



Illustrating Privacy Engineering Concepts with Potty Talk

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[@lorrietweet](https://twitter.com/lorrietweet)

Carnegie Mellon University



privacy
ENGINEERING



Carnegie Mellon University
Security and Privacy Institute



What does privacy mean to you?
Please draw a picture

cups.cs.cmu.edu/privacyillustrated/



PRIVACY ILLUSTRATED

What does
PRIVACY
mean to you?

**DRAW
IT!**

INTERNET SAFETY & PRIVACY SURVEY

\$2.00 TO PTO PER SURVEY

CMU

SCHOOL OF COMPUTER SCIENCE

ABOUT RESEARCH CHILDREN AND ONLINE SAFETY

WHO:

- PARENTS OF 10-18 y.o. SMARTPHONE USER
- MUST INSTALL FREE PARENTING SOFTWARE

WHAT:

- ONE MONTH STUDY
- START AND EXIT INTERVIEWS
- WEEKLY SURVEY

Carnegie Mellon University

RESEARCHERS AT CMU ARE CURRENTLY RECRUITING PARENTS OF CHILDREN WHO OWN A SMARTPHONE (AGE 10-18) FOR A RESEARCH STUDY.



Mechanical Turk is a marketplace for work.

We give businesses and developers access to an on-demand, scalable workforce.

Workers select from thousands of tasks and work whenever it's convenient.

376,614 HITs available. [View them now.](#)

Make Money by working on HITs

HITs - *Human Intelligence Tasks* - are individual tasks that you work on. [Find HITs now.](#)

As a Mechanical Turk Worker you:

- Can work from home
- Choose your own work hours
- Get paid for doing good work



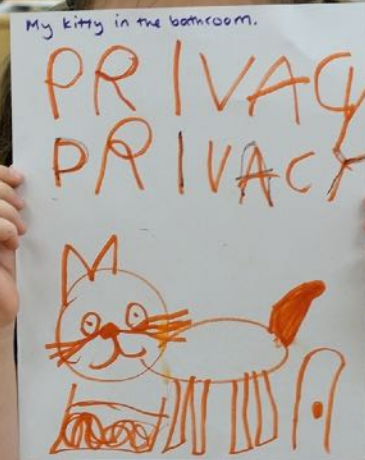
Get Results from Mechanical Turk Workers

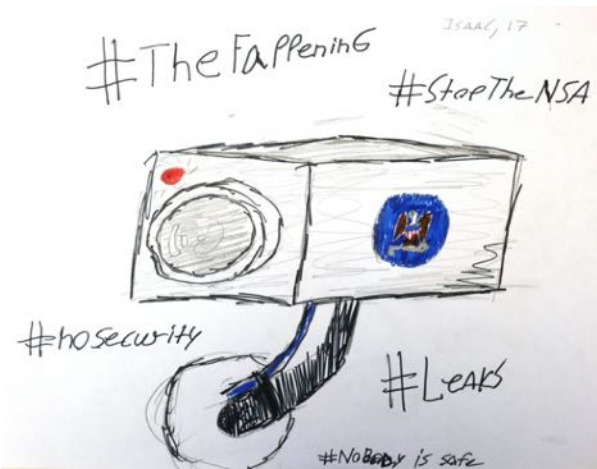
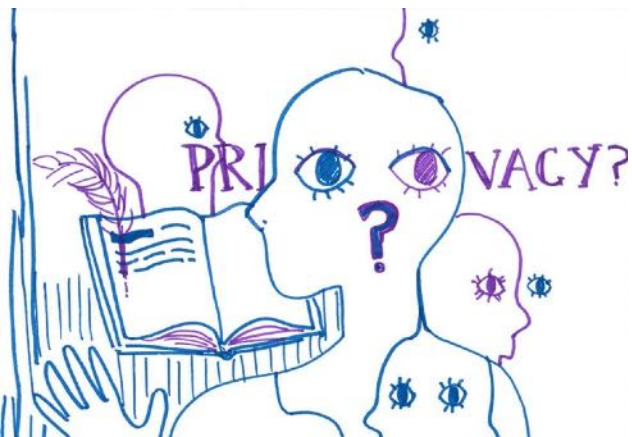
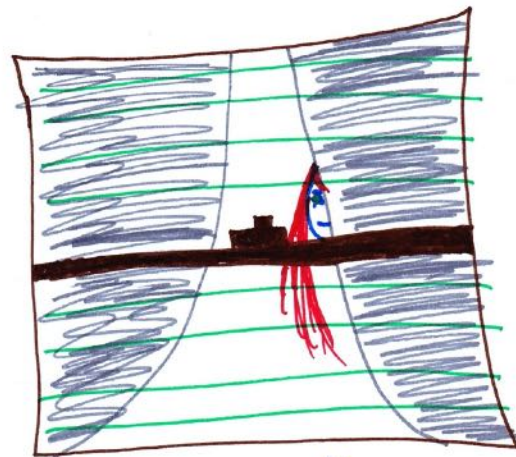
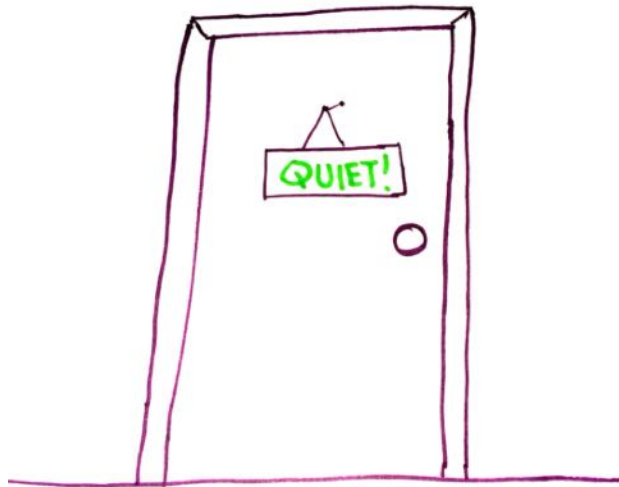
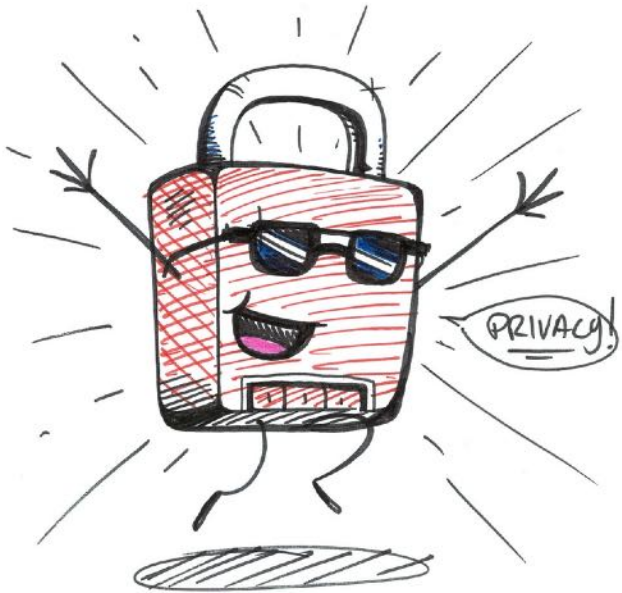
Ask workers to complete HITs - *Human Intelligence Tasks* - and get results using Mechanical Turk. [Get Started.](#)

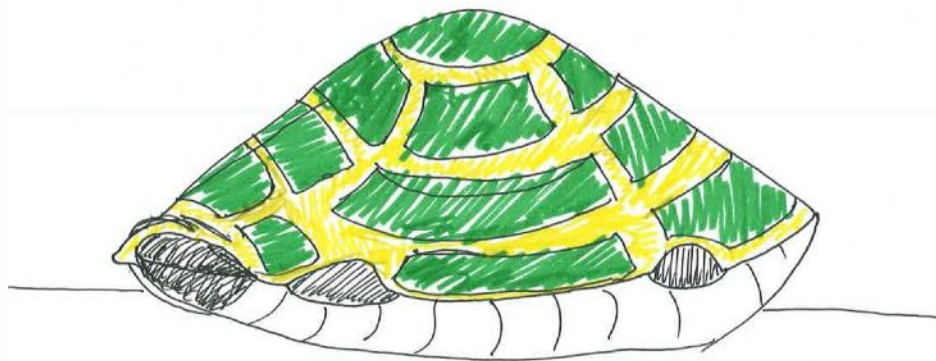
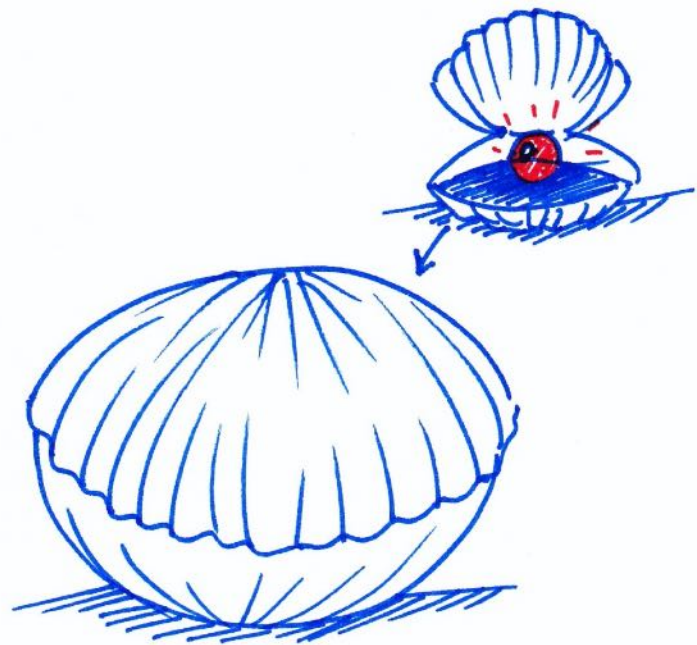
As a Mechanical Turk Requester you:

- Have access to a global, on-demand, 24 x 7 workforce
- Get thousands of HITs completed in minutes
- Pay only when you're satisfied with the results









Anisha
age 8½

Privacy

SHOWERING
PRIVACY

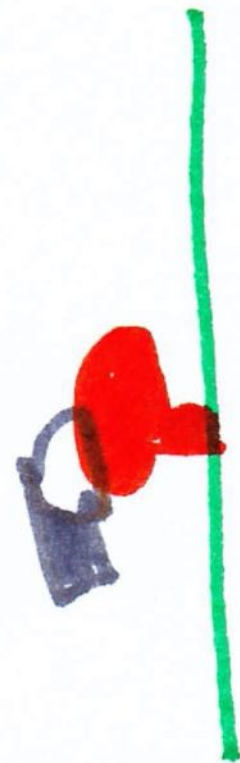


Someone going to the bathroom.

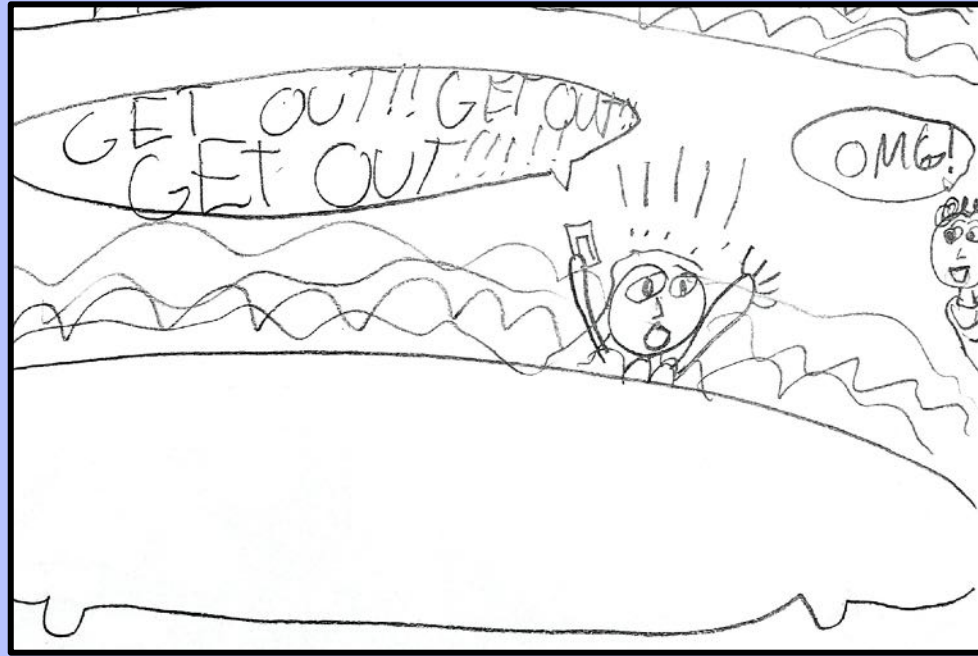
My kitty in the bathroom.

PRIVACY
PRIVACY

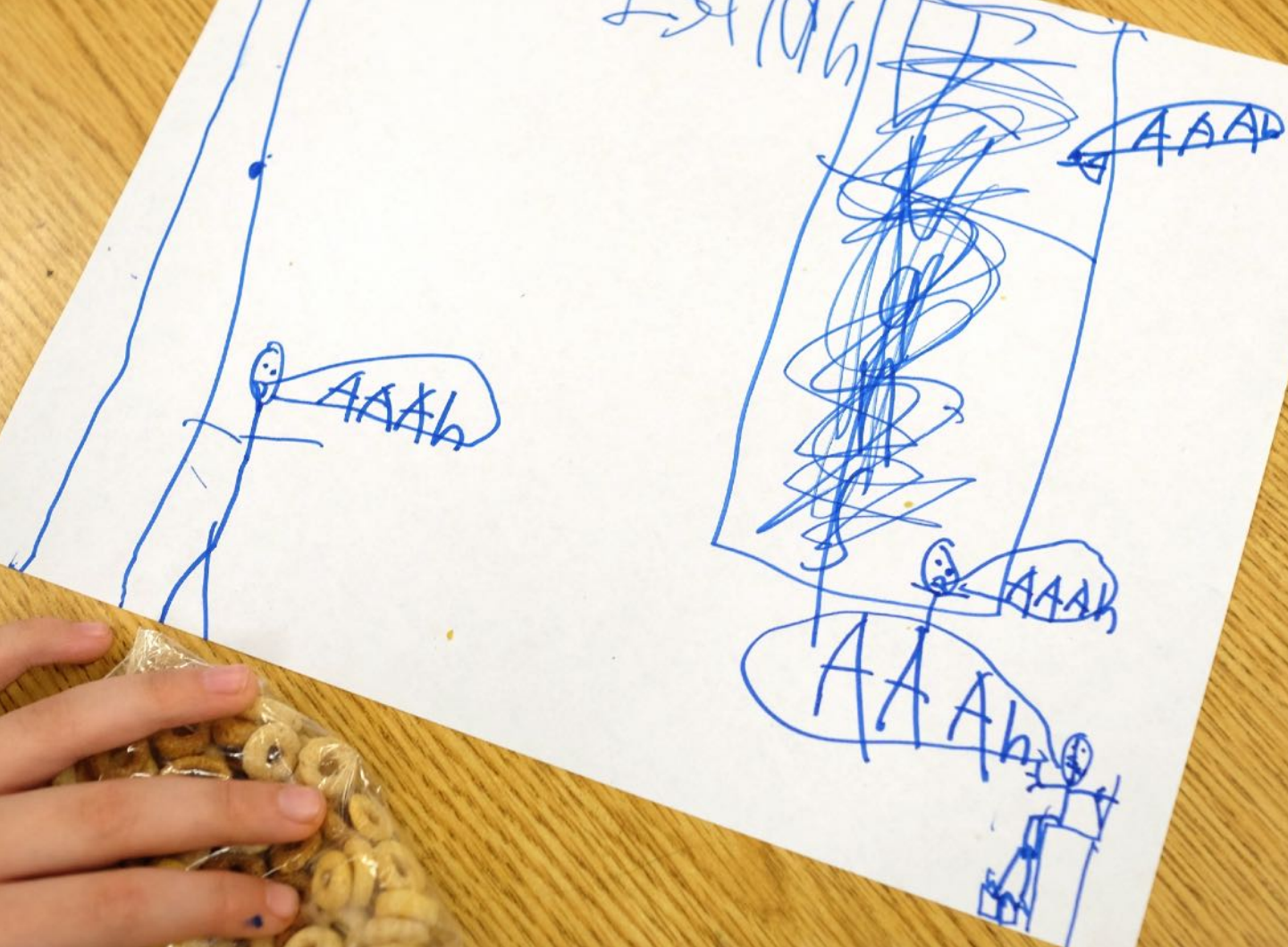


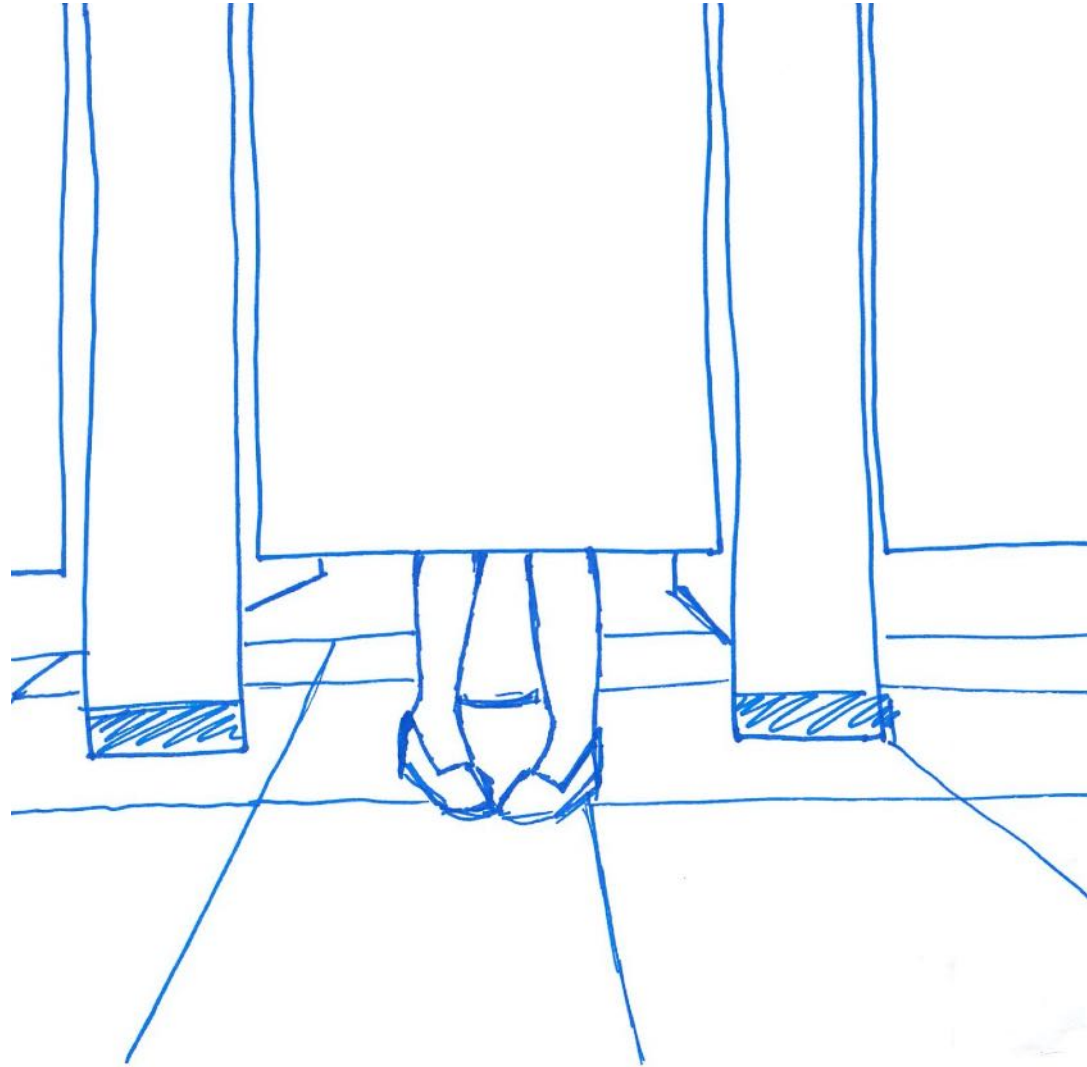


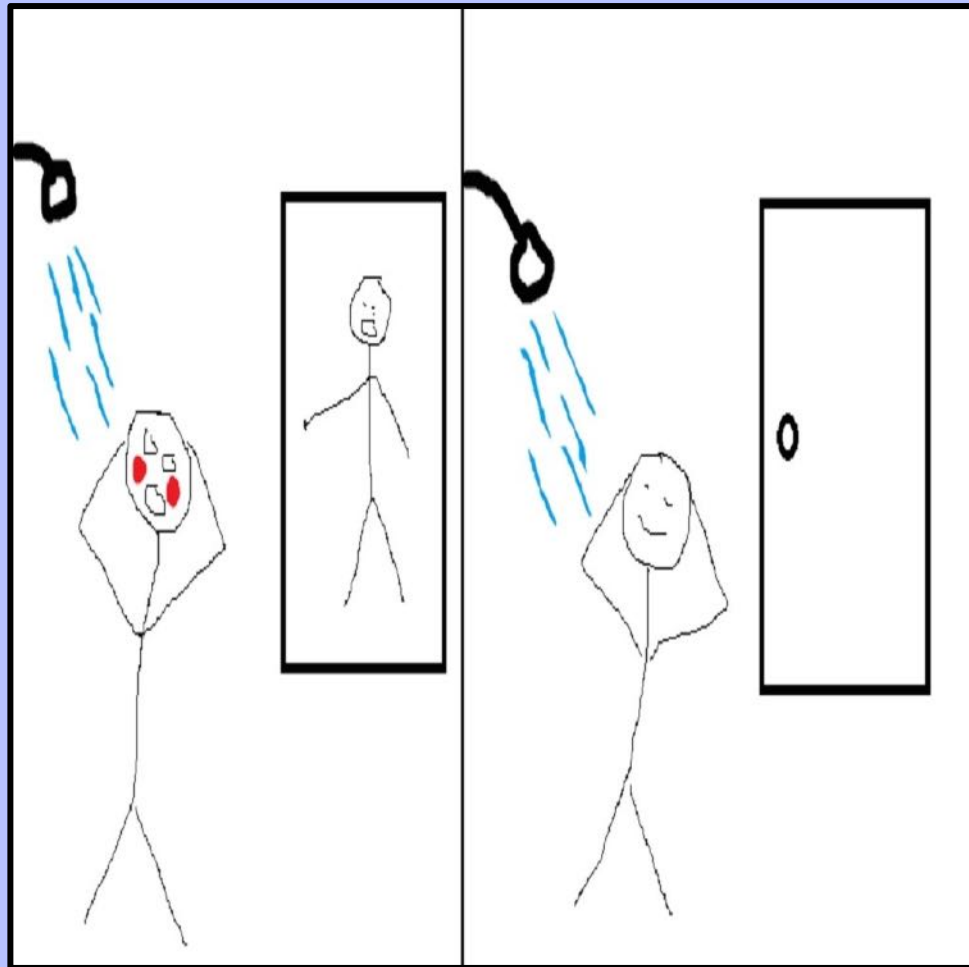




2-24-1966







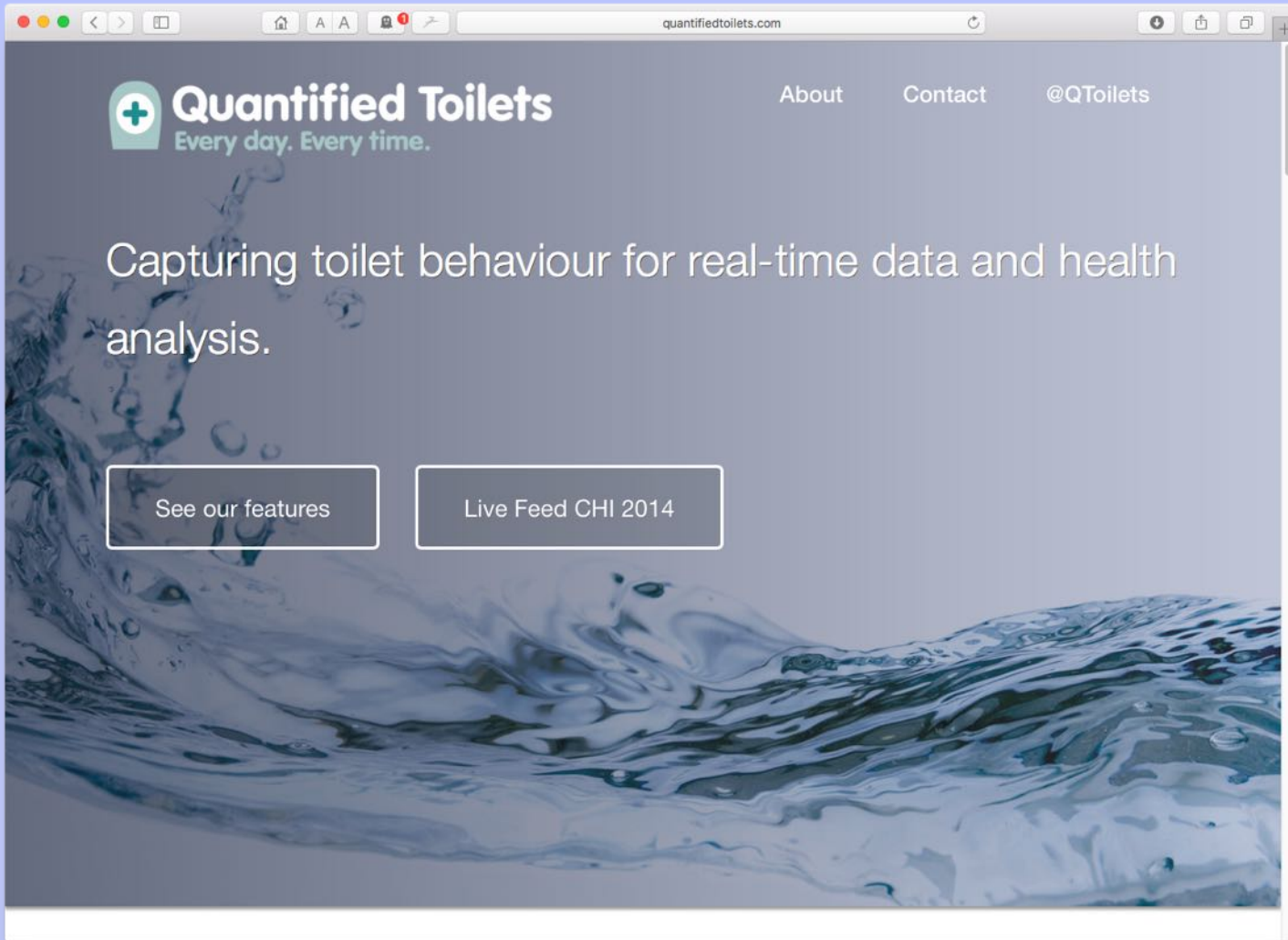
This is the only time during the day, where I am truly alone and nothing bothers me. No man, no children, no dogs.



This facility is proud to participate in the healthy building initiative.
Behaviour at these toilets is being recorded for analysis.
Access your live data at **quantifiedtoilets.com**



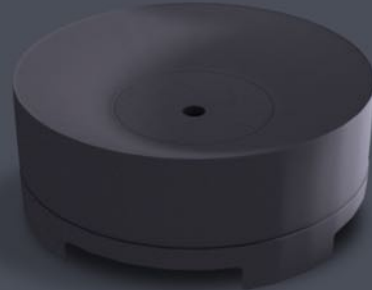
Recent anonymized random data feed								
Time	Toilet ID	Sex	Deposit	Odor	Blood alcohol	Drugs detected	Pregnancy	Infections
02:17:43 PM	T119	male	90ml	neutral	0.061%	no	no	none
02:17:23 PM	T115	female	135ml	neutral	0.000%	no	no	none
02:16:44 PM	T300	female	150ml	neutral	0.002%	yes	no	none
02:15:55 PM	T711	male	100ml	acidic	0.000%	no	no	none
02:10:00 PM	T113	male	90ml	neutral	0.000%	no	no	none
01:59:48 PM	T210	female	100ml	neutral	0.002%	no	no	none
01:55:43 PM	T719	female	255ml	acidic	0.000%	no	no	none
01:54:48 PM	T212	male	100ml	neutral	0.000%	yes	no	none
01:48:37 PM	T209	male	225ml	neutral	0.000%	no	no	none





Hydralert is the world's first highly engaging, real time, non-invasive hydration testing and warning device for individuals.

Hydralert automates traditional manual hydration testing, assists in evaluating a groups' risk of heat related illness and actively engages individuals in proper hydration habits via self-testing.



SMART DISC HARDWARE

The Hydralert hardware consists of the Hydralert smart disc, approximately the size of a hockey puck, and an easily mountable OLED screen. The Hydralert smart disc is placed at the bottom of a urinal with the screen mounted at the users' approximate line of sight. As urine contacts the Hydralert smart disc the individual's hydration range is read and displayed on the screen instantaneously via Bluetooth communication.

- ✓ WATERPROOF HARDWARE
- ✓ BLUETOOTH CONNECTIVITY

SCI-TECH

AI toilets will scan your poop to diagnose your ailments

Micron CEO Sanjay Mehrotra sees smart loos in our future and is anxious to sell the chips they will need.

BY STEPHEN SHANKLAND | NOVEMBER 12, 2018 3:46 PM PST

The Duravit BioTracer
Das erste App-gesteuerte WC zur Urinanalyse.

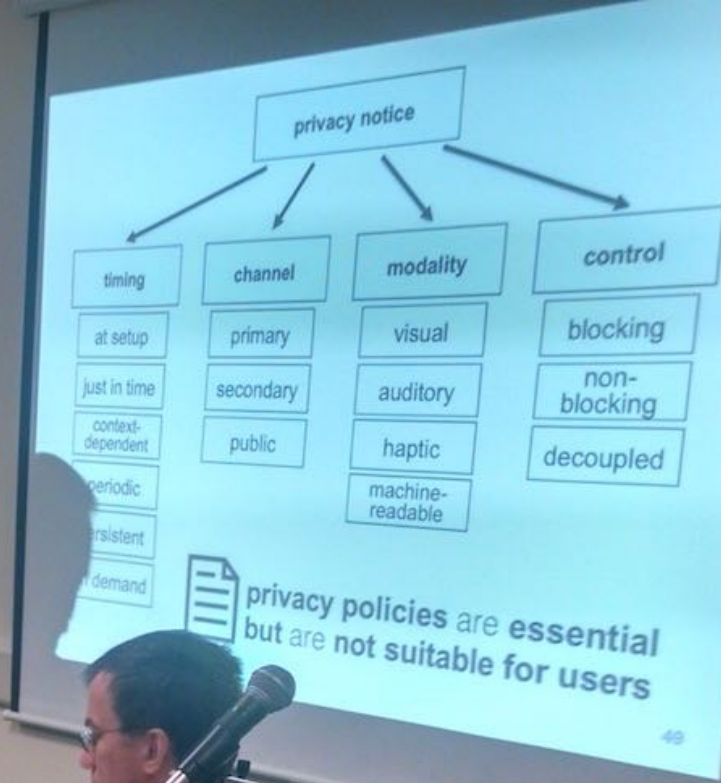
The Duravit BioTracer
The first app-controlled toilet for urine analysis.



Design exercise: quantified toilets



In your breakout groups, come up with an effective way to provide privacy notices to users. Feel free to redesign the toilet, stall, or entire restroom. Bonus points for integrating consent options!



2

<SIGN>

Flush up!



Decline



<SIGN>

Confirm



Flushdown



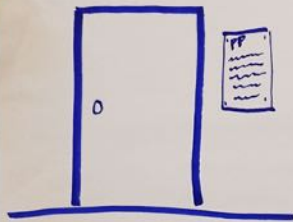
← DECLINE

→ ACCEPT/CONFIRM

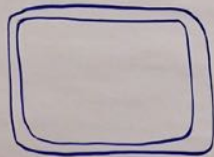
AT SETUP:

PRIVACY POLICY
POSTED OUTSIDE
OF BATHROOM
ENTRANCE.

INCLUDES
LINK TO
WEBSITE W/
PRIVACY POLICY



FOOT
CONTROLLED
OPT IN/OUT
CONTROLS



SCREEN MONITOR
WITH AUDITORY
CAPABILITIES FOR
VISUALLY IMPAIRED





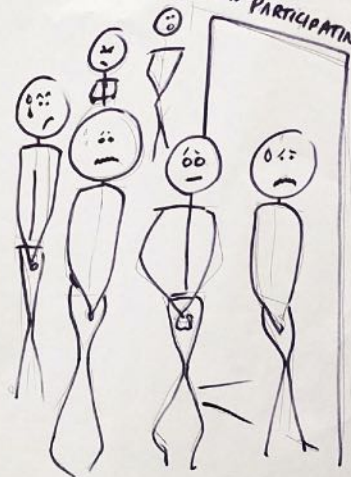
YOUR HEALTH,
YOUR CHOICE!

NOTICE ①

NOTICE PARTICIPATING



NO NOTICE
NON-PARTICIPATING



Would you like
to be analyzed?

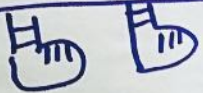
- o Yes
- o No

Sanitizer
o

(touch screen) default
(microphone)

—

"Speak now or forever hold
your pee...."



Do your
Duty!

Your deposit makes
a difference.

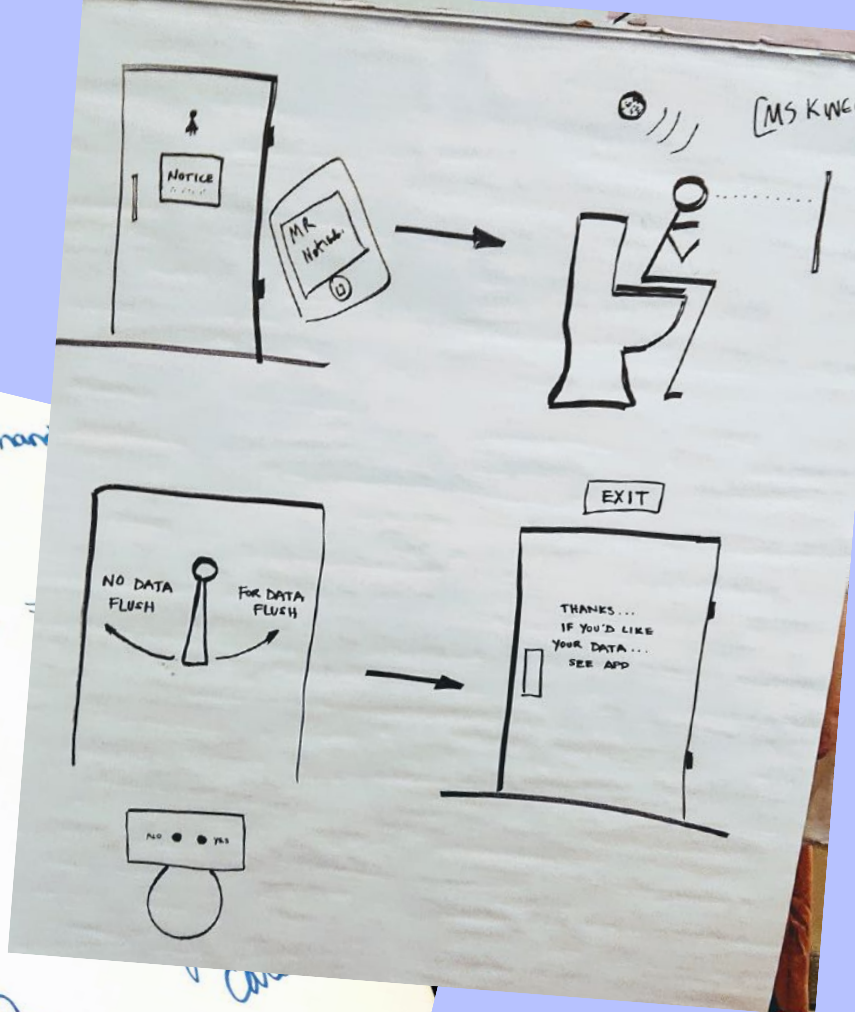
regular
health care costs

no
swipe of
badge

"Swipe +
Wipe"
Program

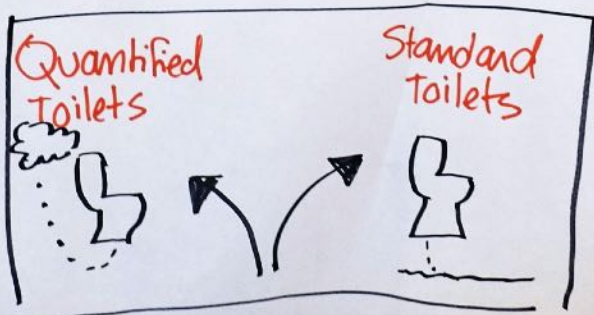
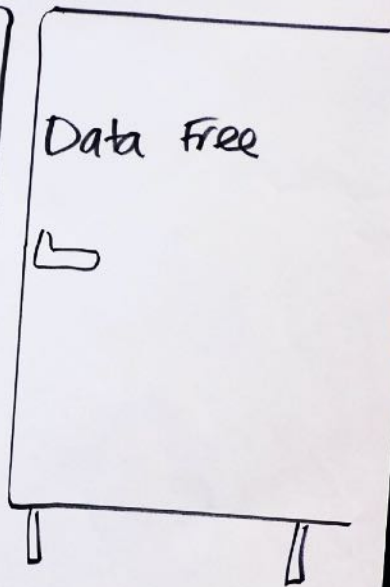
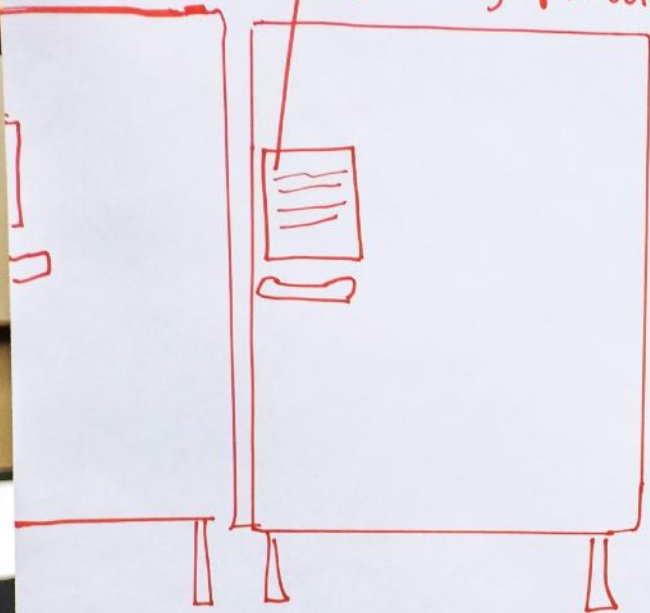


notice
HR Group
+ Employee hand



build in
incentives
... = \$\$\$ back

By opening door - consent
to processing of biobotta





INNOVATION

Here's how smart toilets of the future could protect your health

"Everything these days is connected and smart, but I feel like the bathroom is a very untapped area."



4 WEATHER ALERTS IN EFFECT

Virus that causes COVID-19 found during wastewater test at two UNCC dorms



(WSOC)



Share



Share



Share

By: WSOCTV.com News Staff

Updated: November 16, 2020 - 6:54 PM

CHARLOTTE, N.C. — Students at the University of North Carolina at Charlotte are having to stay inside their dorms after the virus that causes COVID-19 was detected in the wastewater at two residence halls.

School officials sent out a Niner Alert Monday evening saying the university's wastewater testing detected the presence of SARS-CoV-2, the virus that causes COVID-19, in its routine sampling at two residence halls.



Morning Mix

The University of Arizona says it caught a dorm's covid-19 outbreak before it started. Its secret weapon: Poop.



Graduate students and employees process nasal swabs from coronavirus tests in a lab at the University of Arizona in Tucson on Aug. 24. (Cheney Orr/Bloomberg News)

By **Jaclyn Peiser**

August 28, 2020 at 5:50 a.m. EDT

+ Add to list

As 5,000 students prepared for move-in day at the University of Arizona this week, the school warned they would be tested periodically for the [coronavirus](#). One test, though, doesn't involve a nose swab. The university is regularly screening the sewage from each dorm, searching for traces of the virus.

WORLD

India's city of Pune focuses on sanitation system of the future

More than 400 million people defecate in the streets in the world's second-most populous country.





A mountable toilet system for personalized health monitoring via the analysis of excreta

Seung-min Park^{1,2,17}, Daeyoun D. Won^{1,3,4,17}, Brian J. Lee^{1,2,17}, Diego Escobedo¹, Andre Esteve⁵, Amin Aalipour^{1,2}, T. Jessie Ge⁶, Jung Ha Kim², Susie Suh⁷, Elliot H. Choi⁷, Alexander X. Lozano^{8,9}, Chengyang Yao¹⁰, Sunil Bodapati¹¹, Friso B. Achterberg^{12,12}, Jeeseu Kim^{12,13}, Hwan Park¹⁴, Youngjae Choi¹⁴, Woo Jin Kim¹⁴, Jung Ho Yu¹², Alexander M. Bhatt¹, Jong Kyun Lee^{3,4}, Ryan Spitler^{1,15}, Shan X. Wang^{8,10,16} and Sanjiv S. Gambhir^{1,2,8,11,15,16,17}

Technologies for the longitudinal monitoring of a person's health are poorly integrated with clinical workflows, and have rarely produced actionable biometric data for healthcare providers. Here, we describe easily deployable hardware and software for the long-term analysis of a user's excreta through data collection and models of human health. The 'smart' toilet, which is self-contained and operates autonomously by leveraging pressure and motion sensors, analyses the user's urine using a standard-of-care colorimetric assay that traces red-green-blue values from images of urinalysis strips, calculates the flow rate and volume of urine using computer vision as a uroflowmeter, and classifies stool according to the Bristol stool form scale using deep learning, with performance that is comparable to the performance of trained medical personnel. Each user of the toilet is identified through their fingerprint and the distinctive features of their anoderm, and the data are securely stored and analysed in an encrypted cloud server. The toilet may find uses in the screening, diagnosis and longitudinal monitoring of specific patient populations.

The US Precision Medicine Initiative defines precision medicine as 'an emerging approach for disease treatment and prevention taking into account individual variability in genes, environment, and life style for each person'¹. Clinicians today can conduct panoramic molecular analyses to characterize many diseases, but current precision medicine is still primarily limited to disease treatment rather than prevention and early detection. The current manifestations of precision medicine address disease retrospectively after many symptoms have already appeared. Although clinicians are able to tailor therapies to address the disease process of each patient, they are at a considerable disadvantage owing to possible delayed treatment. Thus, equal emphasis should be given to disease prevention and early detection as well as disease treatment.

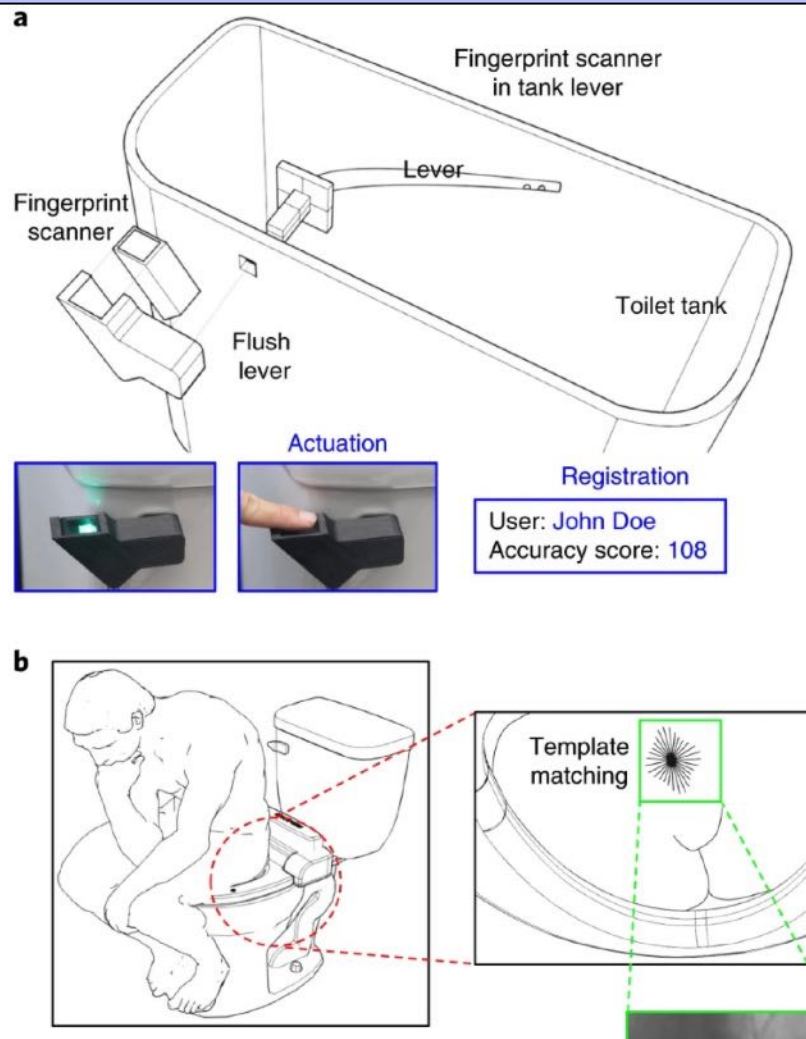
Instead of precision medicine, the rapidly evolving field of precision health has expanded efforts in the prevention and early detection of disease through risk-tailored longitudinal monitoring². A similar idea is already realized in the aircraft industry, which implements continuous monitoring of jet engines with hundreds of sensors to prevent engine failure. Unfortunately, in contrast to the aircraft industry, the fact that a normal adult in the United States visits a healthcare provider fewer than four times per year³ implies that surveillance of the human body is limited, infrequent and possibly

insufficient. Implementing precision health strategies is therefore believed to make a considerable difference to both the habits and the health of a person over a long period of time. In this regard, we previously proposed a framework for precision health⁴, suggesting the importance of 'passive monitoring and the smart home' and 'delivering information and guidance through the health portal'.

Invasive clinical procedures are not suitable for continuous health monitoring in a non-clinical environment, as they are often distressing, costly and burdensome for the public. Even a minimally invasive blood draw, despite its great potential in diagnostics⁵, is burdensome when it comes to the healthy population. Thus, the ideal sources of diagnostic information for continuous health monitoring are the potentially information-rich molecular contents of breath^{6,7}, sweat^{8,9}, saliva^{10,11}, urine and stool^{12–15}, all of which are complex by-products that are affected by human body systems, activities and external environments that provide valuable information on an individual's health and are naturally excreted every day. Routine medical tests for these excreta include urinalysis, uroflowmetry and stool analysis, such as microscopic examination, chemical tests and microbiological tests. Criminals are important for accessing the biochemical constituents of the urine and its relationship with various disease states, such as diabetes, metabolic

¹Department of Radiology, Stanford University School of Medicine, Stanford, CA, USA. ²Molecular Imaging Program at Stanford, Stanford University School of Medicine, Stanford, CA, USA. ³Department of Surgery, Seoul Song Do Hospital, Seoul, Republic of Korea. ⁴Cancer Immunology Laboratory, Seoul, Song Do Hospital, Republic of Korea. ⁵Salesforce Research, Palo Alto, CA, USA. ⁶Department of Urology, Stanford University School of Medicine, Stanford, CA, USA. ⁷Department of Pharmacology, Case Western Reserve University School of Medicine, Cleveland, OH, USA. ⁸Department of Materials Science and Engineering, Stanford University, Stanford, CA, USA. ⁹Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada. ¹⁰Department of Electrical Engineering, Stanford University, Stanford, CA, USA. ¹¹Department of Biomedical Engineering, Stanford University, Stanford, CA, USA. ¹²Department of Surgery, London University Medical Center, London, UK. ¹³Department of Engineering, Pohang University of Science and Technology (POSTECH), Pohang, Republic of Korea. ¹⁴College of Medicine, The Catholic University of Korea, Seoul, Republic of Korea. ¹⁵Precision Health and Integrated Diagnostic Center (PHIND), Stanford University School of Medicine, Palo Alto, CA, USA. ¹⁶Canary Center at Stanford for Cancer Early Detection, Stanford University School of Medicine, Palo Alto, CA, USA. ¹⁷These authors contributed equally: Seung-min Park, Daeyoun D. Won, Brian J. Lee.

[✉]e-mail: sgambhir@stanford.edu



TOMORROW'S PIPE



TODAY.

[adult swim]



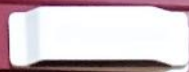


USER PRIVACY AGREEMENT



📍 YOUR LOCATION

ACCEPT







止

おしり

ムーフ入切

ビデ

ムーフ入切

乾燥

水勢

着座センサー

運転

Is the lavatory
occupied?







Disconnect Privacy Icons

Info Share

examplesite.com



Privacy Icons Search

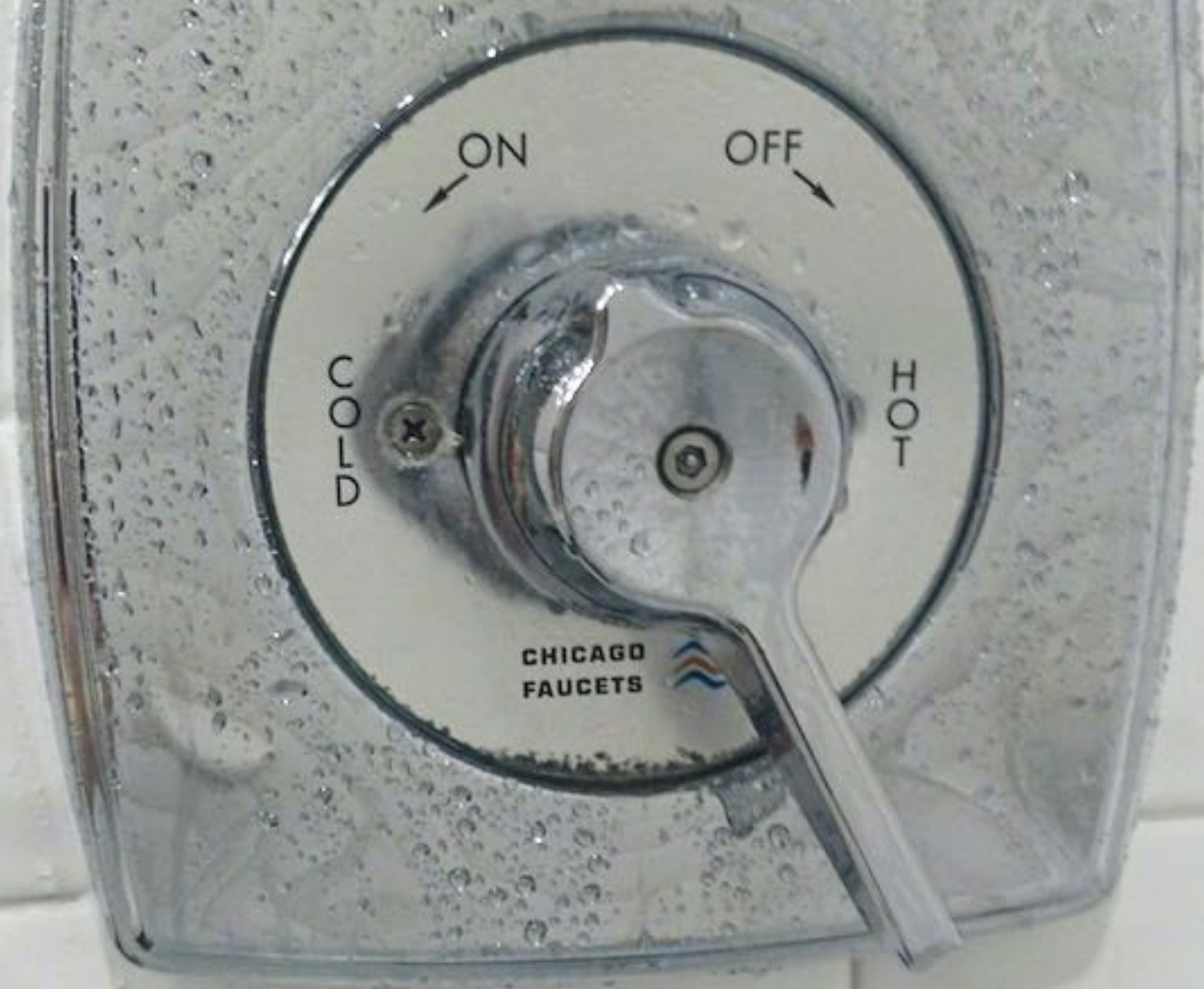


Display Options

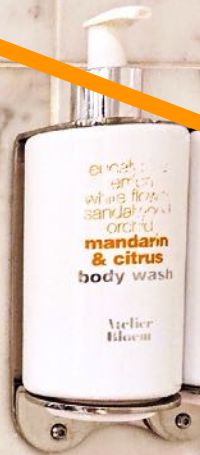








To Activate Shower
Pull Handle Forward
For Hot Water
Turn Red Arrow to Left
For Cold Water
Turn Blue Arrow to Right



To Activate Shower
Pull Handle Forward
For Hot Water
Turn Red Arrow to Left
For Cold Water
Turn Blue Arrow to Right






PUSH
ON





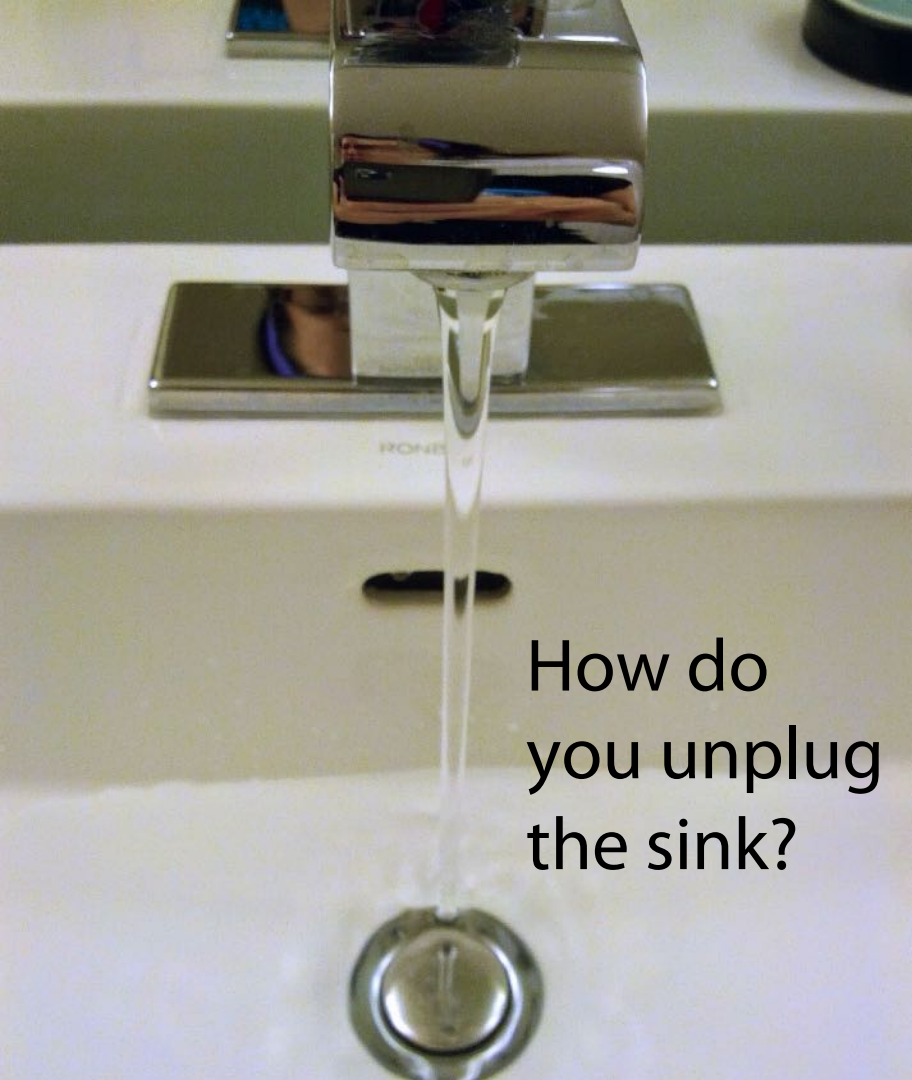
A photograph of a bathroom corner. A white towel hangs on a brass towel rack with a blue card attached. To the left, a round mirror on a brass stand sits on a white ledge. To the right, a door with a floral pattern and a brass handle is visible. The text "Where is the light switch?" is overlaid in the center.

Where is
the light
switch?



Where is
the light
switch?

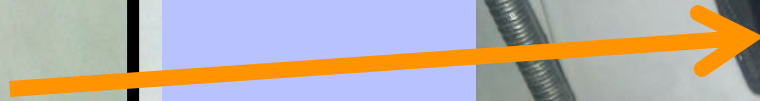




How do
you unplug
the sink?







A close-up photograph of a person's hands being washed under a stream of water from a modern, cylindrical stainless steel faucet. The faucet is mounted on a dark grey countertop. A blue cylindrical sensor is attached to the side of the faucet, with a white label that reads "Wait for air to activate." and a small icon of a hand. The person, wearing a bright green t-shirt and a purple wristband, has their hands under the water. The background shows a white subway tile wall and a mirror reflecting part of the scene.

Hand dryer is
attached to faucet



It's a bit awkward to
wash your hands



Unfortunately these Urinals are out of order.
We aim to resolve this maintenance problem
as soon as possible.
We apologise for any inconvenience caused.

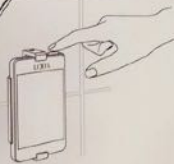


Where can
we find one
that works?



Quick guide to using LIXIL SENSIA for women

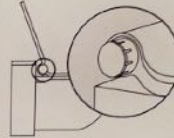
Start



Push the button on
the top of the remote control.



When you sit on the toilet seat,
The remote control & the side control
will be activated.



Now the functions of sensia can be controlled
by the remote control or the side control.

Wash



with Side control

Lady shower

Start / Stop*



*Press the button shortly.

Rear shower

Start / Stop*



Lady shower



Rear shower



Decrease
spray intensity



Increase
spray intensity



Extend
spray arm



Retract
spray arm



Oscillation



Pulsation



Stop



Power
shower



Dry



Dryer



with Side control

To stop the dryer,
press the button shortly.

Decrease dryer
temperature



Increase dryer
temperature



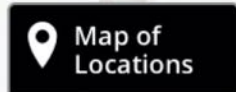
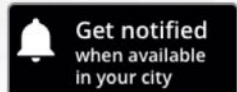
Stop



Unlock the door to a brand new restroom experience

Just launched! Find and
securely access modern
restrooms – all through your
smartphone

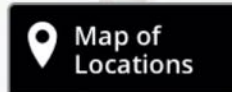
Free for a limited time!



Unlock the door to a brand new restroom experience

Just launched! Find and
securely access modern
restrooms – all through your
smartphone

Free for a limited time!



juan in sf



@juanbuis

Follow



i'm in san francisco, the city where I can't
use the restroom as it requires me to sign up
for an app with a US phone number



音姫
FLUSHING SOUND
流水音
유수음

BIDET

音姬 FLUSHING
SOUND



音量
VOLUME



流す
FLUSH
冲洗
물 내림

III
流す
FLUSH



NO



YES



Inside latch



Outside
indicator

Restroom Need Attention?

Send a text to: **43766**

Include the room code below
along with any comments:

"7334 needs soap!"

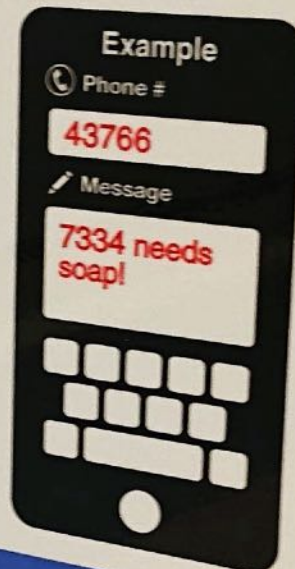
All feedback is completely anonymous. Your name and phone
number are never disclosed.



PITTSBURGH
INTERNATIONAL AIRPORT

RestroomAlert.com

Message and data rates may apply. Send STOP to opt-out.



Room Code **7334**

"THE PRIVACY COVER"

PATENT PENDING

www.theprivacycover.com





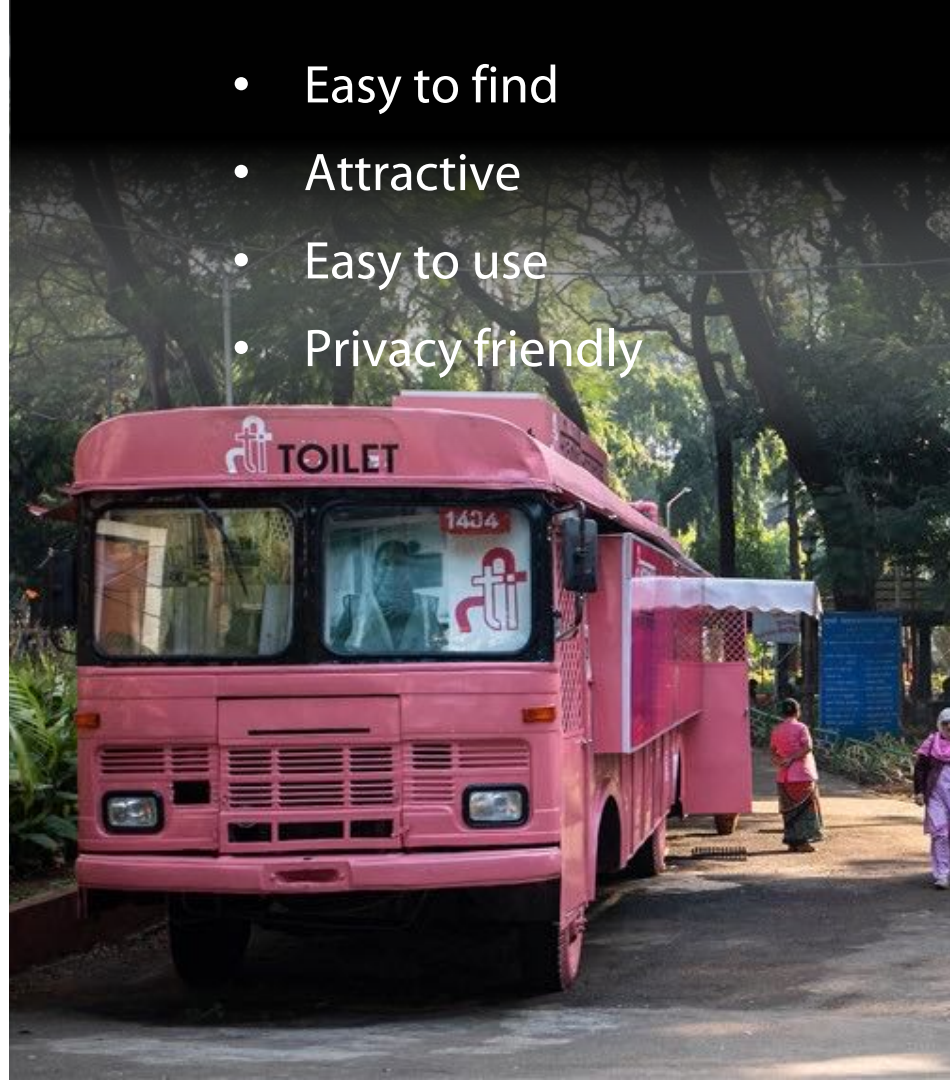
tokyotoilet.jp/en/yoyogifukamachi_mini_park/



tokyotoilet.jp/en/yoyogifukamachi_mini_park/



- Easy to find
- Attractive
- Easy to use
- Privacy friendly



- Add words to icons
- Standardize controls
- Don't hide controls
- Build PETs that are simple, intuitive, attractive, and fail safe
- Test with users