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ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

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edited by Michele Zannoni, Roberto Montanari

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THE HUMAN BODY INTERACTION OPEN DATABASE

Michele Zannoni, Giorgio Dall'Osso*, Ludovica Rosato*, Luca Barbieri**

A database as a multilevel dialogue tool

In the methodology adopted in the Human Body Interaction project of the Department of Architecture of the University of Bologna, a research tool designed within the Advanced Design Unit was used: the HBI open database. The reason for adopting the database was to improve collaborative processes in knowledge development.

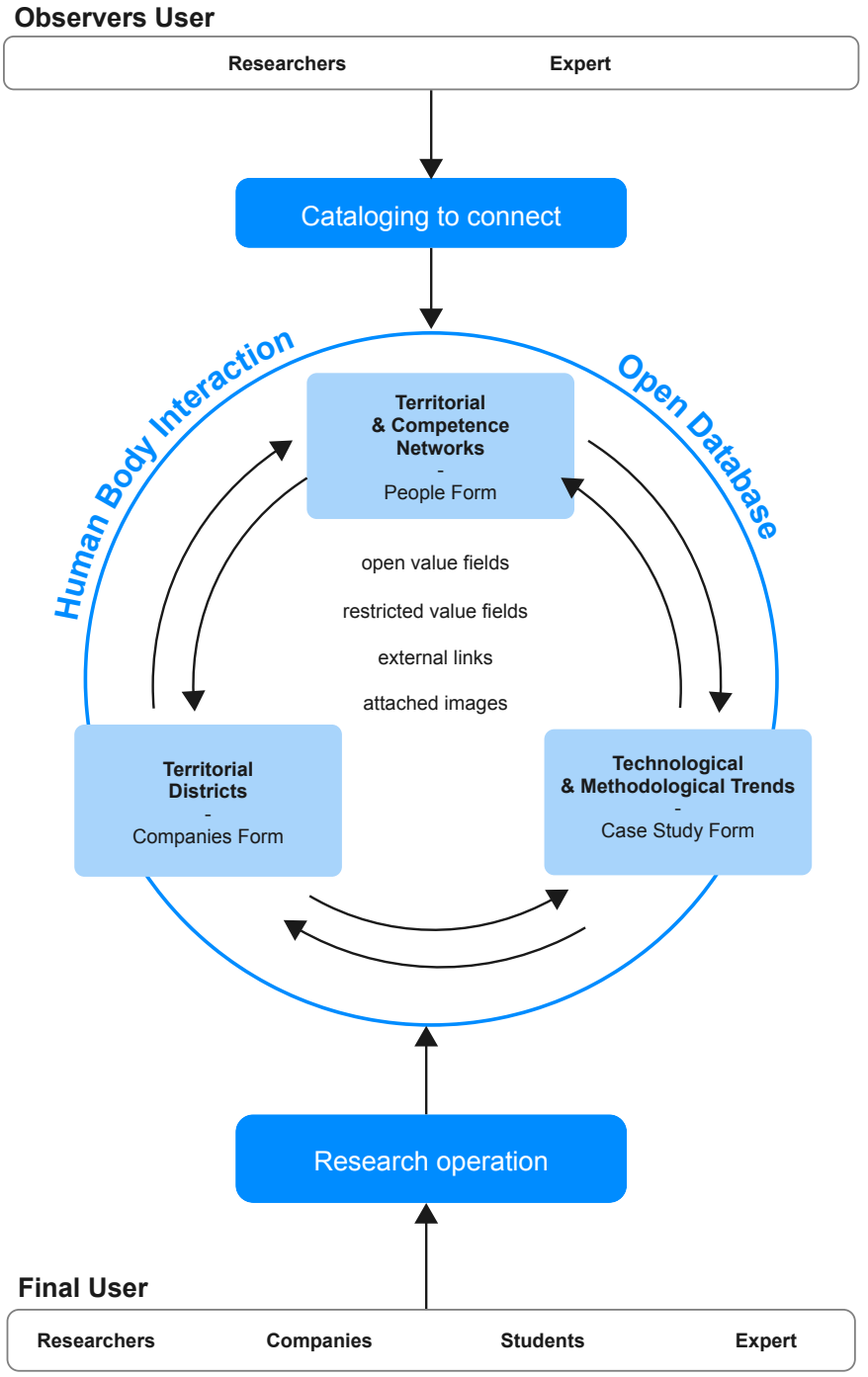
In the context of collaborative tools, numerous technical solutions allow a lot of information to be cataloged in a shared way. In many cases, these are closed commercial solutions that, while serving open-science processes, are difficult to modify and whose licenses are not suitable for future research developments.

The ADU research group platform for sharing and cataloging case studies is the tool at the heart of the Human Body Interaction Observatory project; its goal is to create relational cataloging of projects at the international level linked together through technological, scientific, and social relationships (fig. 1).

The common thread of the case studies is the search for innovation processes in the relationship between digital technologies and the physical, chemical, and relational properties of human bodies.

The platform is designed to centralize the cataloging process among different ongoing projects and with the possibility of developing outputs dedicated to research and the third mission. The HBI observatory system presents two interfaces: the first one is aimed at workgroup research and case study cataloging; the second one is dedicated to the public through free access in the scope of open science. The open-access service is presented as a web-based workspace divided into regular two-dimensional grids. Within each module, there is an image

** Dipartimento di Architettura, Alma Mater Studiorum - Università di Bologna, Italy*


Observers User
Researchers
Expert
Cataloging to connect
Human Body Interaction
Open Database
Territorial & Competence Networks - People Form
open value fields
restricted value fields
external links
attached images
Territorial Districts - Companies Form
Technological & Methodological Trends - Case Study Form
Research operation
Final User
Researchers
Companies
Students
Expert

and the name of the case study. Selecting one of the modules provides access to the descriptive tab of the case study characterized by textual information, images, tags, and links inside and outside of the platform.

The features of the interface serving the workgroup are focused on the function of entering new case studies. Researchers together with expert reporters – figures who joined the research over the course of the project – can fill out a descriptive form that relates multiple cataloging tables consisting of open and restricted value menus. The data entry process allows a link between researchers, designers, and companies; it also enables the storage of an apparatus of sources and information through links inside and outside the platform that ensure the completeness of case study communication.

Effective cataloging of the case study is achieved when relationships are built with all those involved in the project, from designers to all the figures within the companies and the university.

The goals behind this research and data exploration tool are to bring out the similarities and connections among the case studies clearly. In this way, common design references can be generated within the networks that exploit the platform for research.

In fact, this database is a working tool designed as a platform for dialogue among designers, companies, and researchers who wish to identify new lines of research and design through the correlation and interpretation of an archive of common case studies.

Cataloging to connect

Case study form

A form is used to file case studies in which 4 types of information are requested (tab. 1):

- attached images;
- external links that allow further investigation of the case study;
- open value fields to be filled in with text;
- restricted value fields.

The table below shows the information, which is not mandatory, required in the scheduling process. Importantly, new tags can be created contextually with each entry. In this way, the unique description of projects is dynamic. The chosen tags clearly and quickly define the special features of the case study and allow it to be found among many.

Table 1. Case study form.

Attachments			
Images			
External links			
Case study Link	Video Link	Reference/source Link	Scientific Paper
Open value filling			
Title	Description	Year	Awards
Funds	Note		
Restricted value filling with internal tags			
Rate	Thematic fields	Technologies	Definition Level
Organization	Person	Designer	Collaborators
Countries	Client	Type of intervention	Material
Signaler	Commodity Sector		

For this reason, the work of tagging is of high relevance to the system's functioning. To avoid subjective categorizations, classifications were identified that could guide the research team in the early stages of mapping. Emphasis was placed on the subcategories of senses and digital technologies used.

Business form and people form

In addition to the cataloging of case studies, the platform also enables the cataloging of companies and people. This action highlights the relational and territorial networks of the case studies. Through territorial, typological, and relational affinities it is possible to identify territorial districts and intercept the emergence of networks around specific skills.

In both forms, it is possible to include information as in the case study form. Moreover, in the company form, it is

possible to indicate the sector and related active people in the database.

In the people form, in addition to basic data, it is possible to indicate the role, personal website, biographies, links to interviews, territory of action (country and city), and years of professional and/or scientific activity. It is then possible to associate *LinkedIn* pages to activate possible project collaborations among database users.

Research operation

The database can be useful for researchers, practitioners, and students who need to perform research on topics related to the relationship between enabling technologies and the human body.

The first level of information is achieved by directly opening individual case studies on the showcase homepage of the database.

Deeper levels of research are achieved through the selection of tags. These are available in a cloud configuration within the menu divided into three sections: tags, technologies, and countries. Once one or more tags have been selected, case studies containing the selected tags remain available in the showcase.

Within tag clouds, moreover, tags turn on and off automatically. Specifically, all tags that are not related to the selected one turn off while the others remain selectable.

The relationship between tags shall have been stated within the case studies, which in this way become the node of the relational network.

Once you have identified a case study of interest, you can also identify other related case studies by selecting the tags of interest. More case studies with the same tag will appear in the pop-up window, and in this way, the researcher can increase the pool of collected case studies.

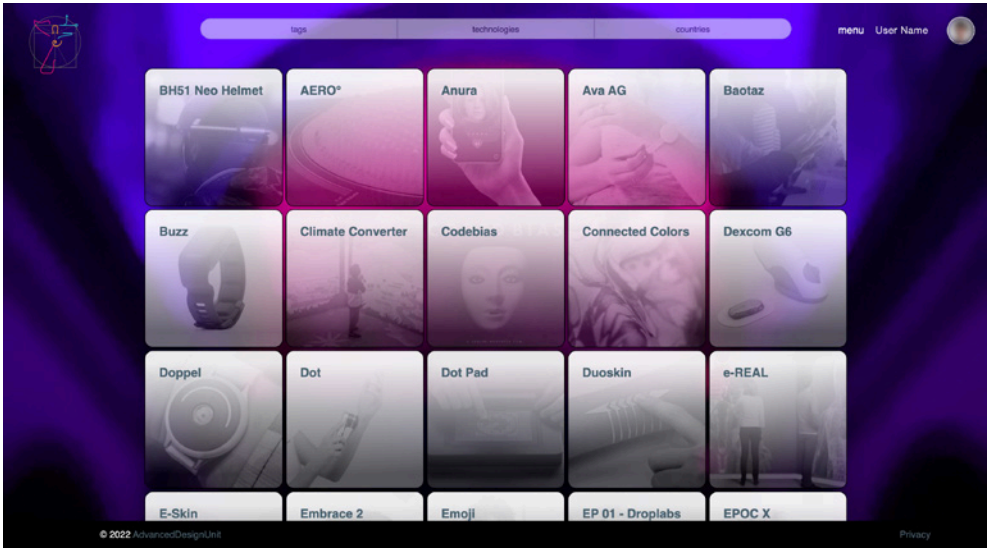
Once the researcher has identified a case study, the database allows the researcher to reach other similar case studies through the selection of tags of interest. More case studies with the same tag will appear in the pop-up window, and it will thus be possible for the researcher to increase the pool of collected case studies.

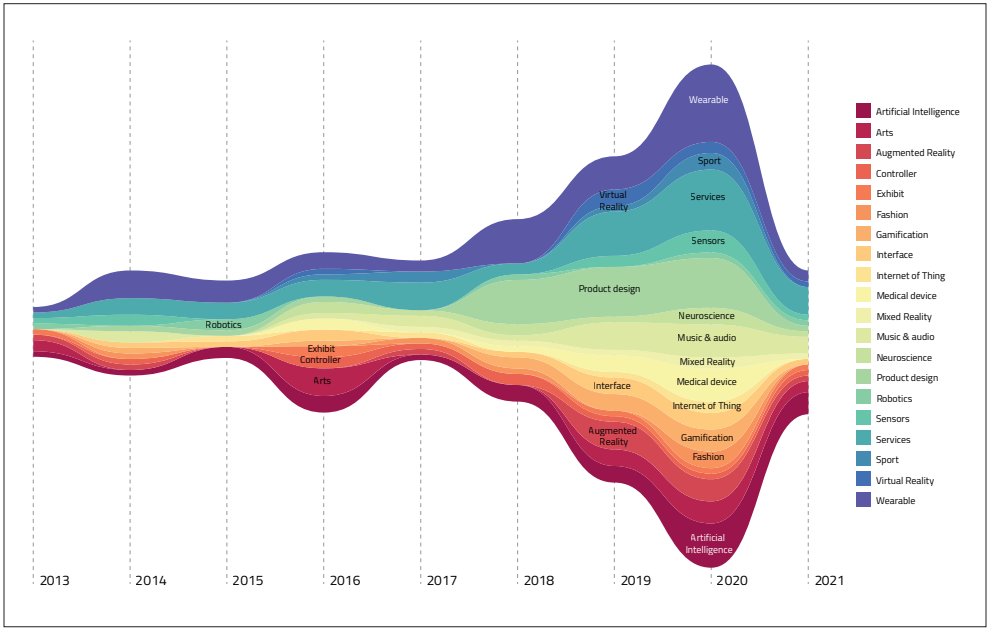
Discussion

The case studies collected mainly refer to the 2019-2021 period but there are also examples of projects from the first decade of the 2000s (fig. 2). The collection represents cartography of the current state of interaction processes between humans and technology. In such fields, the analysis of the body parts and physiological processes involved is a key research element. For this reason, within the categorization process, emphasis was placed on the human senses activated in the case studies. Most of the case studies relate to technology through sight (123 projects), which is the first form of knowledge. Secondly, touch (94) and hearing (49) are catalyzers of attention. Numerous projects have proprioception (26), haptics, but also gestures as the primary means of activating interaction. Such projects make unusual use of sensors by collecting information often in the form of big data. The latter is one of the most mapped technologies in the database. In many case studies, big data (41) is used in projects for monitoring and tracking body-related data and is visualized through web applications, which is the most widely used tool. The database also shows that a widely experimented technology today is AI (81), followed by augmented reality (25).

Regarding innovation by sector, it is remarkable that most of the case studies identified are in the medical and wellness/well-being sphere. Products in this sector are mostly wearables but also digital services that communicate with users through digital interfaces. It is therefore common that case studies from design studios, companies, and university research integrate multiple design methodologies in the production of these multi-level objects. Product, interaction, and experience design are the design fields that are most involved in tackling the same macro-theme in very different ways.

As anticipated, the database and the relationships it brings to light can be useful to identify territorial districts. Most of the case studies collected come from Italy (121), the United States (62), and finally the United Kingdom (36).





1. The HBI observatory web site.

2. A case study analysis in the years 2013-2021.

Conclusion

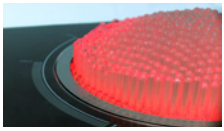
During the first few months, the development of the platform underwent numerous advancements regarding the processes and data entry methods according to the needs of the research group. These advancements were particularly directed at two objectives: increasing efficiency by simplifying the filing process and improving the readability of the database. As for the first point, a horizontally scrolling interface was developed to keep the filing tools in view at all times. As far as the second point goes, an interface with pop-up tabs was launched, allowing the tabs to be opened while maintaining orientation within the workflow.

The database is now a shared working tool that allows a relational filing, which can be adapted to multiple research projects by adapting to the research context and the people collaborating in the project.

Future developments of the platform will be directed towards improving the collaborative and decision-making processes to improve the validation tools for cataloging and the use of information. A specific forthcoming objective will be to map the large number of categories. They are a fundamental value for the relational platform but represent a complexity to be managed in-use and which – in the continuation of the project – can be put at the service of the HBI observatory. As the database grows, the tags will also change and increase according to, for example, the obsolescence of technologies and future innovations. In addition to this, a possible future integration could include a collection of tags linked to parts of the human body.



Acoesis
(2019) *https://adu.unibo.it/hbi/u/256*
1 *active and assisted living aal, hearing, music & audio, product*



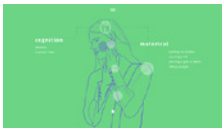
AERO
(2018) *https://adu.unibo.it/hbi/u/309*
2 *big data, data physicalization, haptic pressure*



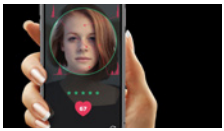
Aladdin
(1999) *https://adu.unibo.it/hbi/u/1430*
3 *ambient information display, force feedback, haptic, touch,*



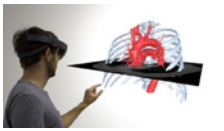
AlterEgo
(2019) *https://adu.unibo.it/hbi/u/251*
4 *ai, hearing, neural interface, touch, wearable*



Animo
(2020) *https://adu.unibo.it/hbi/u/86*
5 *ar, gamification, health, physical rehabilitation, proprioception*



Anura
(2020) *https://adu.unibo.it/hbi/u/402*
6 *ai, biometric sensor, computer vision, health,*



Artiness
(2018) *https://adu.unibo.it/hbi/u/153*
7 *3d holographic, 3d rendering, mixed reality, sight, startup*



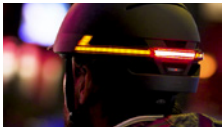
Ava AG
(2018) *https://adu.unibo.it/hbi/u/206*
8 *health, monitoring system, sight, sleep, touch*



BalanceBelt
(2020) *https://adu.unibo.it/hbi/u/1453*
9 *health, wearable*



Baotaz
(2016) *https://adu.unibo.it/hbi/u/406*
10 *ai, art, big data, data physicalization, semantic analysis*



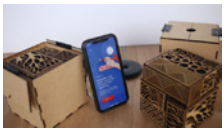
BH51 Neo Helmet
(2020) *https://adu.unibo.it/hbi/u/1600*
11 *iot, orientation, product design, urban mobility, wearable*



Biologizing the Machine
(2019) *https://adu.unibo.it/hbi/u/1429*
12 *ai, art, multisensory, sight, smell*



Bionic Chair
(2014) *https://adu.unibo.it/hbi/u/1576*
13 *controller, force feedback, interaction, product design*



Bukas
(2021) *https://adu.unibo.it/hbi/u/76*
14 *3d scanner, ar, laser, sight, touch*



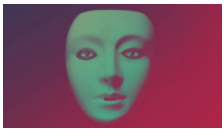
ButterfLife
(2020) *https://adu.unibo.it/hbi/u/193*
15 *anamnesis, health, medical device, sight, touch*



Buzz
(2013) *https://adu.unibo.it/hbi/u/315*
16 *haptic, health, hearing, touch, wearable*



Climate Converter
(2019) *https://adu.unibo.it/hbi/u/123*
17 *collective interaction, experience design, gamification, hearing*



Codebias
(2020) *https://adu.unibo.it/hbi/u/404*
18 *ai, facial recognition*



Cognixion one
(2021) *https://adu.unibo.it/hbi/u/196*
19 *ai, brain computer interface bci, hearing, mixed reality, neuroscience*



Coie
(2020) *https://adu.unibo.it/hbi/u/236*
20 *experience design, hearing, product design, sight, touch*



Cone bluetooth speaker
(2019) *https://adu.unibo.it/hbi/u/89*
21 *gesture, hearing, interface, music & audio, natural language interface*



Connected Colors
(2016) *https://adu.unibo.it/hbi/u/353*
22 *art, projection mapping, visual arts*



Crave 4d
(2020) *https://adu.unibo.it/hbi/u/1580*
23 *multisensory, projection mapping, projection wall, sight, smell*



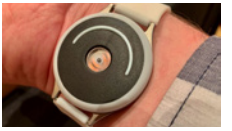
Dexcom G6
(2019) *https://adu.unibo.it/hbi/u/203*
24 *ai, diabetes, experience design, health, hearing*



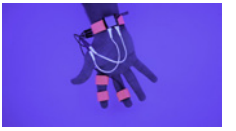
Ditto Wearable
(2012) *https://adu.unibo.it/hbi/u/311*
25 *notifications, wearable, wellbeing*



Dodecaudion
(2011) *https://adu.unibo.it/hbi/u/370*
26 *gesture, music & audio, service, spatial relation*



Doppel
(2015) *https://adu.unibo.it/hbi/u/307*
27 *haptic, natural language interface, rhythmic entrainment, touch*



Dormio
(2018) *https://adu.unibo.it/hbi/u/173*
28 *biofeedback, neuroscience, product design, wearable, wellbeing*



Dot
(2020) *https://adu.unibo.it/hbi/u/144*
29 *ai, anamnesis, interface, medical device, sight*



Dot Pad
(2021) *https://adu.unibo.it/hbi/u/1599*
30 *accessibility, ai, blindness, braille, haptic*



Duoskin
(2016) *https://adu.unibo.it/hbi/u/258*
31 *controller, interface, spatial relation, touch,*



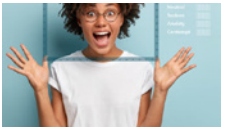
e-REAL
(2011) *https://adu.unibo.it/hbi/u/1452*
32 *ar, collective interaction, educational, mixed reality*



E-Skin
(2019) *https://adu.unibo.it/hbi/u/363*
33 *biometric sensor, health, medical device, motion analysis, service*



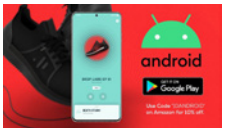
Embrace 2
(2016) *https://adu.unibo.it/hbi/u/154*
34 *ai, health, neuroscience, touch, wearable*



Emoji
(2017) *https://adu.unibo.it/hbi/u/389*
35 *ai, algorithms, emotion recognition, machine learning, service*



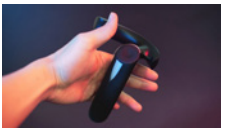
Emotion Haptic Sleeve
(2021) *https://adu.unibo.it/hbi/u/1455*
36 *blindness, emotion recognition, facial recognition, sight*



EP 01 - Droplabs
(2019) *https://adu.unibo.it/hbi/u/1417*
37 *ar, haptic vibrators, music & audio, virtual reality, wearable*



EPOC X
(2018) *https://adu.unibo.it/hbi/u/1561*
38 *controller, neural interface, neuroscience, product design*



Etee
(2020) *https://adu.unibo.it/hbi/u/393*
39 *controller, haptic, interactive material, mixed reality, sensors*



Exogun Wrap
(2020) *https://adu.unibo.it/hbi/u/1427*
40 *health, sport, wellness*



Feelzing
(2020) *https://adu.unibo.it/hbi/u/390*
41 *neuroscience, neurostimulation, sensors, wearable*



Festo Animals
(2010) *https://adu.unibo.it/hbi/u/351*
42 *bionics, natural movement, robotics, spatial relation*



Forciot
(2015) *https://adu.unibo.it/hbi/u/379*
43 *interactive material, interface, iot, product design, touch*



Fulu
(2019) *https://adu.unibo.it/hbi/u/176*
44 *ar, haptic, touch, wearable*



Geolitica
(2012) *https://adu.unibo.it/hbi/u/220*
45 *ai, big data, semantic analysis*



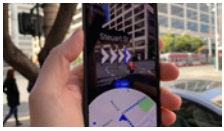
Get
(2015) *https://adu.unibo.it/hbi/u/212*
46 *digital wellbeing, haptic, hearing, service, sight*



GlassUp F4
(2017) *https://adu.unibo.it/hbi/u/270*
47 *ar, hearing, iot, mixed reality, service*



Google Maps Hacks
(2020) *https://adu.unibo.it/hbi/u/401*
48 *body absence, performing arts*



Google maps live view
(2019) *https://adu.unibo.it/hbi/u/373*
49 *ar, proprioception, service, sight*



Gravity sketch
(2021) *https://adu.unibo.it/hbi/u/334*
50 *controller, industry, service, virtual reality*



Hannes - Prosthesis Hand
(2018) *https://adu.unibo.it/hbi/u/160*
51 *health, medical device, product design, prosthesis, robotics*



Haptx Gloves DK2
(2019) *https://adu.unibo.it/hbi/u/382*
52 *force feedback, haptic, microfluidic haptic, motion capture, service*



Hitrech Evo Kit
(2019) *https://adu.unibo.it/hbi/u/232*
53 *big data, optical sensor, prediction, proprioception, service*



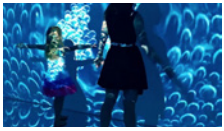
Holey
(2016) *https://adu.unibo.it/hbi/u/225*
54 *3d modelling, 3d printing, 3d scanner, health, medical device*



HUGSHIRT
(2004) *https://adu.unibo.it/hbi/u/253*
55 *collective interaction, fashion, haptic, multi-user, pressure sensor*



Identity stories
(2021) *https://adu.unibo.it/hbi/u/75*
56 *exhibit, experience design, hearing, multisensory, music & audio*



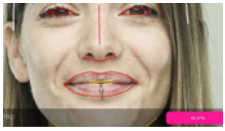
Illusion
(2019) *https://adu.unibo.it/hbi/u/1581*
57 *projection mapping, projection wall*



In love with the world
(2021) *https://adu.unibo.it/hbi/u/1428*
58 *art, robotics, sight, taste,*



Incognitio
(2019) *https://adu.unibo.it/hbi/u/408*
59 *facial recognition, product design*



Indice di Stendhal
(2021) *https://adu.unibo.it/hbi/u/244*
60 *ai, algorithms, art, emotion recognition, machine learning*



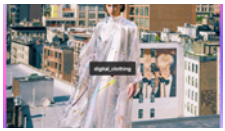
Ingress
(2012) *https://adu.unibo.it/hbi/u/345*
61 *ar, game*



Interactive Light
(2014) *https://adu.unibo.it/hbi/u/185*
62 *ar, gamification, interaction, interface, projector*



Intomacy
(2018) *https://adu.unibo.it/hbi/u/157*
63 *collective interaction, haptic, interaction, multi-user*



Iridescence
(2020) *https://adu.unibo.it/hbi/u/355*
64 *3d modelling, blockchain, digi-couture, fashion, nft*



Jame
(2021) *https://adu.unibo.it/hbi/u/403*
65 *active and assisted living aal, ai, health, parkinson, wearable*



Jaspr - Woodoo
(2016) *https://adu.unibo.it/hbi/u/378*
66 *automotive, display, interactive material, touch*



Kagami
(2016) *https://adu.unibo.it/hbi/u/394*
67 *exhibit, projection mapping, video mapping*



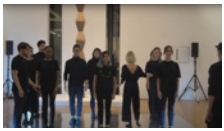
Keiron HIIT
(2016) *https://adu.unibo.it/hbi/u/168*
68 *computer vision, proprioception, sight, touch, virtual reality*



KINETIC Reflex
(2016) *https://adu.unibo.it/hbi/u/313*
69 *haptic, health, industry, motion analysis, proprioception*



KitMe
(2015) *https://adu.unibo.it/hbi/u/291*
70 *deafness, haptic, health, hearing, startup*



L'Odyssée du Toucher
(2017) *https://adu.unibo.it/hbi/u/322*
71 *music & audio, performing arts, touch electronic board*



LECHAL sole
(2014) *https://adu.unibo.it/hbi/u/352*
72 *blindness, haptic, health, orientation, spatial relation*



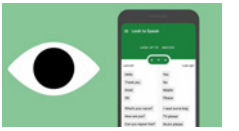
LEGO¬Æ Braille Bricks
(2020) *https://adu.unibo.it/hbi/u/165*
73 *blindness, braille, educational, touch*



Lift
(2019) *https://adu.unibo.it/hbi/u/1416*
74 *health, movement disorder, product design*



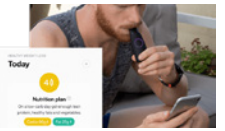
Liteboxer
(2020) *https://adu.unibo.it/hbi/u/170*
75 *hearing, sport, touch, wellness*



Look To Speak
(2020) *https://adu.unibo.it/hbi/u/72*
76 *ai, hearing, mobile app, music & audio, neuroscience*



Lucas 3
(2016) *https://adu.unibo.it/hbi/u/348*
77 *cardiopulmonary resuscitation cpr, health, medical device*



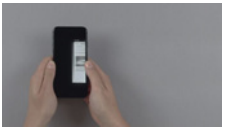
Lumen
(2022) *https://adu.unibo.it/hbi/u/1596*
78 *health, healthcare nutrition, iot, mobile app*



Lumen MR
(2019) *https://adu.unibo.it/hbi/u/95*
79 *ar, exhibit, gamification, interface, mixed reality*



M HKA Wall
(2020) *https://adu.unibo.it/hbi/u/77*
80 *collective interaction, exhibit, communication and media,*



Magic UX
(2019) *https://adu.unibo.it/hbi/u/96*
81 *ar, gesture, interaction, mobile app, sight*



Makr Shakr
(2015) *https://adu.unibo.it/hbi/u/333*
82 *ai, experience design, food, robotics, service*



Melo Ring
(2019) *https://adu.unibo.it/hbi/u/197*
83 *gesture, interaction, music & audio, touch, wearable*



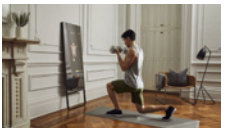
Mictic
(2018) *https://adu.unibo.it/hbi/u/376*
84 *gamification, gesture, hearing, motion capture, music & audio*



Midi Controller Touchme
(2020) *https://adu.unibo.it/hbi/u/320*
85 *music & audio, performing arts*



MIMU glove
(2014) *https://adu.unibo.it/hbi/u/167*
86 *flex sensor, haptic, imu sensor, led, music & audio*



Mirror
(2016) *https://adu.unibo.it/hbi/u/296*
87 *computer vision, motion capture, product design, sight*



Mollii
(2010) *https://adu.unibo.it/hbi/u/349*
88 *electrostimulation, health, medical device, neuroscience*



Moving buttons
(2021) *https://adu.unibo.it/hbi/u/328*
89 *interaction, interface, service, sight, touch*



Mudita Pure
(2020) *https://adu.unibo.it/hbi/u/94*
90 *hearing, product design, sight, touch*



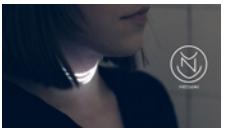
Muscle Suit
(2015) *https://adu.unibo.it/hbi/u/343*
91 *exoskeleton, industry, robotics, wearable, wellbeing*



Musy
(2018) *https://adu.unibo.it/hbi/u/125*
92 *experience design, gamification, gesture, hearing, interaction*



MYMANU
(2014) *https://adu.unibo.it/hbi/u/317*
93 *ai, hearing, wearable*



Neclumi
(2014) *https://adu.unibo.it/hbi/u/369*
94 *fashion, interaction, projection mapping, service, sight*



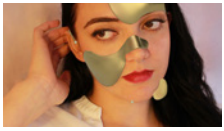
Neuroshirt
(2020) *https://adu.unibo.it/hbi/u/1454*
95 *feedback, haptic, health, medical device, wearable*



NEWBORN
(2017) *https://adu.unibo.it/hbi/u/73*
96 *clothes, fashion, sostenibility, touch*



NextMind
(2019) *https://adu.unibo.it/hbi/u/384*
97 *controller, neural interface, neuroscience, product design*



Orwell
(2020) *https://adu.unibo.it/hbi/u/409*
98 *cybersecurity, emotion recognition, facial recognition, product design,*



Paexo Back
(2020) *https://adu.unibo.it/hbi/u/350*
99 *exoskeleton, health, industry, wearable, wellbeing*



Paper Phone
(2019) *https://adu.unibo.it/hbi/u/65*
100 *product design, ui user interface, wellbeing*



PASSO
(2021) *https://adu.unibo.it/hbi/u/335*
101 *health, hearing, natural language interface, parkinson*



Petting Zoo
(2013) *https://adu.unibo.it/hbi/u/388*
102 *ai, art, exhibit, natural language interface, natural movement*



Play Impossible Gameball
(2020) *https://adu.unibo.it/hbi/u/179*
103 *game, product design, service, sight, sport*



Pleinair
(2019) *https://adu.unibo.it/hbi/u/327*
104 *interaction, sensors, service, spatial relation, wellbeing*



Plyon
(2021) *https://adu.unibo.it/hbi/u/381*
105 *automotive, interactive material, sensors, service*



Practico
(2017) *https://adu.unibo.it/hbi/u/1597*
106 *interiors and furniture,*



Progloves
(2020) *https://adu.unibo.it/hbi/u/342*
107 *industry, laser scanners, wearable*



Project Jacquard
(2016) *https://adu.unibo.it/hbi/u/330*
108 *gesture, interaction, service, ui user interface, wearable*



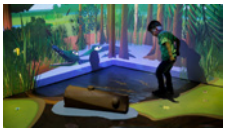
Project Soli
(2016) *https://adu.unibo.it/hbi/u/329*
109 *ai, gesture, interaction, ui user interface*



Pupil Invisible
(2020) *https://adu.unibo.it/hbi/u/341*
110 *iot, product design, service, sight, wearable*



Revealing Couture
(2020) *https://adu.unibo.it/hbi/u/354*
111 *art, memory - remembrance, video*



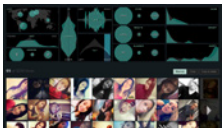
River of Grass
(2017) *https://adu.unibo.it/hbi/u/1527*
112 *biodiversity, collective interaction, educational, multi-user, projection*



S7 Imagination Machine
(2016) *https://adu.unibo.it/hbi/u/372*
113 *controller, experience design, gamification, neural interface*



Scaeva InSitu
(2020) *https://adu.unibo.it/hbi/u/377*
114 *hearing, memory - remembrance, music & audio, wearable*



Selfiecity
(2015) *https://adu.unibo.it/hbi/u/397*
115 *ai, big data, instagram*



Shadow Wall
(2019) *https://adu.unibo.it/hbi/u/122*
116 *collective interaction, experience design, interaction, sight*



Shampora
(2018) *https://adu.unibo.it/hbi/u/280*
117 *ai, cosmetics and personal care, fashion, service, wellbeing*



Siid
(2019) *https://adu.unibo.it/hbi/u/121*
118 *biohacking, internet of thing, medical device, touch*



Silmu
(2020) *https://adu.unibo.it/hbi/u/156*
119 *experience design, problem solving, product design, spatial relation*



Simulated Reality
(2010) *https://adu.unibo.it/hbi/u/383*
120 *imaging 2d/3d, interaction, service, stereoscopic image, ui*



Sixty Hidratation Monitor
(2018) *https://adu.unibo.it/hbi/u/162*
121 *biometric sensor, health, product design, sight, touch*



SleepMate
(2020) *https://adu.unibo.it/hbi/u/102*
122 *ai, hearing, interaction, product design, sight*



Smart Beaming
(2021) *https://adu.unibo.it/hbi/u/1425*
123 *directional audio, music & audio, spatial relation*



Soundbrenner Pulse
(2015) *https://adu.unibo.it/hbi/u/314*
124 *haptic, music & audio, natural language interface*



SOUNDSHIRT
(2020) *https://adu.unibo.it/hbi/u/252*
125 *ar, bluetooth, fashion, haptic, hearing*



spatial flux
(2018) *https://adu.unibo.it/hbi/u/346*
126 *haptic, health, wearable, wellbeing,*



Surfacide
(2020) *https://adu.unibo.it/hbi/u/208*
127 *disinfection, product design, service, sight, wellbeing*



Tactigon
(2018) *https://adu.unibo.it/hbi/u/174*
128 *ai, arduino, controller, product design, proprioception*



Teslasuit
(2019) *https://adu.unibo.it/hbi/u/392*
129 *gamification, haptic, interaction, monitoring system, product design*



Tg0
(2015) *https://adu.unibo.it/hbi/u/380*
130 *capacitive sensing, interactive material*



The Handphone Table
(1978) *https://adu.unibo.it/hbi/u/344*
131 *art, music & audio, touch*



Time Capsule
(1997) *https://adu.unibo.it/hbi/u/1598*
132 *memory - remembrance, performing arts*



TMA-2
(2019) *https://adu.unibo.it/hbi/u/106*
133 *hearing, music & audio, product design, sostenibility*



Transform Visitors
(2016) *https://adu.unibo.it/hbi/u/74*
134 *exhibit, experience design, interface, sight, touch*



Turntable
(2021) *https://adu.unibo.it/hbi/u/1585*
135 *colour, music & audio, sight*



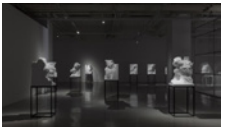
Tympa Health
(2020) *https://adu.unibo.it/hbi/u/259*
136 *hearing, interface, product design, service, sight*



Ultraleap
(2013) *https://adu.unibo.it/hbi/u/298*
137 *ar, haptic, interactive experience, mid-air haptic, touch*



Undress or fail
(2020) *https://adu.unibo.it/hbi/u/400*
138 *paper*



Unfinished Sculptures
(2016) *https://adu.unibo.it/hbi/u/395*
139 *3d modelling, art*



Upmood
(2018) *https://adu.unibo.it/hbi/u/87*
140 *ai, heart rate variability hrv, wearable, wellbeing,*



Venous materials
(2020) *https://adu.unibo.it/hbi/u/374*
141 *haptic, interaction, interface, pressure sensor, sight*



Veri
(2020) *https://adu.unibo.it/hbi/u/391*
142 *biometric sensor, food, health, healthcare nutrition, mobile app*



Verso
(2017) *https://adu.unibo.it/hbi/u/213*
143 *controller, gesture, interaction, music & audio, proprioception*



Vibre
(2017) *https://adu.unibo.it/hbi/u/148*
144 *biometrica, monitoring system, neural interface, neuroscience*



Vickey

(2015) *https://adu.unibo.it/hbi/u/289*

145 *cybersecurity, internet of thing, product design, startup*

voice med

(2020) *https://adu.unibo.it/hbi/u/302*

146 *ai, biofeedback, deep learning, hearing, medical device*



WAHU

(2020) *https://adu.unibo.it/hbi/u/318*

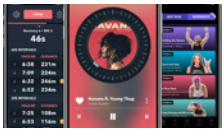
147 *ai, sensors, spatial relation, wearable*



Weather system

(2020) *https://adu.unibo.it/hbi/u/235*

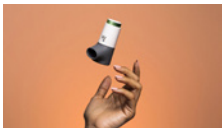
148 *arduino, big data, data physicalization, iot, prediction*



Weav Run

(2017) *https://adu.unibo.it/hbi/u/1426*

149 *music & audio, sport, wellbeing*



Wellbeings mist inhaler

(2020) *https://adu.unibo.it/hbi/u/207*

150 *health, medical device, product design, service, smell*



Wise

(2019) *https://adu.unibo.it/hbi/u/356*

151 *hearing, medical device, service, sight, touch*



wob

(2016) *https://adu.unibo.it/hbi/u/70*

152 *experience design, gesture, hearing, music & audio, product design*



Woojer

(2014) *https://adu.unibo.it/hbi/u/386*

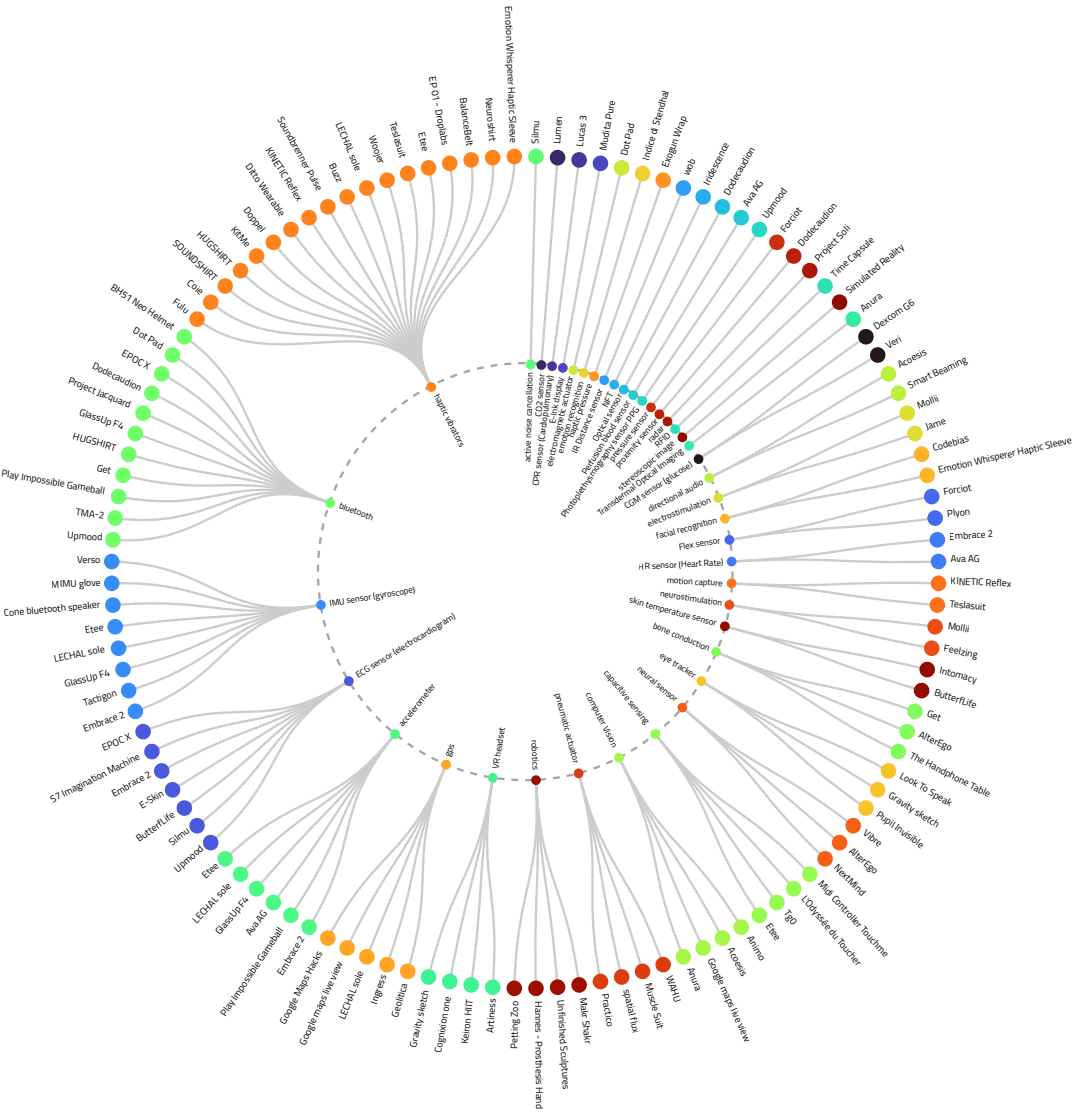
153 *haptic, music & audio, sensors, service, wearable*



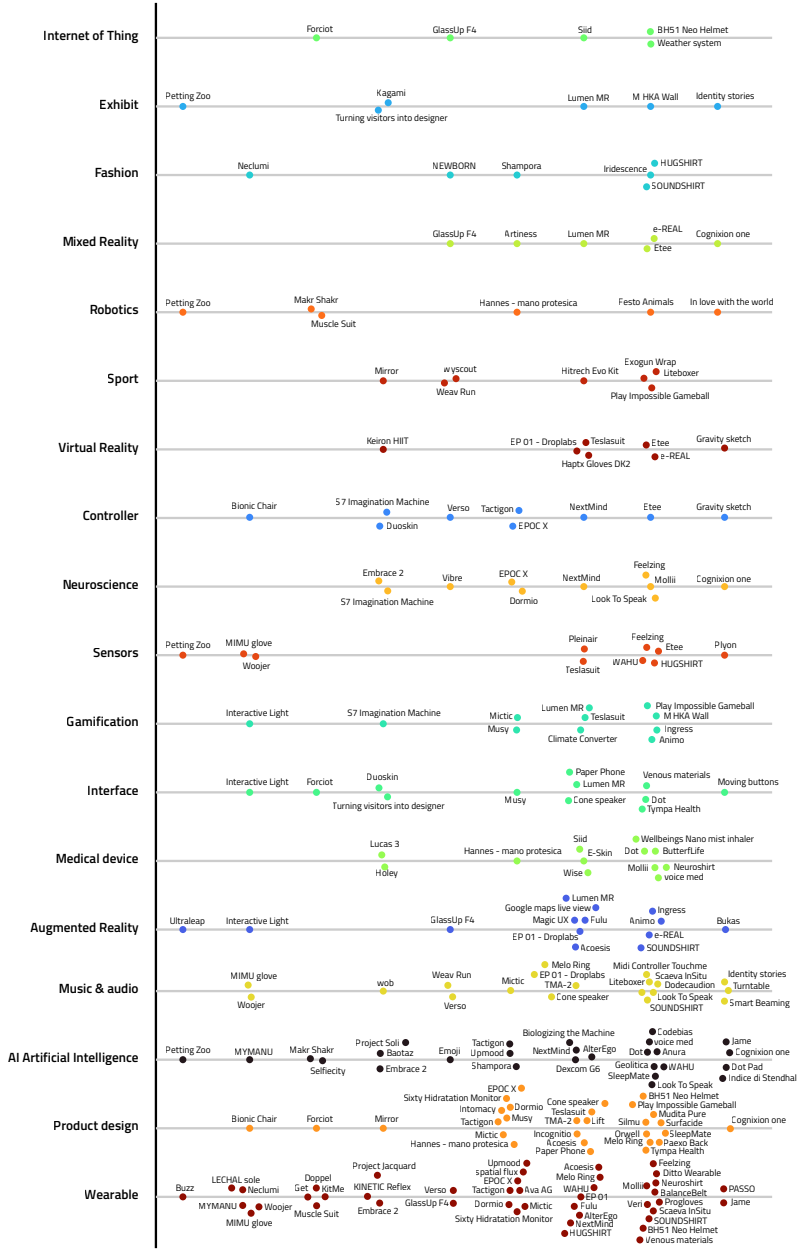
wyscout

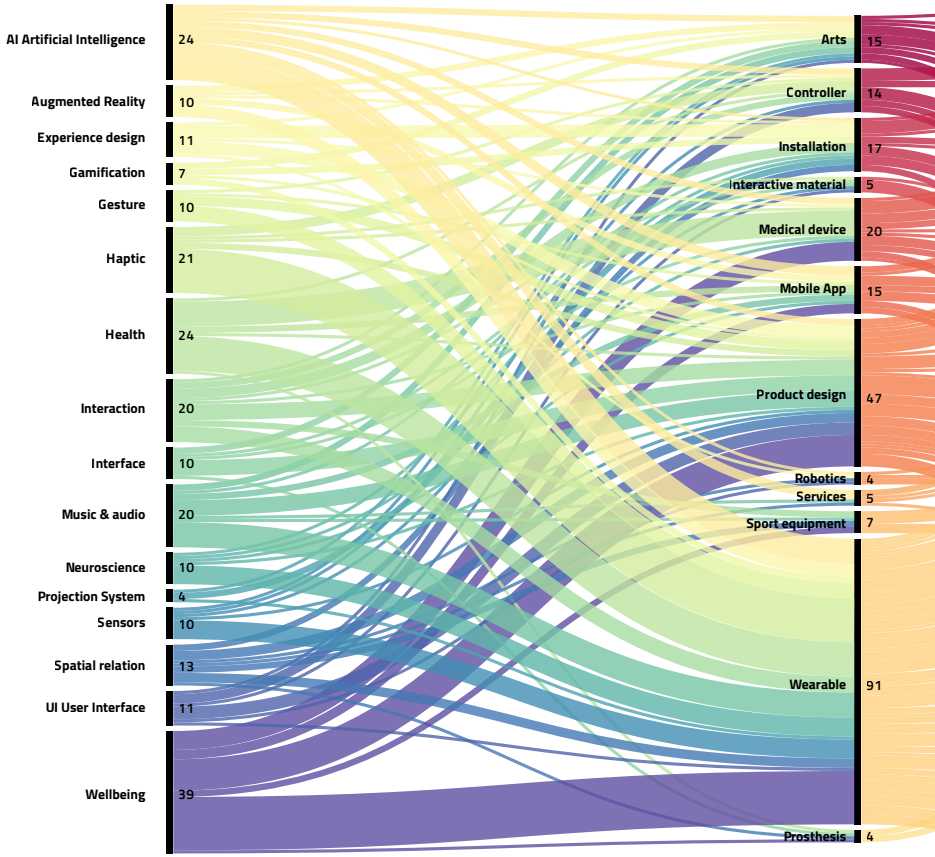
(2017) *https://adu.unibo.it/hbi/u/229*

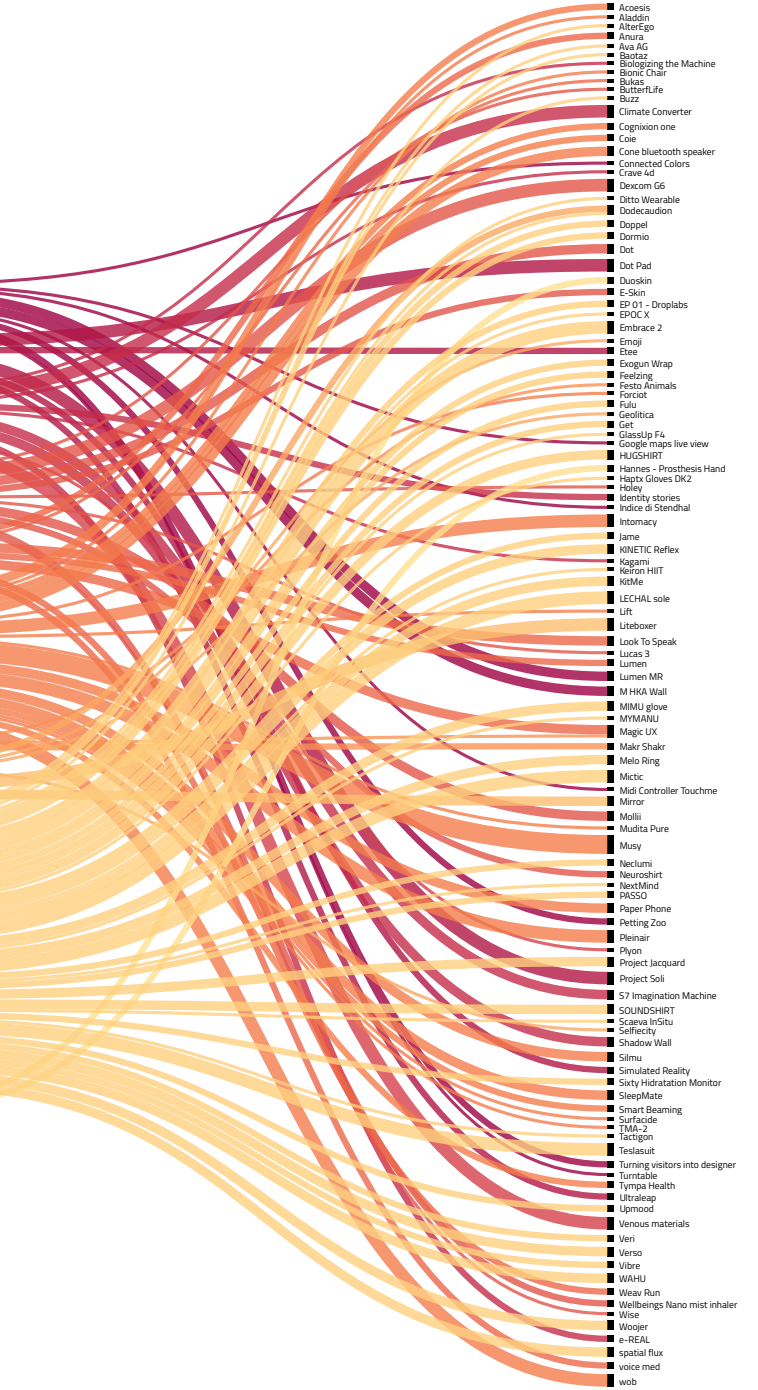
154 *big data, eye tracker, prediction, proprioception, service*



3. Taxonomy of case studies in relation to the tagging categories (projects published in the book e and available on the observatory http://adu.unibo.it/hbi).


Internet of Thing
Forciot
GlassUp F4
Siid
BH51 Neo Helmet
Weather system
Exhibit
Petting Zoo
Kagami
Turning visitors into designer
Lumen MR
M HKA Wall
Identity stories
Fashion
Neclumi
NEWBORN
Shampora
Iridescence
HUGSHIRT
SOUNDSHIRT
Mixed Reality
GlassUp F4
Artiness
Lumen MR
e-REAL
Etee
Cognixion one
Robotics
Petting Zoo
Makr Shakr
Muscle Suit
Hannes - mano protesica
Festo Animals
In love with the world
Sport
Mirror
wyscout
Weav Run
Hitrech Evo Kit
Exogun Wrap
Liteboxer
Play Impossible Gameball
Virtual Reality
Keiron HIIT
EP 01 - Droplabs
Teslasuit
Etee
Gravity sketch
Haptx Gloves DK2
e-REAL
Controller
Bionic Chair
S7 Imagination Machine
Duoskin
Verso
Tactigon
EPOC X
NextMind
Etee
Gravity sketch
Neuroscience
Embrace 2
S7 Imagination Machine
Vibre
EPOC X
Dormio
NextMind
Feelzing
Mollii
Look To Speak
Cognixion one
Sensors
Petting Zoo
MIMU glove
Woojer
Pleinair
Teslasuit
Feelzing
Etee
WAHU
HUGSHIRT
Plvon
Gamification
Interactive Light
S7 Imagination Machine
Mictic
Musy
Lumen MR
Teslasuit
Climate Converter
Play Impossible Gameball
M HKA Wall
Ingress
Animo
Interface
Interactive Light
Forciot
Duoskin
Turning visitors in designer
Musy
Paper Phone
Lumen MR
Cone speaker
Venous materials
Dot
Tympa Health
Moving buttons
Medical device
Lucas 3
Holey
Hannes - mano protesica
Siid
E-Skin
Wise
Wellbeings Nano mist inhaler
Dot
ButterfLife
Mollii
Neuroshirt
voice med
Augmented Reality
Ultraleap
Interactive Light
GlassUp F4
Google maps live view
Magic UX
Fulu
EP 01 - Droplabs
Acoesis
Lumen MR
Animo
Ingress
e-REAL
SOUNDSHIRT
Bukas
Music & audio
MIMU glove
Woojer
wob
Weav Run
Verso
Mictic
Melo Ring
EP 01 - Droplabs
TMA-2
Cone speaker
Midi Controller Touchme
Liteboxer
Scaeva InSitu
Dodecaudion
Look To Speak
SOUNDSHIRT
Identity stories
Turntable
Smart Beaming
AI Artificial Intelligence
Petting Zoo
MYMANU
Makr Shakr
Selfiecity
Project Soli
Baotaz
Embrace 2
Emoji
Tactigon
Upmood
Shampora
Biologizing the Machine
NextMind
AlterEgo
Dexcom G6
Codebias
voice med
Anura
Dot
Geolitica
SleepMate
WAHU
Look To Speak
Jame
Cognixion one
Dot Pad
Indice di Stendhal
Product design
Bionic Chair
Forciot
Mirror
Sixty Hidratation Monitor
Intomacy
Dormio
Musy
Tactigon
EPOC X
Cone speaker
Teslasuit
TMA-2
Lift
Mictic
Hannes - mano protesica
Incognitio
Acoesis
Paper Phone
BH51 Neo Helmet
Play Impossible Gameball
Mudita Pure
Surfacide
Silmu
SleepMate
Onwell
Melo Ring
Paxeo Back
Tympa Health
Cognixion one
Wearable
Buzz
LECHAL sole
Neclumi
MYMANU
Woojer
MIMU glove
Doppel
Get
KitMe
Muscle Suit
Project Jacquard
KINETIC Reflex
Embrace 2
Verso
GlassUp F4
Upmood
spatial flux
EPOC X
Tactigon
Ava AG
Dormio
Mictic
Sixty Hidratation Monitor
Acoesis
Melo Ring
WAHU
EP 01
Fulu
AlterEgo
NextMind
HUGSHIRT
Feelzing
Ditto Wearable
Neurosnirt
BalanceBelt
Mollii
Progloves
Scaeva InSitu
SOUNDSHIRT
BH51 Neo Helmet
Venous materials
Veri
PASSO
Jame
2013
2014
2015
2016
2017
2018
2019
2020
2021


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4. Analysis of the main tagging categories in relation to the main typologies of products (projects published in the book e and available on the observatory http://adu.unibo.it/hbi).