

COMPUTER SCIENCE AND HUMAN-COMPUTER INTERACTION

Alessio Bellino

Postdoctoral researcher

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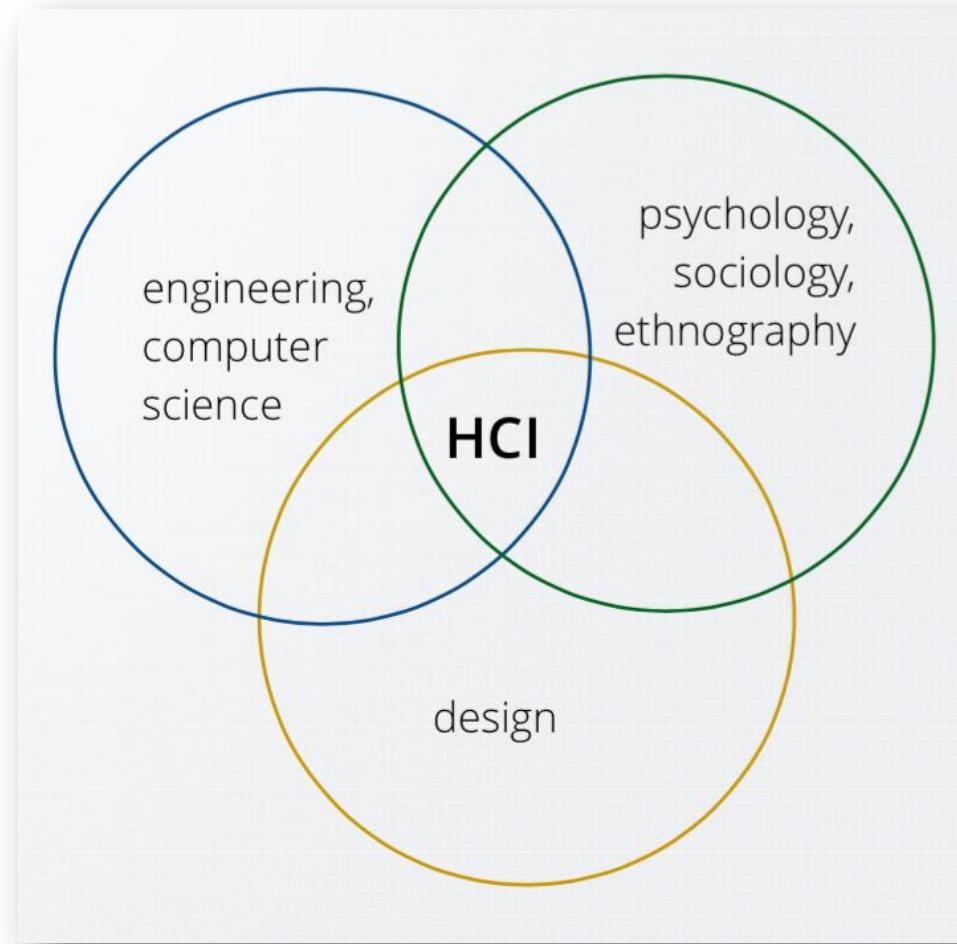
abellino@uc.cl

ABOUT ME

PhD in Computer Science, master degree in Theory and Technology of Communication (between psychology and computer science) and *bachelor degree in Communication Studies* (social science).

<https://alessiobellino.com>

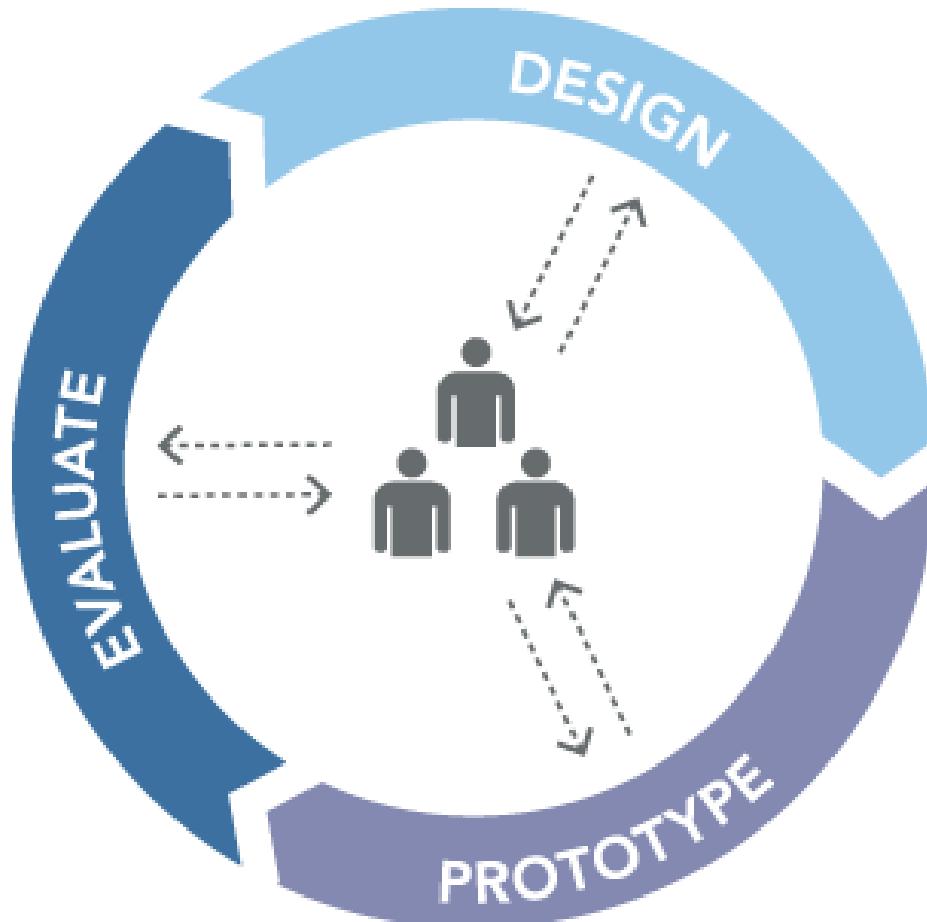
Interdisciplinarity in HCI



- Accessibility
- Aesthetics
- Ambient Devices / Internet of Things
- Analysis Methods
- Application Instrumentation / Usage Logs
- Applying Development Theory
- Applying Theories on Learning
- Architecture
- Art
- Artifact or System
- Assistive Technologies
- Audio/Video
- Automobile
- Behavior Change
- Biofeedback Games, Affective Games and Neurogaming
- Camera-Based UIs
- Children/Parents
- City
- Classical GUI
- Collaboration
- Collaboration Architectures
- Collaborative Information Retrieval
- Collaborative Software Development
- Collaborative Visualization
- Commerce / Business
- Community Analysis and Support, Virtual or Physical
- Computer Mediated Communication
- Computer Vision
- Concurrency Control
- Content Analysis
- Contextual Inquiry
- Conversation Analysis
- Creativity and Children
- Crisis/Disaster
- Critical/Activism/Ethics
- Cross-Cultural Systems or Studies
- Crowdfunding
- Crowdsourced
- Crowdsourcing
- Cultural Heritage/History
- Cultural Theory
- Curation
- Dataset
- Design Case
- Design Guidelines
- Design Methods
- Design Research Methods
- Desktop/Laptop Computers
- Diary Study
- Digital Art
- Distributed/Virtual Teams
- Education/Learning
- Email/Texting/Communication
- Embodied Cognition
- Embodied Interaction
- Emotion / Affective Computing
- Empirical Methods
- Engineering
- Entertainment
- Entertainment/Games
- Essay/Argument
- Ethnography
- Evaluation Methods
- Experience Sampling
- Eye Tracking
- Fabrication
- Fashion/Clothing
- Field Study
- Finance/Money
- Game Design
- Game Development and Tools
- Game Economies and Esports
- Game Interfaces and Controllers
- Games for Health, Learning, Persuasion, Or Change
- Games User Research, Evaluation, and Game Analytics
- Games/Play
- Gamification
- Gender/Identity
- Graphics / 3d
- HCI for Development
- Health - Clinical
- Health - Wellbeing
- Home
- Humanities
- Image and Video Processing in UI
- Individuals with Disabilities
- Industrial Design
- Information Seeking & Search
- Infrastructure
- Innovation
- Input Techniques
- Installation
- Interaction Design
- Interview
- Lab Study
- Location-Aware/Contextual Computing
- Location-Based and Context-Aware Computing
- Machine Learning
- Maker Culture
- Media Studies
- Medical and Health Support
- Medical: Nursing Homes/Hospitals
- Meta-Analysis/Literature Survey
- Method
- Methods for Involving Children in Design
- Mixed Methods
- Mixed Reality
- Mixed-Reality and Alternate Reality Games
- Mobile and Embedded Devices
- Mobile Devices: Phones/Tablets
- Movement / Dance / Choreography
- Music + Audio
- Navigation
- Novel Applications for Children
- Novel Interaction Techniques
- Older Adults
- Other Domain-Specific Support
- Participatory Design
- Pen-Based UIs
- Performance Metrics
- Personal Data/Tracking
- Personalization
- Pets/Animals
- Player Experience and Motivation
- Playfulness
- Policy/Politics/Legal Issues
- Privacy
- Product Design
- Programming Kits for Children
- Programming/Development Support
- Prototyping/Implementation
- Psychology of Players and Player Typologies
- Public Displays
- Qualitative Methods
- Quantitative Methods
- Reflection on Design Processes
- Reflection Papers on IDC
- Robot
- Rural Areas
- Safety
- Safety-Critical Systems
- Schools/Educational Setting
- Security
- Sensors
- Service Design
- Sketching
- Smart Environments / Connected Home
- Smart Materials
- Social Media
- Social Media/Online Communities
- Social Network Analysis
- Social Networking Site Design and Use
- Social Psychology
- Sociology
- Software Architecture and Engineering
- Sports/Exercise
- Storytelling
- Studies of Wikipedia/Web
- Survey
- Sustainability
- Tangible
- Tangible UIs
- Tasks/Interruptions/Notification
- Technical Advances
- Telepresence/Video/Desktop Conferencing
- Television/Video
- Text Entry
- Text/Speech/Language
- Theory
- Touch Surfaces and Touch Interaction
- Touch/Haptic/Pointing/Gesture
- Transportation
- Tutorial and Help Systems
- Ubiquitous computing
- Usability Study
- User Experience Design
- User Interface Design
- Video Analysis
- Virtual Worlds/Avatars/Proxies
- Virtual/Augmented Reality
- Visions for IDC
- Visual Art
- Visual Design
- Visual Thinking
- Visualization
- Wearable Computers
- Workflow Management
- Workplaces
- World Wide Web And Hypermedia

Source: CHI conference (area of expertise)

Design Process in HCI



My research in HCI

Touch&Screen: widget collection for large screens controlled through smartphones

TraceMatch: a computer vision technique for user input by tracing of animated controls

Two new gestures to zoom: Two-Finger-Tap for tablets and Tap&Tap for smartphones

Camera Keyboard: text entry for touch devices using cameras

Probject: a rapid prototyping platform for IoT and smart home

An evaluation of WriteBetter: a concordancer integrated into a word processor

SEQUENCE: a remote control technique to select objects by matching their rhythm

My research in HCI

Protobject: a sensing tool for the rapid prototyping of UbiComp systems

Alessio Bellino

Adjunct Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing
PhD Dissertation, University of Milan-Bicocca

INTERACTION WITH THE EVERYDAY ENVIRONMENT IS SOURCE OF CONTEXT THAT CAN BE LEVERAGED TO SUPPORT USERS WITH CONTEXT-AWARE SYSTEMS.

MANY INTERACTIONS CAN BE LEVERAGED

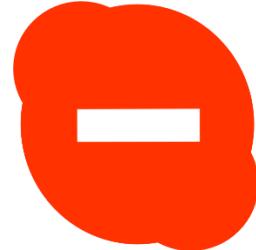
Picking up the phone (interaction)



Hanging up the receiver (interaction)



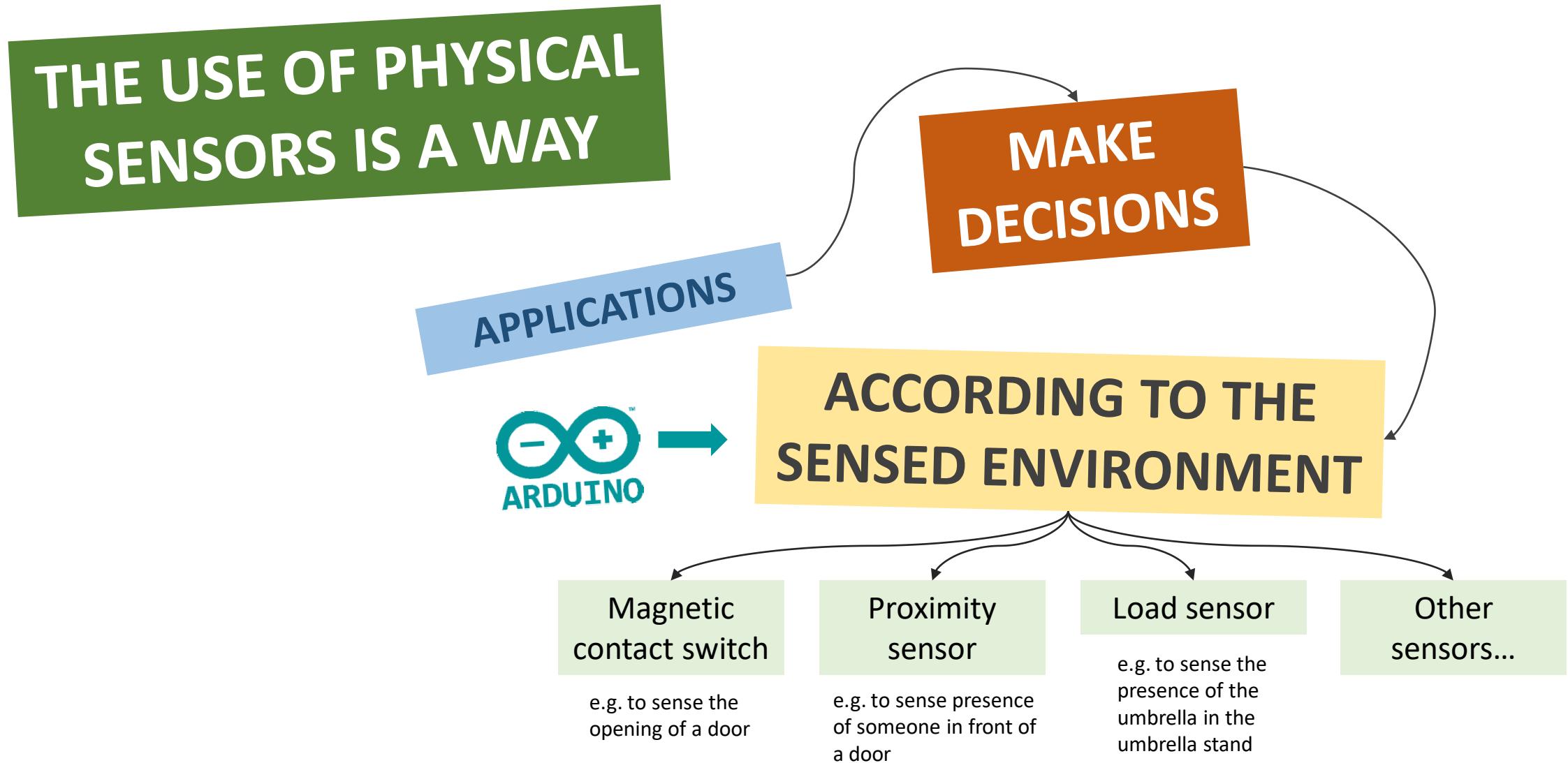
Skype goes to busy automatically
(context-aware application)



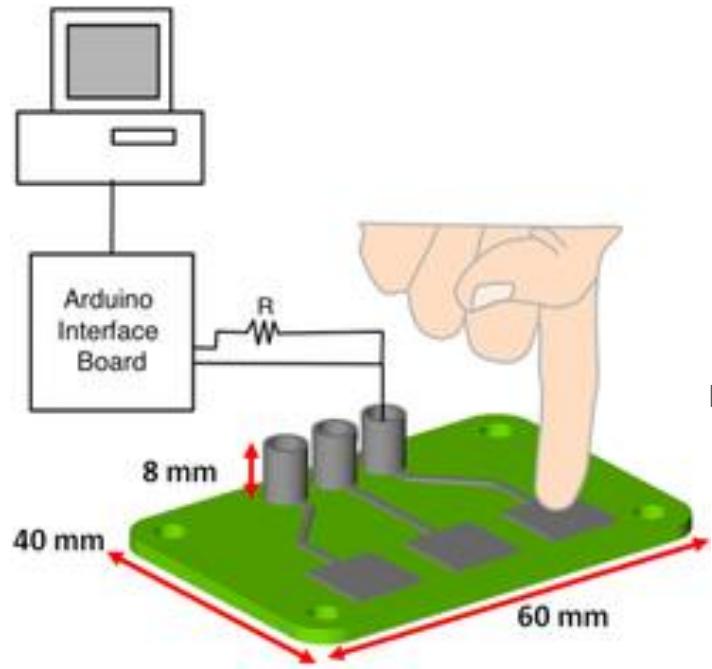
Skype returns to available automatically
(context-aware application)



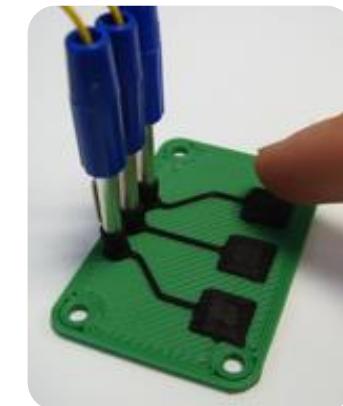
PROTOTYPING OF CONTEXT-AWARE APPLICATIONS



3D-PRINTED COMPONENTS EMBEDDING SENSORS



CAD Design



3D-Printed component with sensors

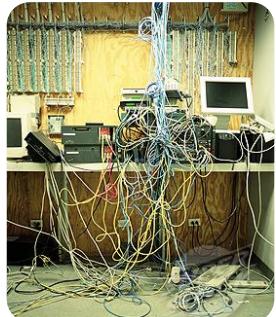
EARLY STAGES OF DESIGN/PROTOTYPING



EARLY STAGES OF DESIGN/PROTOTYPING REQUIRES FLEXIBILITY

Arduino and Sensors are cumbersome:

- Require wires around
- Require installation (of sensors)
- Hardware modifications are usually irreversible



3D Printers are cumbersome:

- Expensive
- Slow
- Require CAD competences



\$ \$ \$ \$ \$

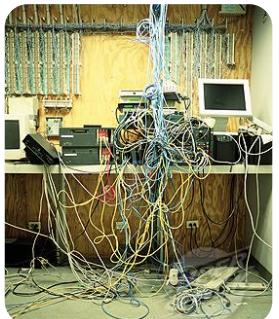
EARLY STAGES OF DESIGN/PROTOTYPING REQUIRES FLEXIBILITY

Arduino and Sensors are cumbersome:

- Require wires around

3D Printers are cumbersome:

*REMARKABLE FOR MAKING, BUT LESS EFFECTIVE
FOR EARLY-STAGE DESIGN/PROTOTYPING*



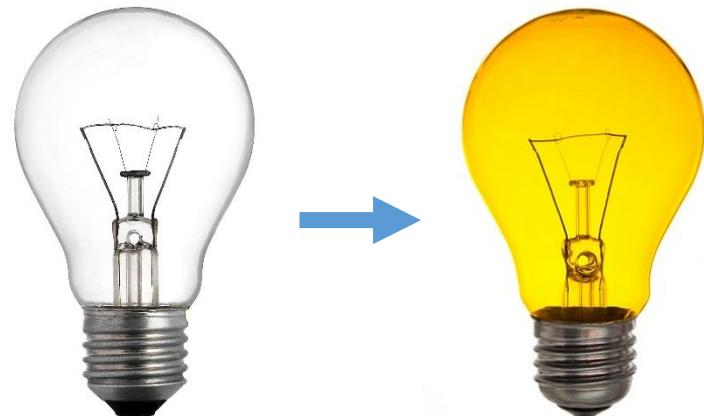
\$ \$ \$ \$

PROTOBJECT: A RAPID PROTOTYPING TOOL FOR INTERNET OF THINGS AND SMART HOME



FROM STATE TO EVENT

Object state changes over time.

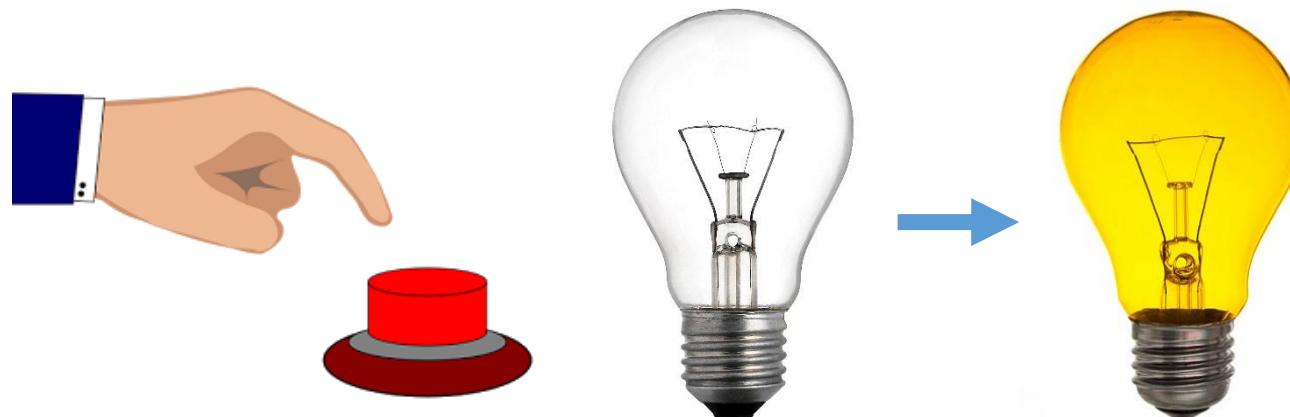


E.g., light changes from turned off to turned on.

Event: light was turned on.

FROM EVENT TO INTERACTION

Frequently, there is an interaction behind an event.



E.g., the light was turned on by Marco.
Interaction: Marco turned on the light.

SUMMING UP

Observing states, designers can capture:

- Events
- Interactions

... which can be leveraged for the prototyping of interactive systems (e.g., smart home, internet of things).

PROTOBJECT OPERATING WAY

IDE to facilitate context-aware app. Development, also integrating Arduino

undefined/untitled.js * - Protoobject IDE

File Edit Preferences Snippets ?

untitled.js*

```
1 function appConfig() {
2   app.setWindowTitle("My first Protoobject app"); //change if you want
3   app.setWindowSize(640,480); //change if you want
4 }
5
6 function appBody() {
7   //when the state of the lamp changes
8   protoobject.onEvent("Lamp", function(e) {
9     console.log("The state of the lamp is: "+e.detail.state);
10   });
11
12   //when the plug is plugged
13   protoobject.onEvent("Plug.Plugged", function(e) {
14     console.log("The plug of the lamp was plugged.");
15   });
16 }
```

Play

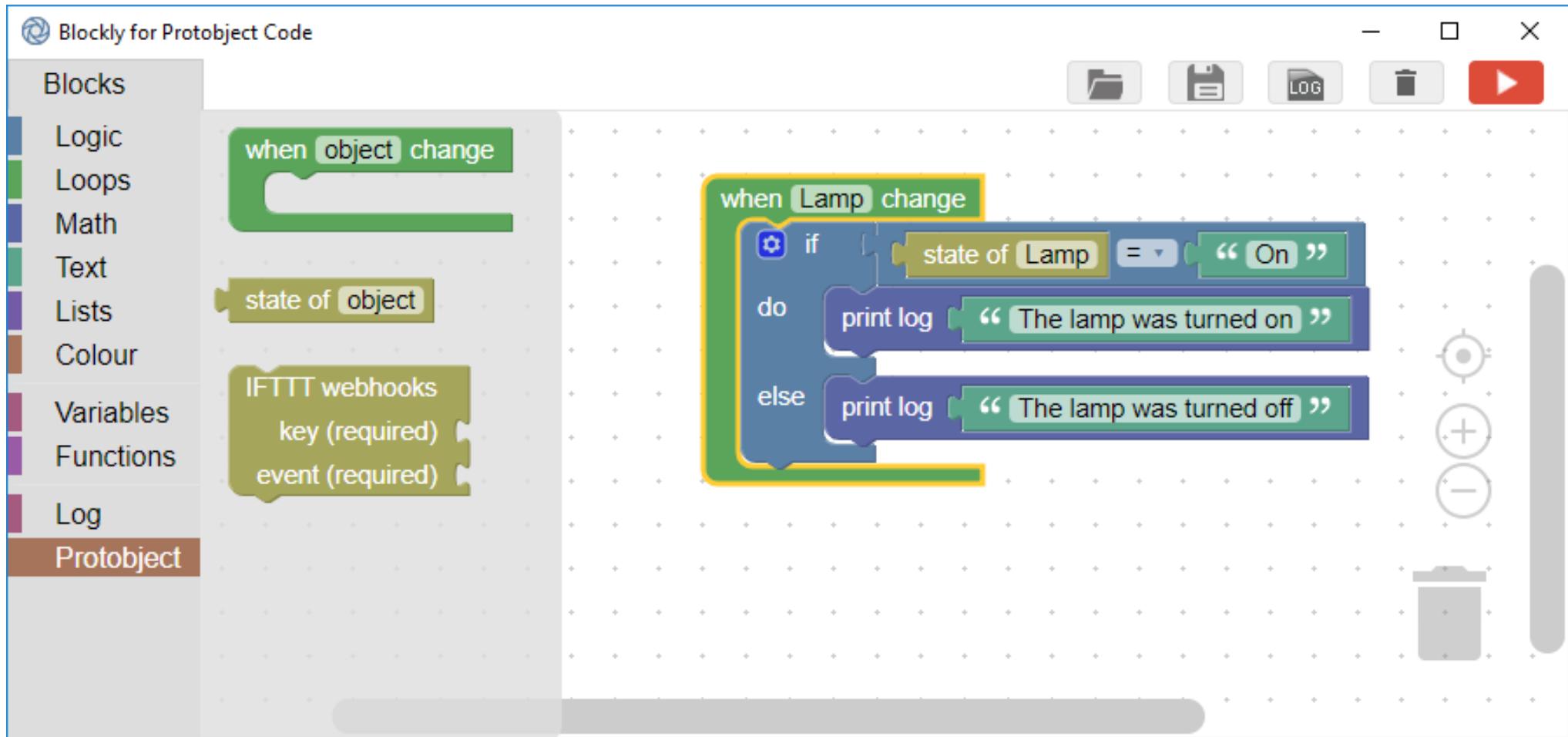


Plug

Lamp

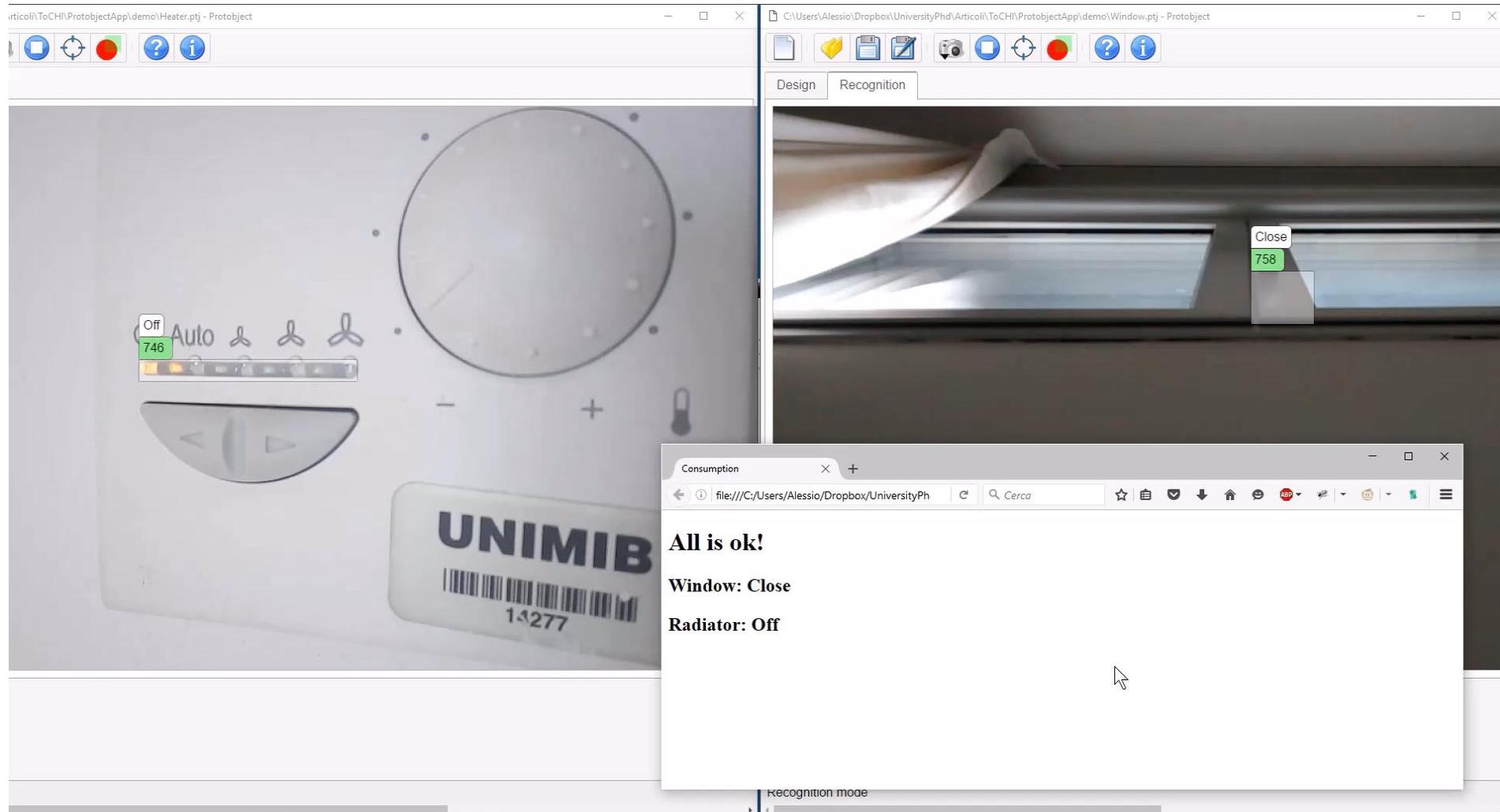
PROTOBJECT OPERATING WAY

Components for Blockly, a visual programming language



PROTOBJECT USAGE SCENARIOS

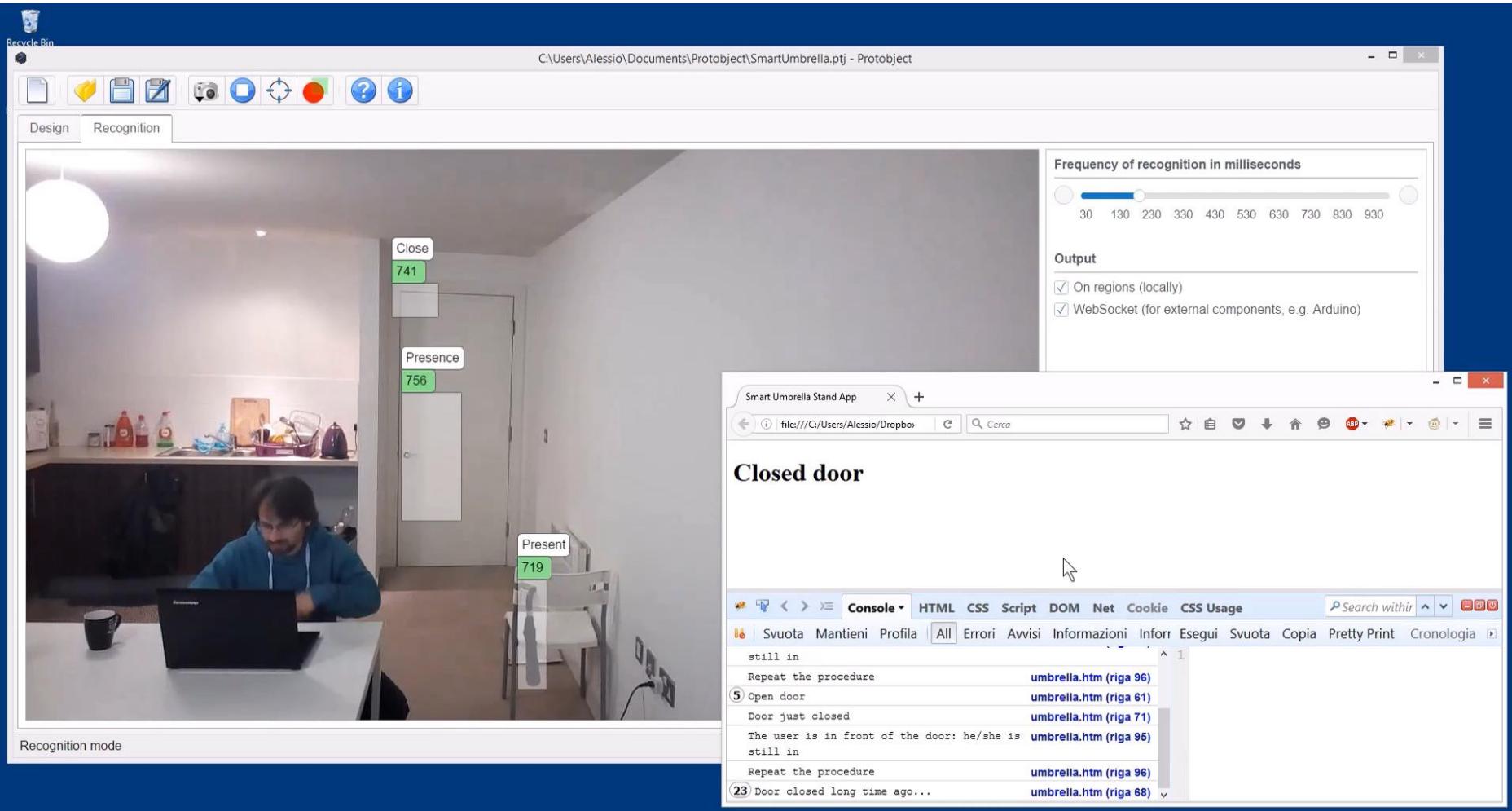
An energy saving tool



Background
When the heater is turned on and the window is open, a notification is displayed saying that you are wasting energy.

PROTOBJECT USAGE SCENARIOS

A smart umbrella stand



Background
If it is raining (information provided by weather.com API) and you forgot the umbrella in the umbrella stand, a notification is sent you just after leaning home.

PROTOBJECT EVALUATION

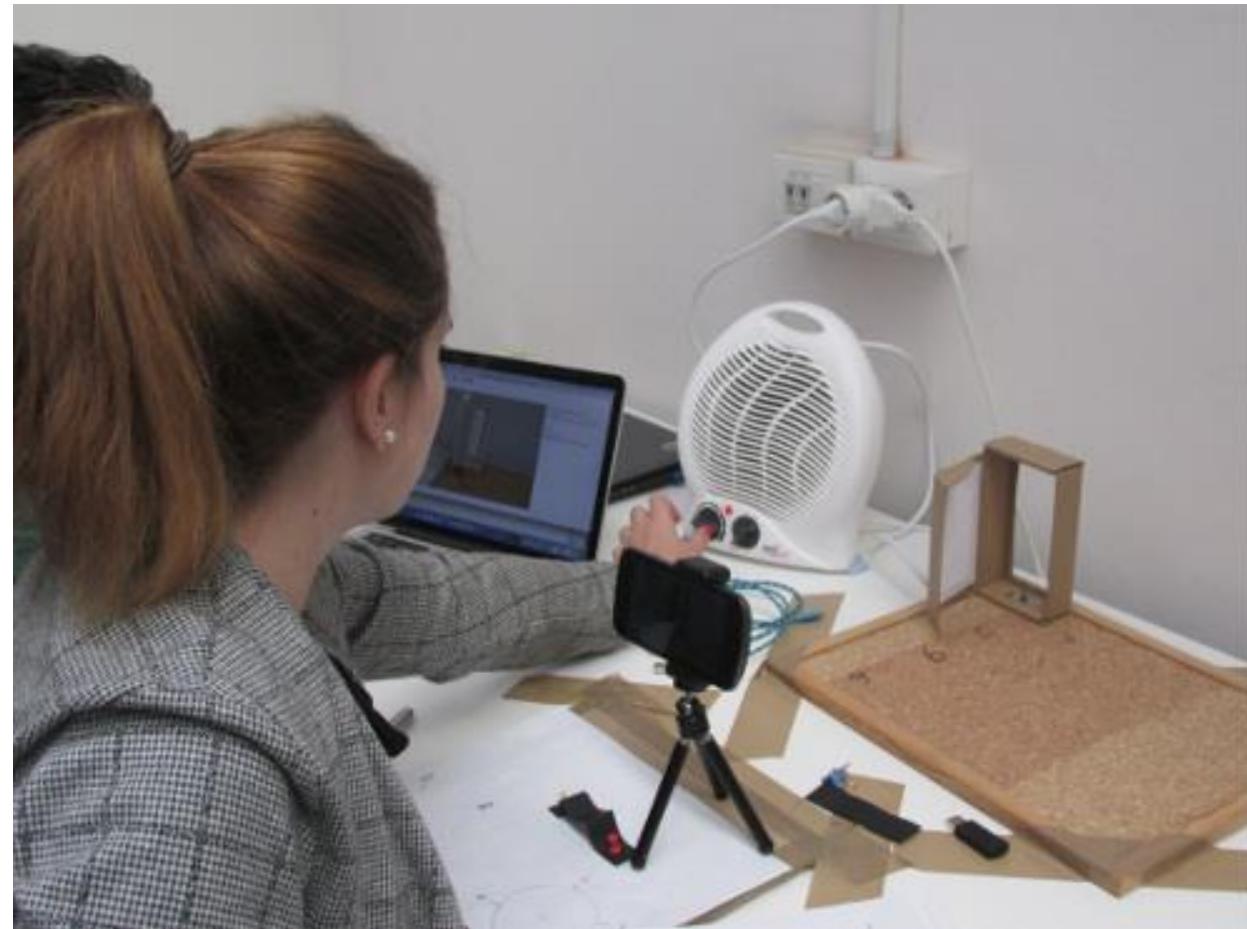
Prototyping approach and UI

Brera DesignDays
TALKS & WORKSHOPS

Probject prototyping approach and UI was evaluated by 22 participants (designers and engineers) in two workshops held on October 1st and 2nd.













CONCLUSIONS



Probject makes early-stage prototyping more rapid and flexible.



Probject facilitate communication between designers and engineers when making interactive prototypes.

My research in HCI

Touch&Screen: widget collection for large screens controlled through smartphones

TraceMatch: a computer vision technique for user input by tracing of animated controls

Two new gestures to zoom: Two-Finger-Tap for tablets and Tap&Tap for smartphones

Camera Keyboard: text entry for touch devices using cameras

Probject: a rapid prototyping platform for IoT and smart home

An evaluation of WriteBetter: a concordancer integrated into a word processor

SEQUENCE: a remote control technique to select objects by matching their rhythm

My research in HCI

**Touch&Screen: widget collection for
large screens controlled through
smartphones**

Alessio Bellino, Federico Cabitza, Flavio De Paoli, Giorgio De Michelis

Proceedings of the 15th International Conference on Mobile and Ubiquitous Multimedia (ACM)

Smartphone interaction



User interfaces are often composed of widgets, e.g., elements of interaction such as lists, videos, maps.

Why and how to control using touch devices?



Why to control using touch devices



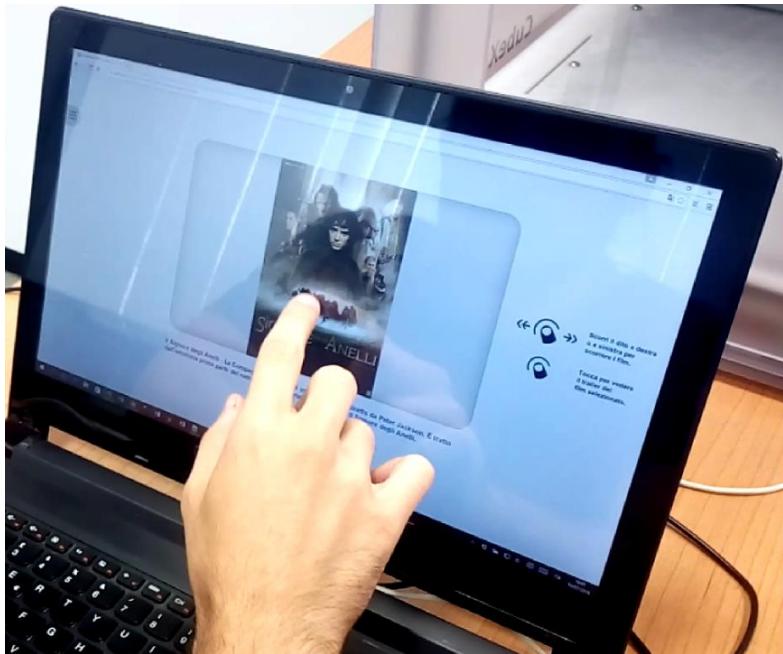
Mouses and keyboards can be used only if they lie on a horizontal surface.

So, how to do in other cases? Use smartphones!

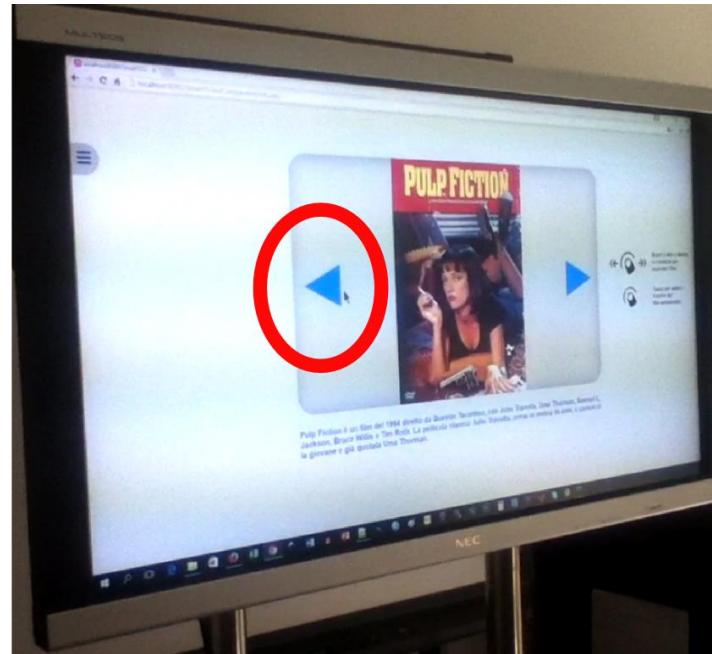
Interaction Techniques for Merging Large Screens and Smartphones

User evaluation

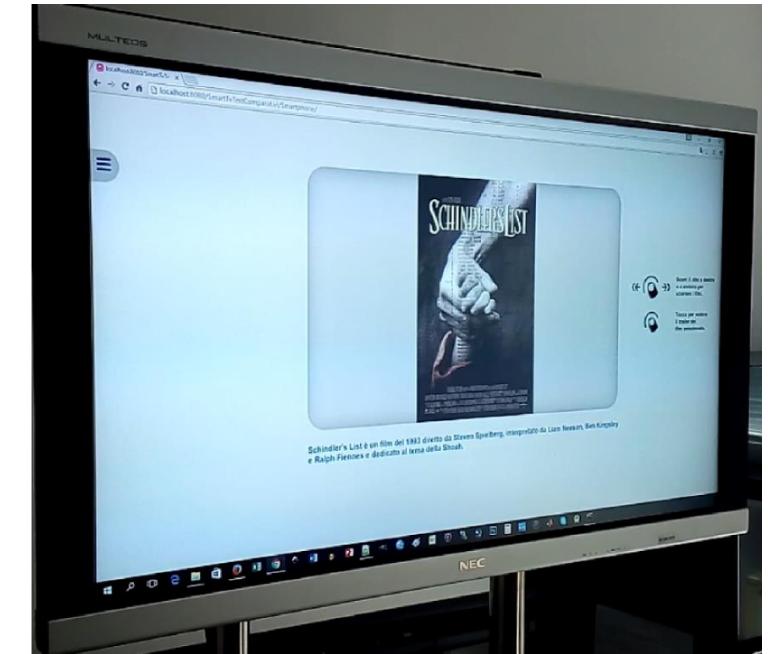
The study: comparison among three techniques



Direct touch



Mouse controlled by smartphone
through PC Remote (Android app)

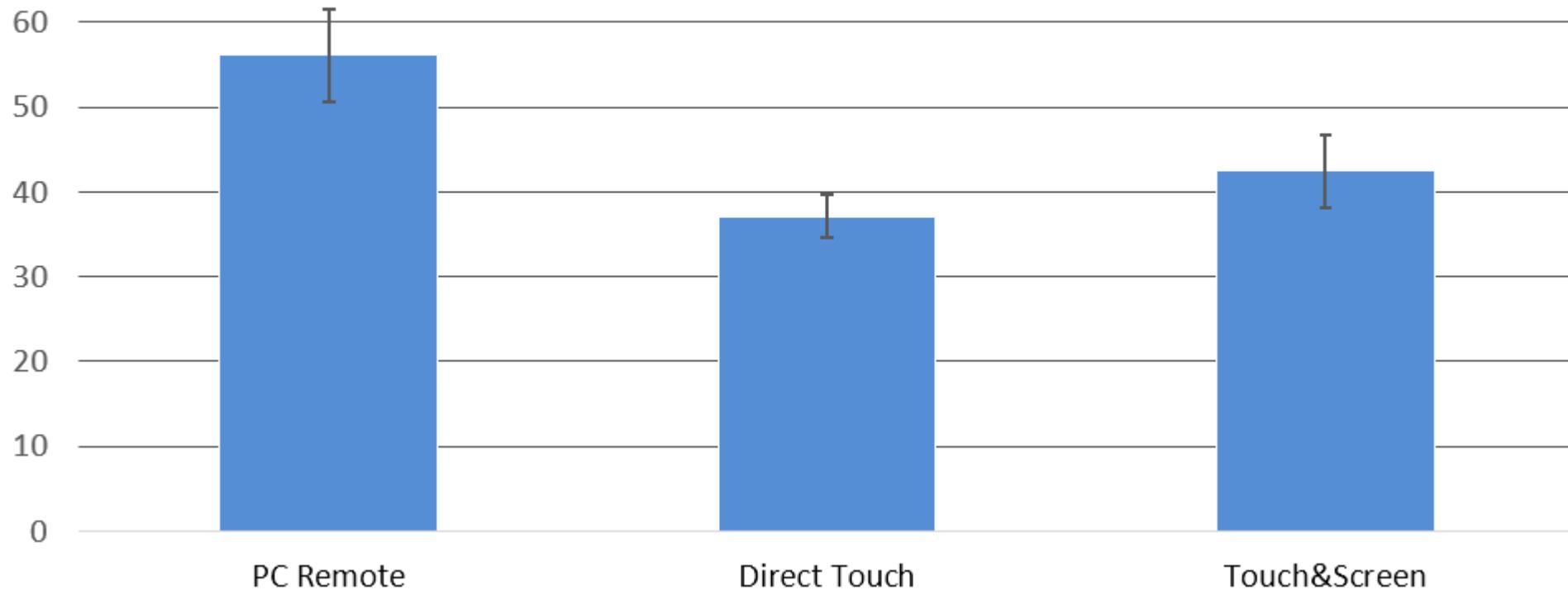


Touch&Screen

User evaluation

Comparison results

Execution times



All the differences are significant ($p < 0.05$).

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TraceMatch: a computer vision technique for user input by tracing of animated controls

Clarke, C., Bellino, A., Esteves, A., Velloso, E. and Gellersen, H., 2016, September. TraceMatch: a computer vision technique for user input by tracing of animated controls. In Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing (pp. 298-303). ACM.

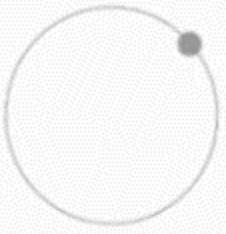
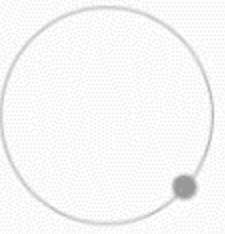
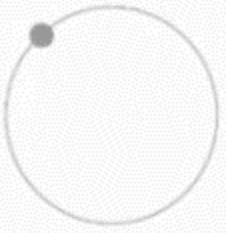
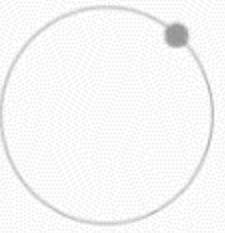
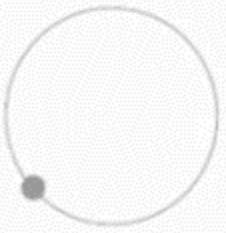
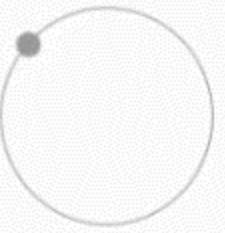
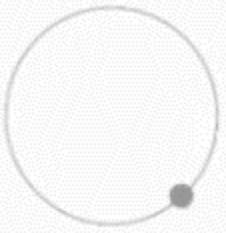
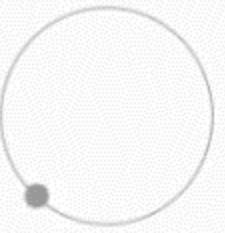
Clarke, C., Bellino, A., Esteves, A. and Gellersen, H., 2017. Remote Control by Body Movement in Synchrony with Orbiting Widgets: an Evaluation of TraceMatch. Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies, 1(3), p.45.

TraceMatch

How Does it Work?

How many orbits can be displayed at the same time?

And how to distinguish between different orbits?



TraceMatch supports any
rotating movement as input:
head, hand, holding an object,
foot and so on.



Some prototypes
for Smart TV

User evaluation

Prototypes were evaluated with 20 participants aged between 21 and 54 years.
(10 males, 10 females)

Interactive story evaluation



Formula 1 multi-screen evaluation



Real prototypes: results

		Interactive Story	Formula 1 Multi-Screen
Number of activations	Head	5 (7%)	18 (6%)
	Dom. hand	49 (70%)	223 (76%)
	Non. hand	6 (9%)	22 (8%)
	Phone	10 (14%)	28 (10%)
	Cup	0 (0%)	0 (0%)
	Foot	0 (0%)	2 (1%)
Total activations		70	293
Incorrect activations		0	8
False activations		0	0
Task success rate		100%	97%

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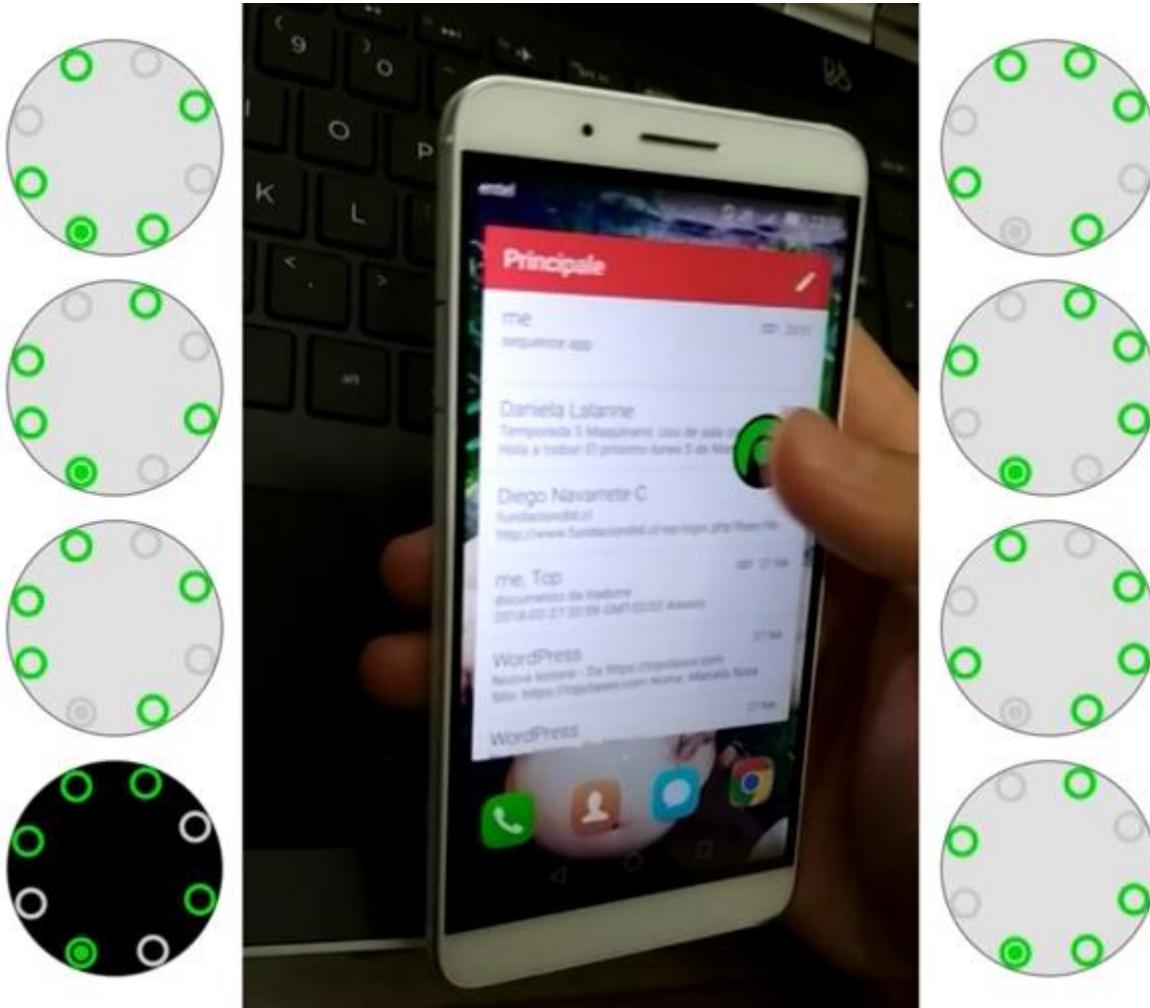
My research in HCI

SEQUENCE: a remote control technique to select objects by matching their rhythm

Alessio Bellino

Personal and Ubiquitous Computing, 2018, Springer London

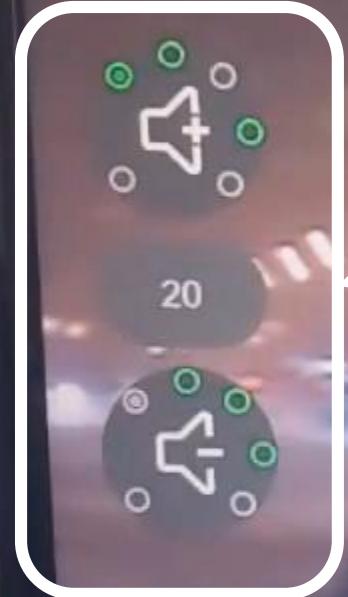
How it works



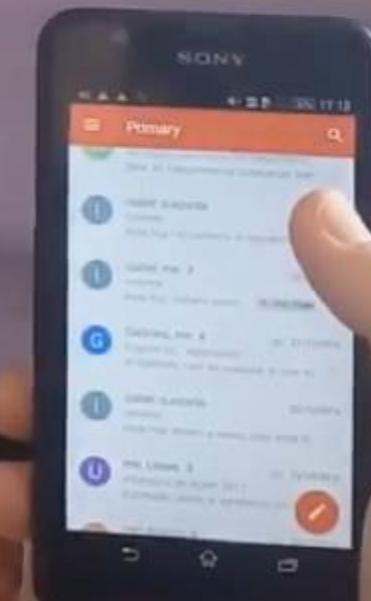
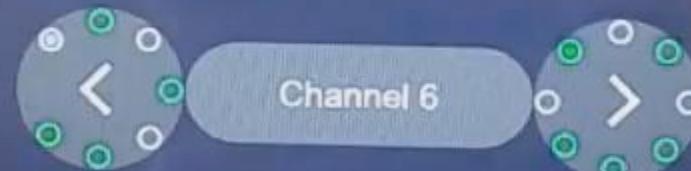
Elements display different rhythmic patterns by means of animated dots, and users can select one of them by matching the pattern through a sequence of taps on a smartphone.

SUBSCRIBE

Usage scenario: smart tv control



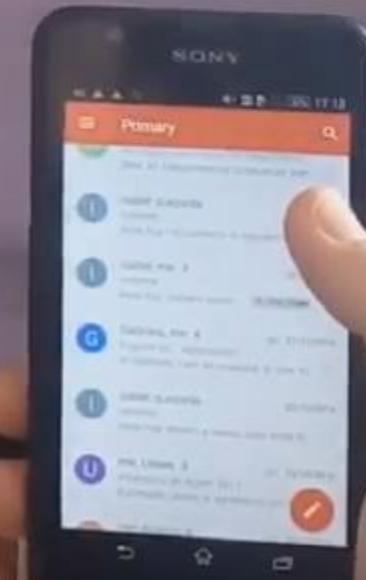
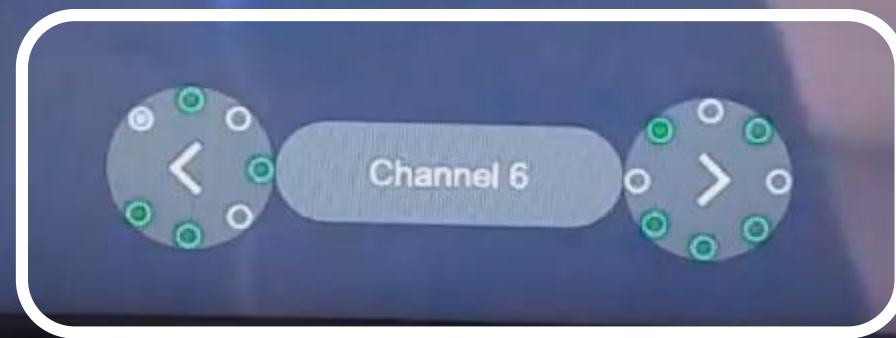
Controls to change volume



SUBSCRIBE

Usage scenario: smart tv control

Controls to change channels



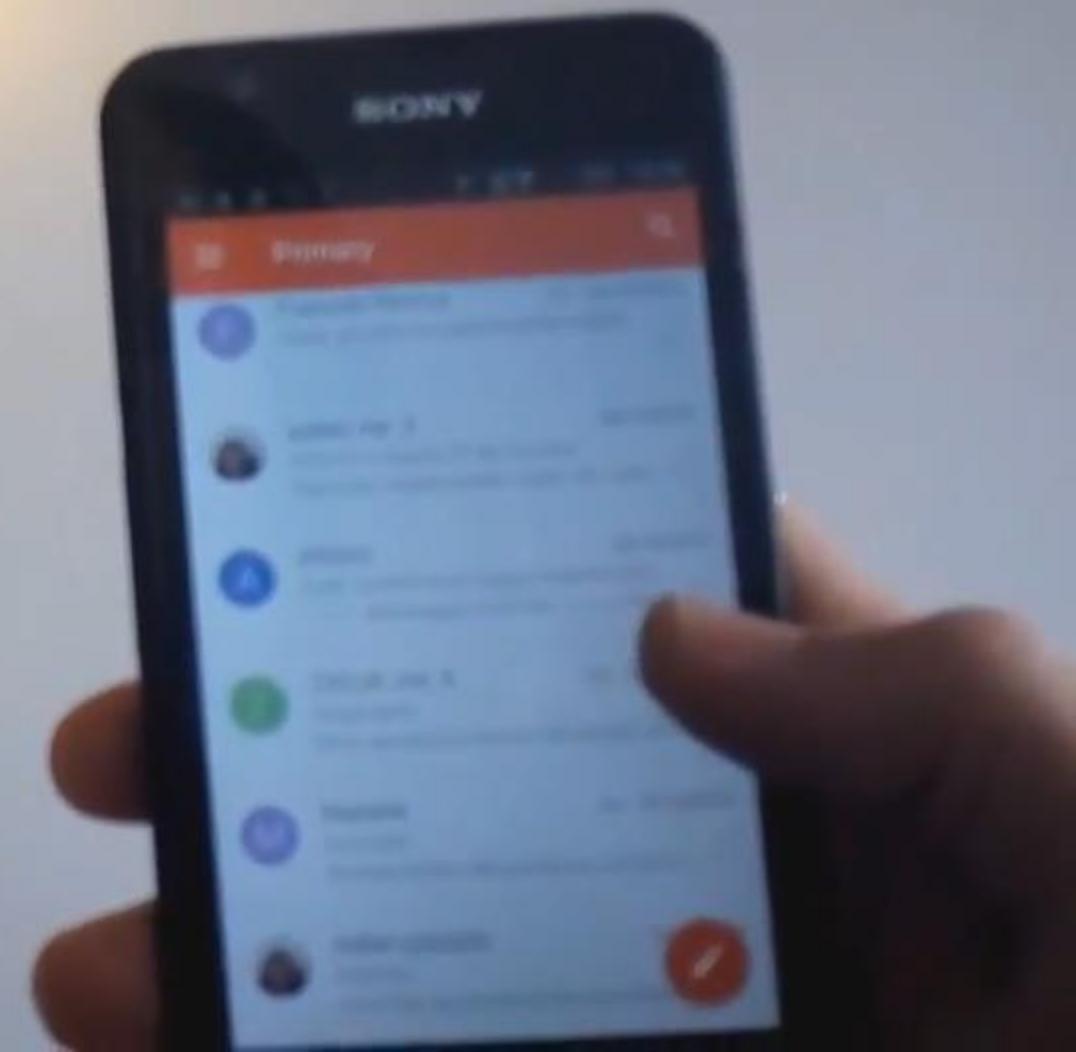
BBC one

Area to tap for
matching the rhythm



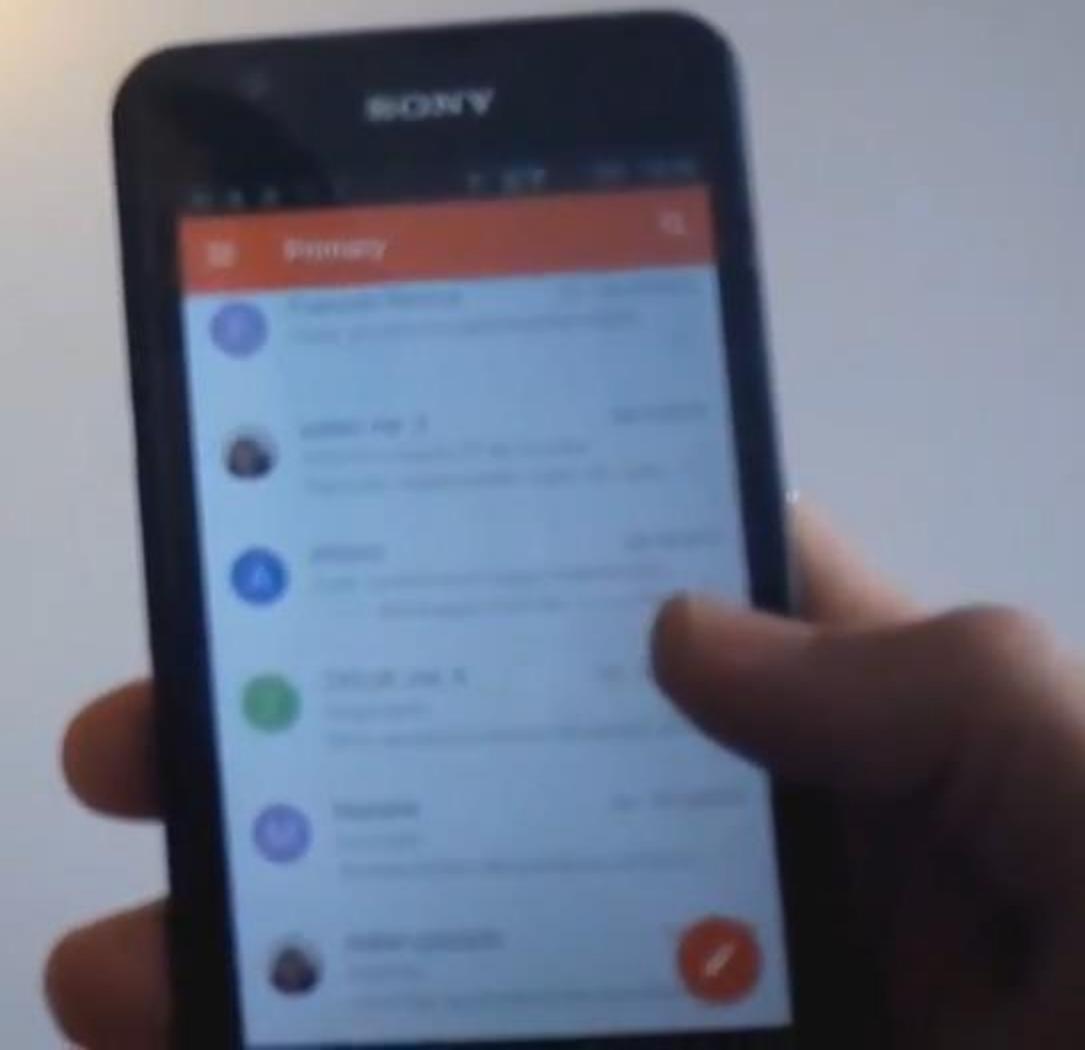
Usage scenario: smart environment

Physical widget to
turn on/off the TV

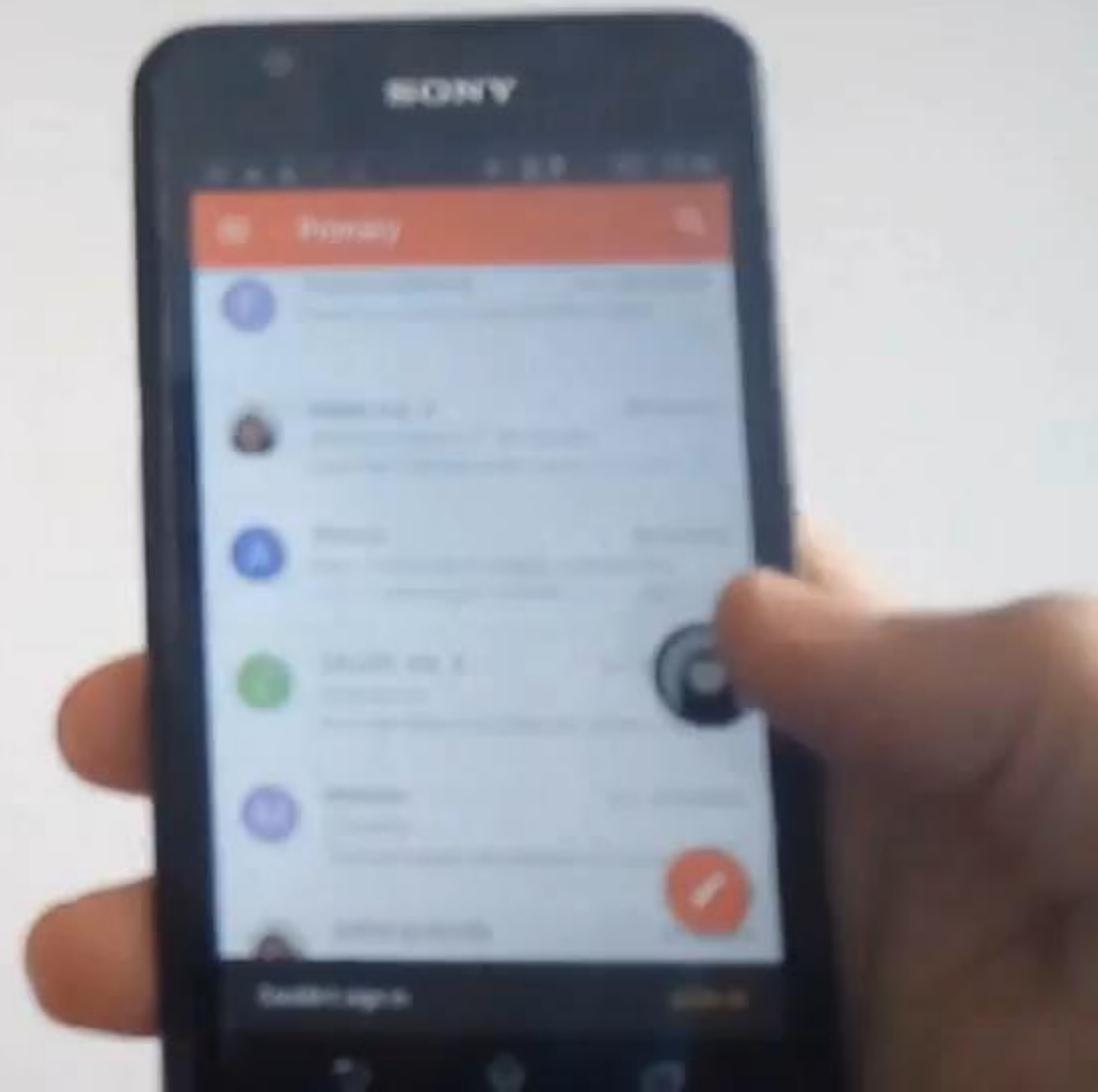


Usage scenario: smart environment

Physical widget to
turn on/off the lamp



Turn on TV



Rhythm is very flexible.
Any binary sensor can be used to mark a rhythm.



Eye blink (open/close)



Mouth open/close

Sequence with Eye blinks

So, using rhythm as input technique is very flexible, and any binary sensor can be used for marking a rhythm.

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An evaluation of WriteBetter: a concordancer integrated into a word processor

Daniela Bascuñán and Alessio Bellino

Submitted

Context

Learning English using data-driven learning

In Data-driven Learning, (English) learner understand patterns or rules of language use by exploring sentences written by native speakers.

Context

Learning English using data-driven learning

In Data-driven Learning, (English) learner understand patterns or rules of language use by exploring sentences written by native speakers.



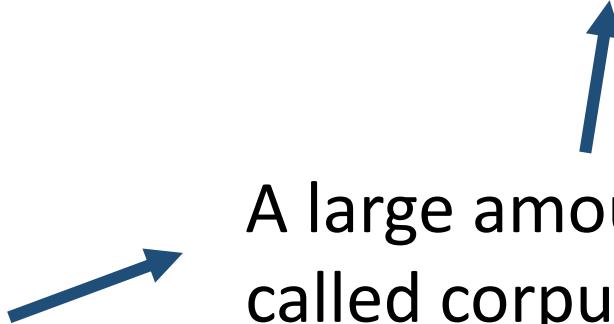
A large amount of sentences, called corpus, is needed

Context

Learning English using data-driven learning

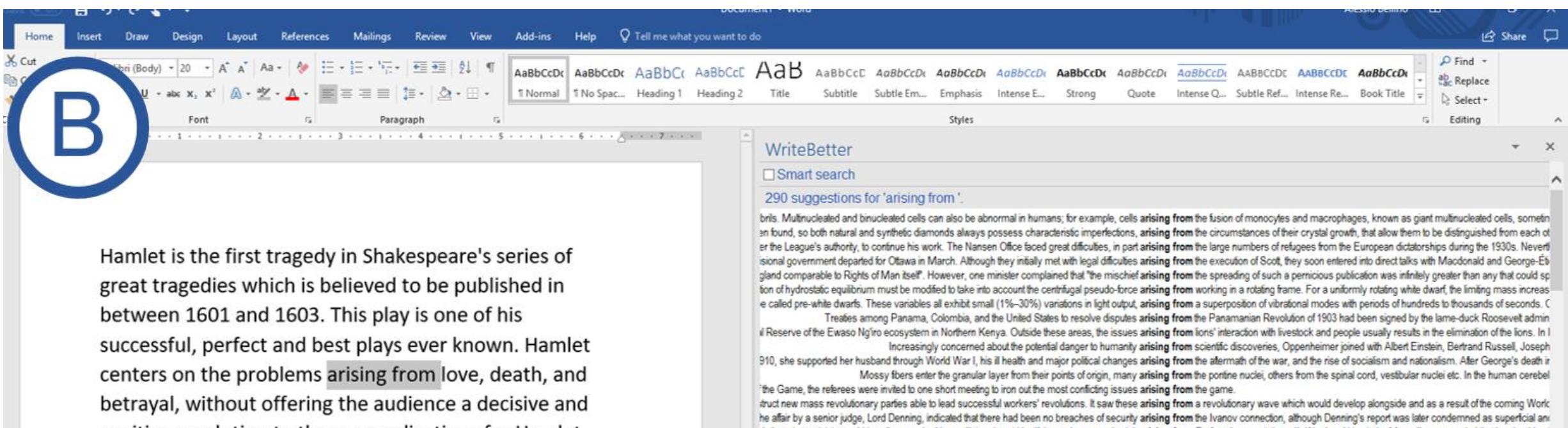
In Data-driven Learning, (English) learner understand patterns or rules of language use by exploring sentences written by native speakers.

A software is needed to explore the corpus.



A large amount of sentences, called corpus, is needed

WriteBetter integrates corpus exploration in the word processor



The screenshot shows a Microsoft Word document titled "Document - Word". A blue circle highlights the letter "B" in the font dropdown menu on the ribbon. The main text area contains the following paragraph:

Hamlet is the first tragedy in Shakespeare's series of great tragedies which is believed to be published in between 1601 and 1603. This play is one of his successful, perfect and best plays ever known. Hamlet centers on the problems arising from love, death, and betrayal, without offering the audience a decisive and positive resolution to those complications for Hamlet.

In the bottom right corner, the "WriteBetter" add-in is open, displaying a sidebar with the heading "WriteBetter" and a checkbox for "Smart search". Below it, it says "290 suggestions for 'arising from'". The sidebar lists several examples of words and phrases that have been suggested, such as "arising from the fusion of monocytes and macrophages", "arising from the circumstances of their crystal growth", "arising from the large numbers of refugees from the European dictatorships during the 1930s", "arising from the execution of Scott", "arising from the spreading of such a pernicious publication", "arising from working in a rotating frame", "arising from a superposition of vibrational modes with periods of hundreds to thousands of seconds", "arising from the Panamanian Revolution of 1903", "arising from the interaction with livestock and people", "arising from scientific discoveries", "arising from the aftermath of the war", "arising from the rise of socialism and nationalism", "arising from the Game", "arising from the most conflicting issues", and "arising from the coming Work".

Smart search

13112 suggestions for 'example'.

use of alcohol or cocaine. Controversies surround other proposed environmental causes; for example the vaccine hypotheses, which have been disproven. Autism affects information processing and respond less to their own name. Autistic toddlers differ more strikingly from social norms; for example, they have less eye contact and turn-taking, and do not have the ability to use simple movement for functional speech, and deficits in joint attention seem to distinguish infants with ASD; for example, they may look at a pointing hand instead of the pointed-at object, and they consistently fail to point autism from other developmental disorders. Differences are greater for under-responsivity (for example, walking into things) than for over-responsivity (for example, distress from loud noises) or for:

frogs have somewhat similar osteoderms forming bony deposits in the dermis, but this is an example of convergent evolution with similar structures having arisen independently in diverse vertebrates. Red or yellow combined with black, with the fire salamander (*Salamandra salamandra*) being an example. Once a predator has sampled one of these, it is likely to remember the colouration next time it identifies the use of coordinated whole-body movement and balance similar to yoga or pilates. For example, many dojos begin each class with *kyo*, which may include stretching and ukemi (break falls).

kyo of a defensive martial art. It makes use of body movement (*tai sabaki*) to blend with uke. For example, an "entering" (*irimi*) technique consists of movements inward towards uke, while a technique *kyo* break their concentration. The target may become unbalanced in attempting to avoid the blow, for example by jerking the head back, which may allow for an easier throw.

kg or 550lb). Prices were fixed across the country and recorded in lists to facilitate trading; for example a shirt cost five copper deben, while a cow cost 140deben. Grain could be traded for other goods. Suffixes are added to form words. The verb conjugation corresponds to the person. For example, the triconsonantal skeleton is the semantic core of the word 'hear'; its basic conjugation is *he*.

apyrus, a poem of lamentations describing natural disasters and social upheaval, is a famous example.

terwoven on tomb and temple walls, coffins, stelae, and even statues. The Narmer Palette, for example, displays figures that can also be read as hieroglyphs. Because of the rigid rules that governed the Second Intermediate Period, Minoan-style frescoes were found in Avaris. The most striking example of a politically driven change in artistic forms comes from the Amarna period, where figures were

oot of the Great Pyramid of Giza in the Fourth Dynasty around 2500BC, is a full-size surviving example that may have filled the symbolic function of a solar barque. Early Egyptians also knew how to

h a numerator greater than one, they had to write fractions as the sum of several fractions. For example, they resolved the fraction two-fifths into the sum of one-third + one-fifteenth. Standard tables of

ments of ancient Egypt have left a lasting legacy on the world. The cult of the goddess Isis, for example, became popular in the Roman Empire, as obelisks and other relics were transported back to

tion of the country's historical legacy, some foreigners left more positive marks. Napoleon, for example, arranged the first studies in Egyptology when he brought some 150 scientists and artists to study (by interpolation or extrapolation), using theoretically or empirically derived methods. For example, halogens get darker with increasing atomic weight—fluorine is nearly colorless, chlorine is yellow, bromine is orange, iodine is purple. Despite this controversy, many properties of diatomic astatine have been predicted; for example, its bond length would be 300 ± 10 pm, dissociation energy 83.7 ± 12.5 kJ·mol⁻¹, Cl₂, Br₂, I₂

persulfate in a solution of perchloric acid. The well characterized anion can be obtained by, for example, the oxidation of astatine with potassium hypochlorite in a solution of potassium hydroxide. Prey

The bismuth (or sometimes bismuth trioxide) target is dissolved in, for example, concentrated nitric or perchloric acid. Astatine is extracted using an organic solvent such as t

at attempting to predict their behavior using classical physics – as if they were billiard balls, for example – gives noticeably incorrect predictions due to quantum effects. Through the development of pl

The number of protons in the nucleus defines to what chemical element the atom belongs: for example, all copper atoms contain 29 protons. The number of neutrons defines the isotope of the element. The nuclear model could explain why water absorbs different gases in different proportions. For example, he found that water absorbs carbon dioxide far better than it absorbs nitrogen. Dalton hypothesized that particles join to form a heavier nucleus, such as through the energetic collision of two nuclei. For example, at the core of the Sun protons require energies of 3–10 keV to overcome their mutual repulsion—the electron binding energy—is far less than the binding energy of nucleons. For example, it requires only 13.6eV to strip a ground-state electron from a hydrogen atom, compared to 2.

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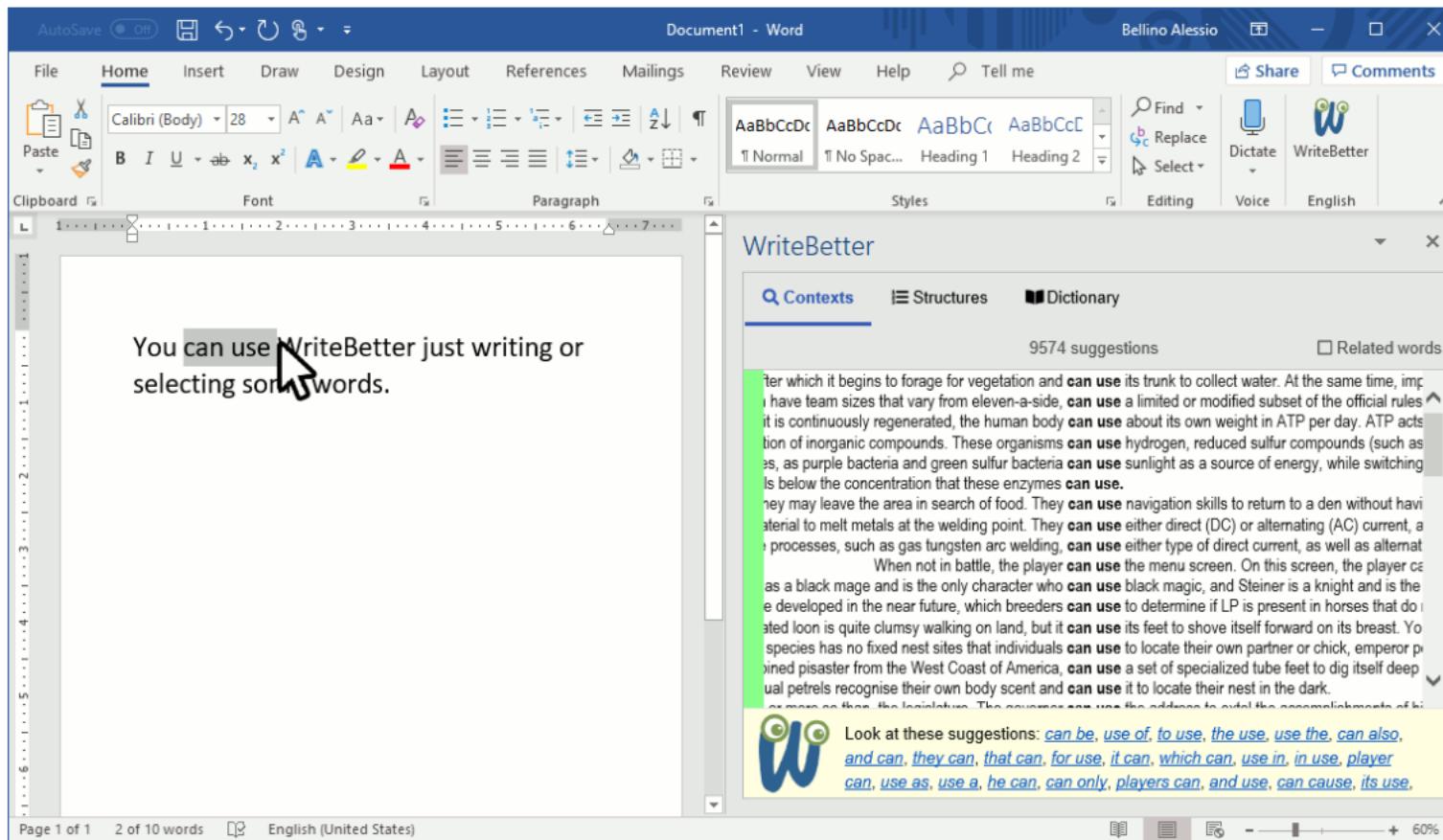
According to an evaluation on 11 users, and in line with other previous works, WriteBetter is able to improve writing...

...so what is the novelty of WriteBetter?

Situated computing

WriteBetter changes the paradigm with which learners access, perceive, and consume corpus, as it allows them to interact with corpus focusing on what to do with it, rather than where to find it and how to get it, without thinking much about the technical features of the software tool.

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WriteBetter is an add-in for Microsoft Word designed for English learners who expect to improve their writing skills and language knowledge through the exposure to real language in context produced by native speakers of English.

My research in HCI

Touch&Screen: widget collection for large screens controlled through smartphones

TraceMatch: a computer vision technique for user input by tracing of animated controls

Two new gestures to zoom: Two-Finger-Tap for tablets and Tap&Tap for smartphones

Camera Keyboard: text entry for touch devices using cameras

Probject: a rapid prototyping platform for IoT and smart home

An evaluation of WriteBetter: a concordancer integrated into a word processor

SEQUENCE: a remote control technique to select objects by matching their rhythm

My research in HCI

Enhancing Pinch-Drag-Flick Paradigm with Two New Gestures: Two-Finger-Tap for Tablets and Tap&Tap for Smartphones

Alessio Bellino

Human-Computer Interaction–INTERACT 2015: 15th IFIP TC 13 International Conference,
Bamberg, Germany, September 14–18, 2015 (Springer)

What Pinch-Drag-Flick Paradigm is



**Navigate
2D spaces**

*Pinch to zoom
Drag&Flick to pan*

The Pinch on Smartphones has a Drawback



*The pinch **cannot**
be used easily
with just one
hand.*

Two new Gestures to Zoom

Tap&Tap for Smartphones



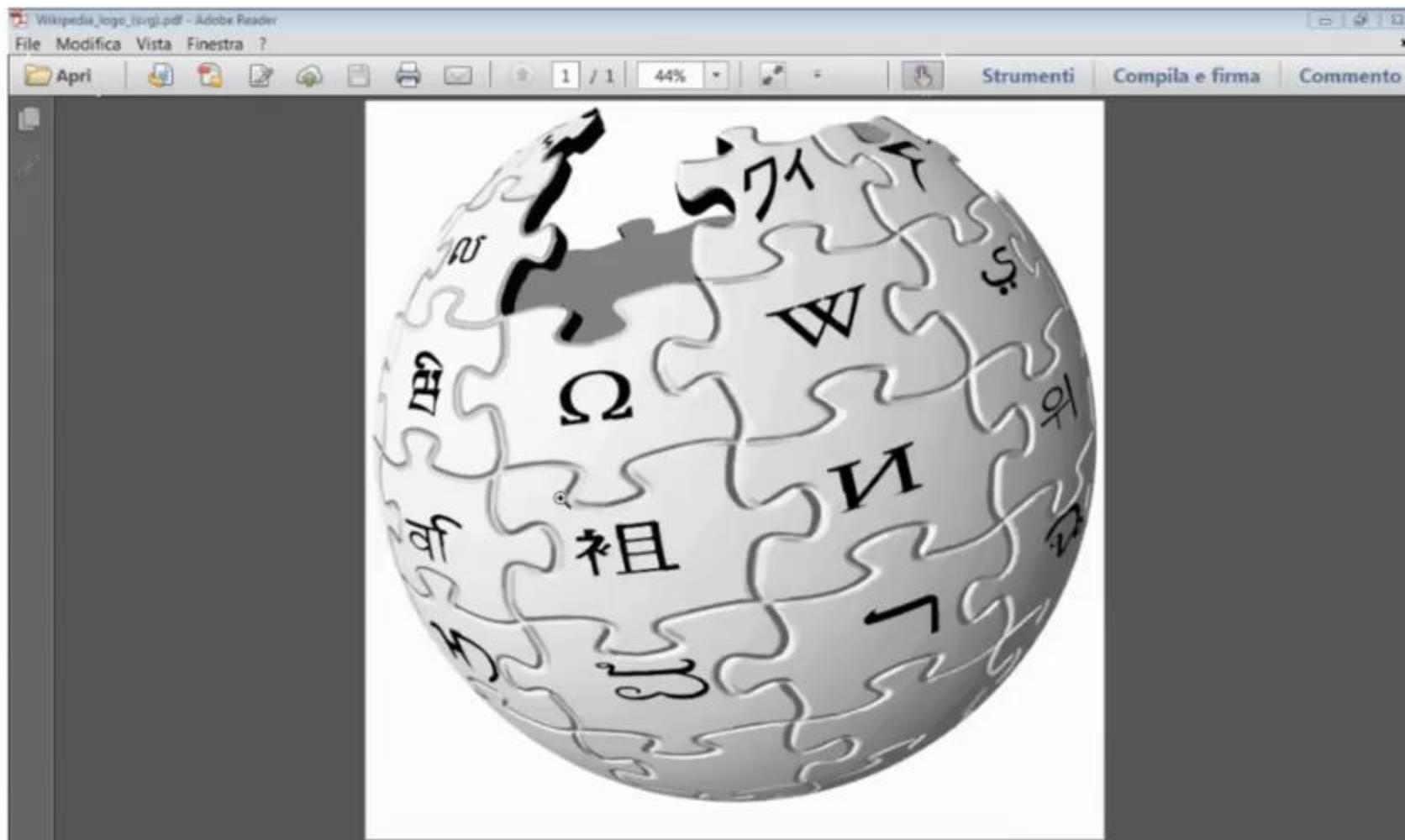
(Designed for one-hand usage)

Two-Finger-Tap for Tablets



(Designed for two-hands usage,
just like the pinch)

The Inspiration: Covering the Container (e.g. Adobe PDF Reader Marquee Zoom)



Speed Test: Pinch vs. new Gestures

Question: how does it take to zoom from the **entire word** into the **four areas** on the right?
Execution times were automatically calculated both with the pinch and the new gestures.



Speed Test: Results of Comparison

(times in milliseconds)

	Tablet times		Smartphone times	
	Pinch	Two-Finger-Tap	Pinch	Tap&Tap
Sicily	└ Z=-2.896; p<0.004* ┐ 3909 (SD=1000)	2375 (SD =1051)	└ Z=-1.851; p<0.064 ┐ 3924 (SD=893)	3285 (SD=947)
Bicocca	└ Z=-2.722; p<0.006* ┐ 8802 (SD=1822)	6644 (SD=2871)	└ Z=-2.809; p<0.005* ┐ 8683 (SD=1466)	7531 (SD=1673)
Denmark (part of)	└ Z=-3.027; p<0.002* ┐ 3760 (SD=1170)	2173 (SD=1167)	└ Z=-1.807; p<0.071 ┐ 2921 (SD=800)	2405 (SD=695)
Berlin	└ Z=-2.853; p<0.004* ┐ 5814 (STD=2506)	4141 (SD=2331)	└ Z=-2.853; p<0.020* ┐ 4953 (SD=1247)	4192 (SD=1005)
Total time	└ Z=-3.680; p<0.001* ┐ 22186 (SD=4994)	15334 (SD=4995)	└ Z=-3.462; p=0.001* ┐ 20482 (SD=2721)	17414 (SD=2595)

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Work in progress



Summing Up

Protobject (prototyping, design, sensing, computer vision, machine learning, collaboration)

Touch&screen (interaction technique, novel UI, touch devices)

TraceMatch (interaction technique, computer vision, sensing, novel UI, gestural interaction)

Sequence (interaction technique, music, computer vision, sensing, novel UI)

WriteBetter (situated computing, data-driven learning, linguistics, data visualization)

Gestures to zoom (interaction technique, novel UI, gestural interaction)

CameraKeyboard (interaction technique, computer vision, touch devices)

Transversal skills: psychology, sociology, design, qualitative and quantitative analysis

References

<https://scholar.google.com/citations?hl=it&user=ttvfkoIAAAJ>

<https://alessiobellino.com>