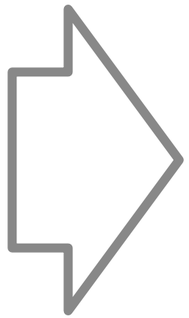
2) use (interact, send emails, …)

input event = (*x*, *y*)

disconnect

traditional process	biometric touch sensing
1) ~~type in passcode~~	
use biometric authentication	
2) use (interact, send emails, …)	use & authenticate
input event = (*x*, *y*)	input event = (*x*, *y*, ***userID***)

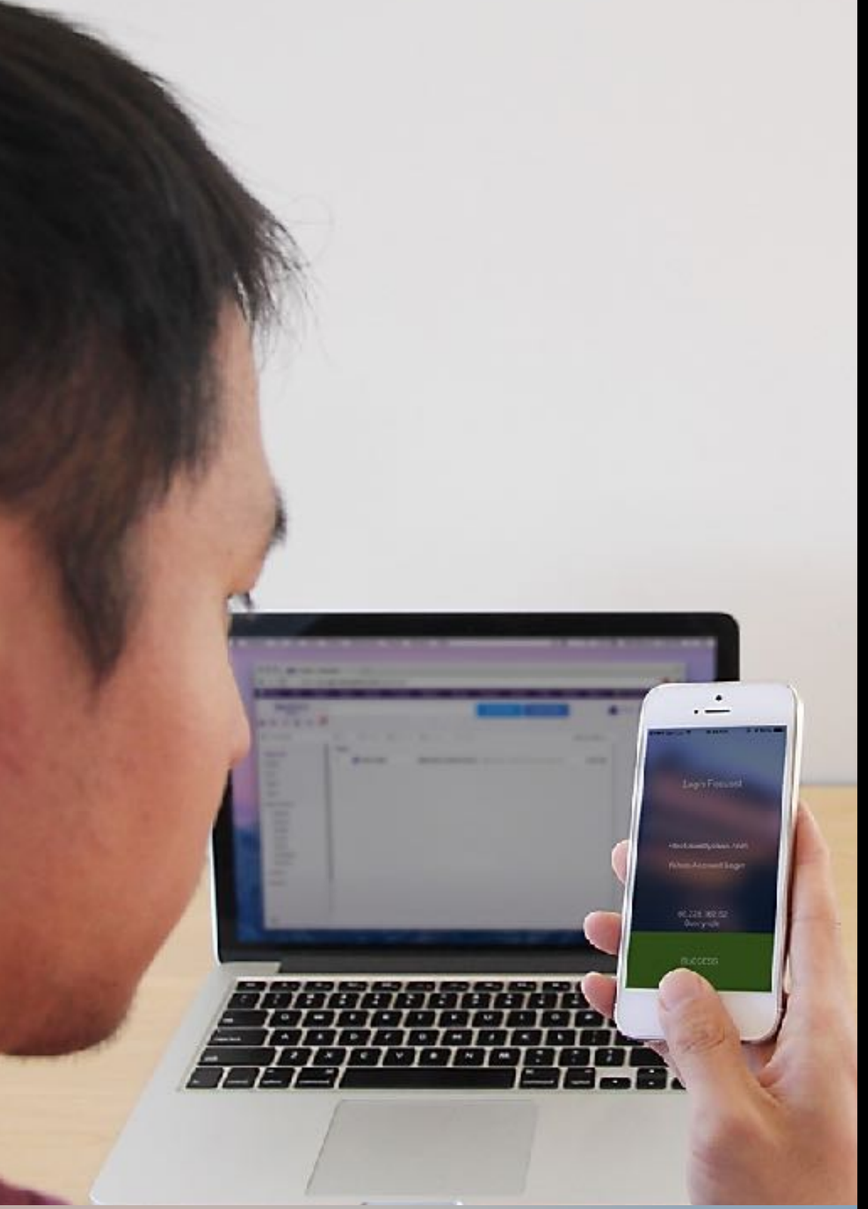
convenience



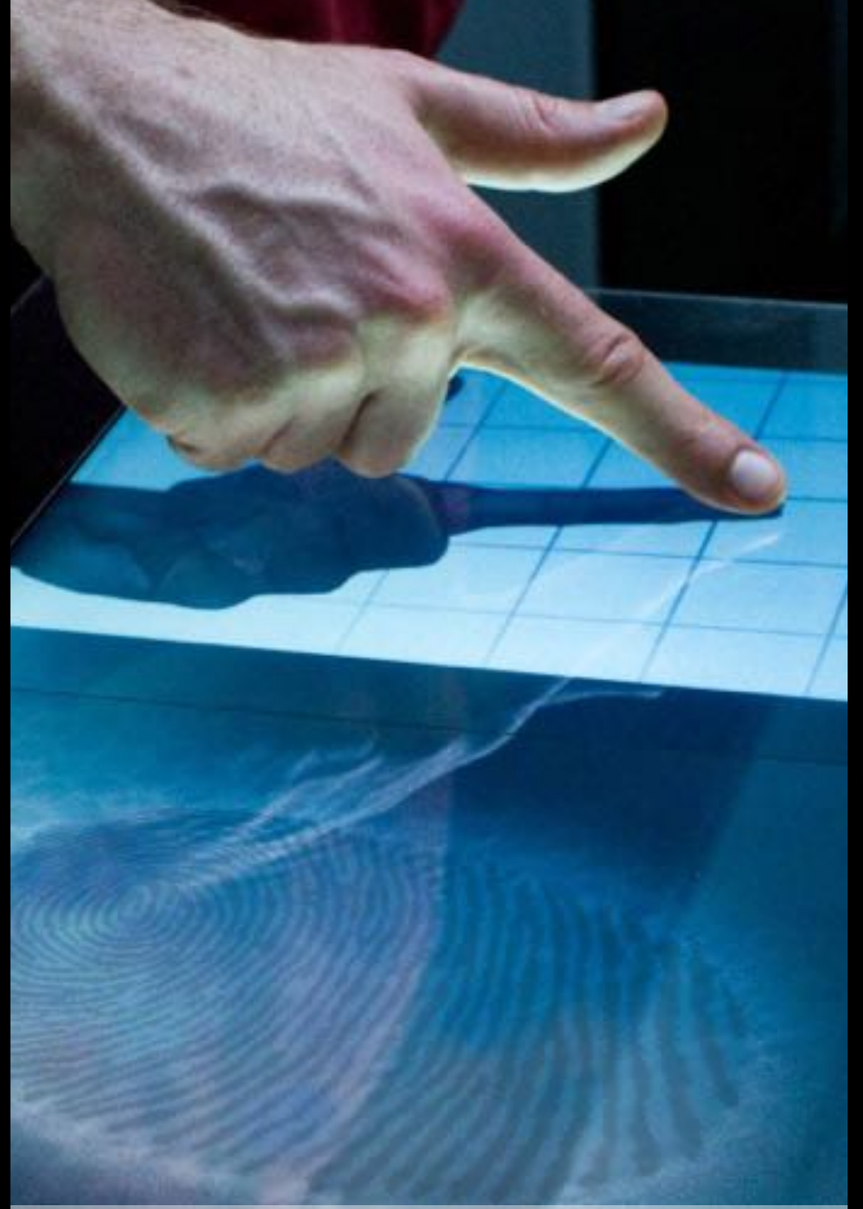
user
authentication

security

input event = (*x*, *y*, ***userID***)

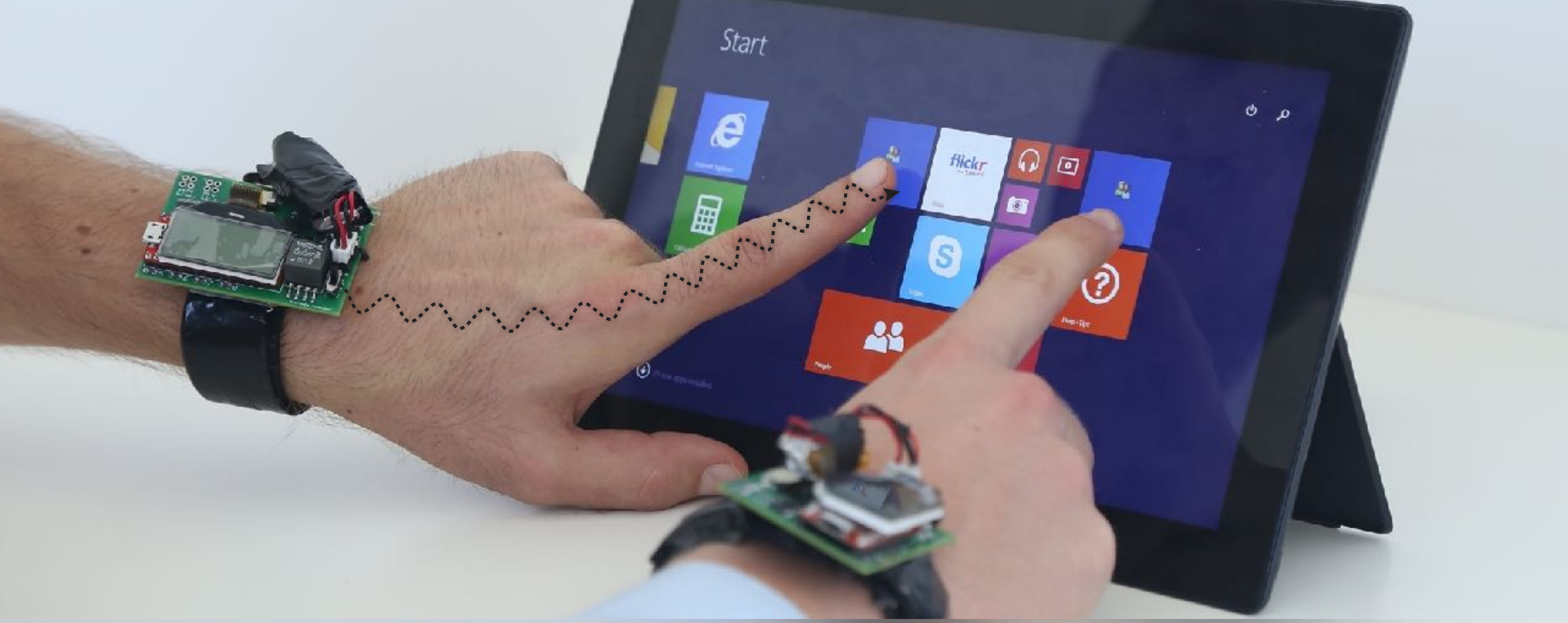


1 two factor authentication



2 touchscreens and fingerprints

3 a new model for authentication



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siplab.ethz.ch