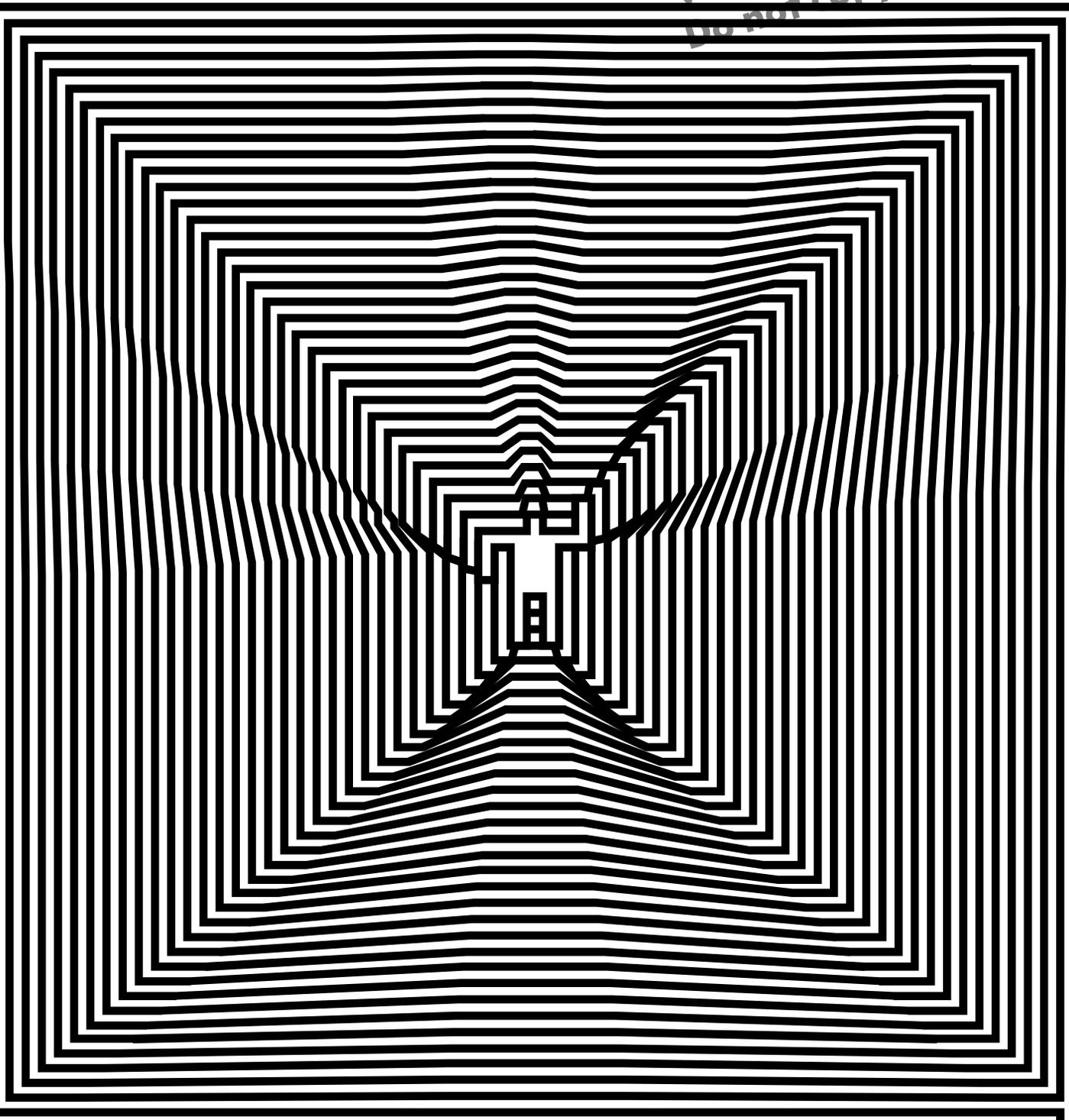


# HELLO, ROBOT

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Museum

DESIGN BETWEEN  
HUMAN AND MACHINE

MAK 

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# MORE URGENT THAN EVER: HELLO AGAIN, ROBOT

Their choice of words was not exactly high-toned. “Fuck you, Silicon Valley!”: this was the header chosen by the venerable German weekly *Die Zeit* in January 2017 for an article illustrated with a pixelated, 1980s-Atari-style image of a rude hand gesture.<sup>1</sup> And the message itself was just as angry as the title implied. “How can it be that no one stands up to the Valley and their breathtaking arrogance? Why is the debate so painfully servile?”, the author demanded. After months of researching and preparing for the exhibition *Hello, Robot. Design between Human and Machine*, I found myself in complete agreement. The article talked about Amazon and the decline of brick-and-mortar trade, about Uber and “non-unionised car coolies”, about Airbnb and the rise in housing prices in the inner cities, about the “armada of Deliveridoo slaves faced with outrageous precarity”.<sup>2</sup> Most of all, however, it talked about the incredible hubris of a tech industry that unblushingly claims to be making the world a better place, and about the fawning eagerness displayed by politicians – and all the rest of us, too. “Man oh man, how sad is that?”, the article concluded.<sup>3</sup>

It’s a question we could ask ourselves over and over again. Since its premiere in 2017, *Hello, Robot.* toured nine museums all around the world and has now been slightly updated for its return to the Vitra Design Museum in autumn 2022. The issues it addresses – as did the *Zeit* article – are as pressing today as they were then. Nothing seems to have changed. No one seems to have taken the least notice of what the article and the exhibition were trying to tell us all along, namely, to stop worrying about the Terminator and, instead, start worrying about developments in our increasingly smart, increasingly robotic world – and about the commercial and political agendas driving them.

## AMELIE KLEIN

To recapitulate: anything can be a robot. All it needs are sensors to receive data; intelligence – i.e. programming – enabling it to successfully process these data; and actuators allowing it to generate an appropriate physical response, such as a dot of light on a screen, sound, motion, or heat.<sup>4</sup> A smartphone is basically a robot; so are drones and self-driving cars. The chatbot that replies to your online customer query? A robot. Algorithms and 3D printing? Robotic tools. The smart house? Yet another robot. Smart cities or any other type of smart environment are robots, too, for in contrast to human beings, intelligent machines do not require bodies. Anything that is “smart” is a robot.

<sup>1</sup> Alard von Kittlitz, “Fuck you, Silicon Valley!”, in: *Die Zeit* (no. 5, 26 January 2017), p. 51

<sup>2</sup> Ibid., p. 52

<sup>3</sup> Ibid., p. 52

“Tech is more like a coat of new paint on everything than a definable set of products or industries,” the *New York Times* wrote in December 2021.<sup>5</sup> And these new layers of paint permeate our daily activities at both the individual and the collective level. All the issues and movements of our time have their hashtagged counterparts, multiplications, and causes and effects on the internet, for better or for worse: #compulsoryvaccination, #greatreplacement, #MAGA, and #BigLie are trending – as are #BlackLivesMatter, #MeToo, #FridaysforFuture, and #ExtinctionRebellion – to name but a very, very few.<sup>6</sup> That is why all our debates are, essentially, debates about technology.

Back in early 2017, reading the *Zeit* article was refreshing, even encouraging. Here, at last, was someone who said what had long needed saying; someone who felt the same anger and rage as I did. If the article did not make it into the first edition of this book, that was only because printing was already in progress. Another article that drew the curatorial team’s attention suffered the same fate: a portrait in the Swiss publication *Das Magazin* of the psychologist Michal Kosinski. In his academic work at Cambridge University, Kosinski had developed a system that amalgamated Facebook likes with established psychological methods in what turned out to be an extremely potent marketing tool.<sup>7</sup> The authors described in detail how Kosinski’s system was hijacked by a political advertising agency called Cambridge Analytica as well as to whom this agency had offered its services. The scandal that brought all this to light and led to the company closing operations did not break until a little more than a year later, however, in March 2018.<sup>8</sup>

Despite numerous investigations, it remains unclear whether Cambridge Analytica’s microtargeting and misuse of data harvested from up to 87 million Facebook users really influenced the outcomes of the US presidential elections and the Brexit campaign.<sup>9</sup> All the same, the scandal marked a turning point in debates about the tech industry. In 2018, the European Union began its efforts to restrain tech companies’ hunger for data by enacting, for all its flaws, the General Data Protection Regulation. The Cambridge Analytica case is still making its way through US courts. The most recent development is a suit against Mark Zuckerberg, founder and CEO of Meta (better known under the company’s former name Facebook), filed by Washington DC Attorney General Karl A. Racine. Zuckerberg, the prosecution argues, must have known about the data leak, and thus must have at least passively approved the siphoning of personal data for microtargeting.<sup>10</sup> “This lawsuit is not only warranted, but necessary,” Racine said during a news conference, “and sends a message that corporate leaders, including CEOs, will be held accountable for their actions.”<sup>11</sup>

<sup>4</sup> See Amelie Klein, “The search for questions”, p. 18, and Carlo Ratti with Daniele Belleri, “A robot for living in”, p. 234 in this publication

<sup>5</sup> Shira Ovide, “Tech Won. Now What?”, in: *The New York Times* (23 December 2021), <https://www.nytimes.com/2021/12/23/technology/tech-won-now-what.html>, accessed on 27 May 2022

<sup>6</sup> The author of this text would like to make clear that she in no way endorses any content that is right-wing or anti-democratic or spreading false information about the COVID-19 pandemic. The list of hashtags provided in the text only serves to demonstrate the broad range of online content.

<sup>7</sup> Hannes Grassegger and Mikael Krogerus, “The Data That Turned the World Upside Down”, in: *Vice* (28 January 2017), <https://www.vice.com/en/article/mg9vvn/how-our-likes-helped-trump-win>, accessed on 13 June 2022. Originally published in German in *Das Magazin* (no. 48, 3 December 2016) under the title “Ich habe nur gezeigt, dass es die Bombe gibt”, <https://web.archive.org/web/20170127181034/https://www.dasmagazin.ch/2016/12/03/ich-habe-nur-gezeigt-dass-es-die-bombe-gibt/>

<sup>8</sup> “The Cambridge Analytica Files”, in: *The Guardian*, <https://www.theguardian.com/news/series/cambridge-analytica-files>, accessed on 26 May 2022

<sup>9</sup> Ingo Dachwitz, “Abschlussbericht der Datenschutzbehörde: Nein, der Cambridge-Analytica-Skandal fällt nicht in sich zusammen”, in: *netzpolitik.org* (23 October 2020), <https://netzpolitik.org/2020/abschlussbericht-der-datenschutzbehoerde-nein-der-cambridge-analytica-skandal-faellt-nicht-in-sich-zusammen/>, accessed on 26 May 2022

<sup>10</sup> Cat Zakrzewski, “D.C. attorney general sues Zuckerberg over Cambridge Analytica scandal”, in: *The Washington Post* (23 May 2022), <https://www.washingtonpost.com/technology/2022/05/23/racine-zuckerberg-privacy/>, accessed on 26 May 2022

<sup>11</sup> Ibid.

12 Caitlin Harrington, "Amazon Staten Island Workers Unionize in a Historic First", in: *Wired* (1 April 2022), <https://www.wired.com/story/staten-island-amazon-elections/>, accessed on 27 May 2022

13 Caitlin Harrington, "An Amazon Warehouse Worker Takes the Fight to Shareholders", in: *Wired* (25 May 2022), <https://www.wired.com/story/amazon-warehouse-worker-shareholder-proposal/>, accessed on 27 May 2022

At Amazon, workers have begun to unionise.<sup>12</sup> Their central aim is to combat productivity quotas that require warehouse "pickers" to scan 300 to 350 items per hour – during ten-hour shifts interrupted only by one thirty-minute break and two fifteen-minute breaks. Anyone who falls short – for example by taking too many trips to the loo – receives a formal warning. Repeat offenders risk termination.<sup>13</sup> Compliance with these brutal standards is ensured by wearable surveillance terminals, one of which is on display in the updated *Hello, Robot*. exhibition.

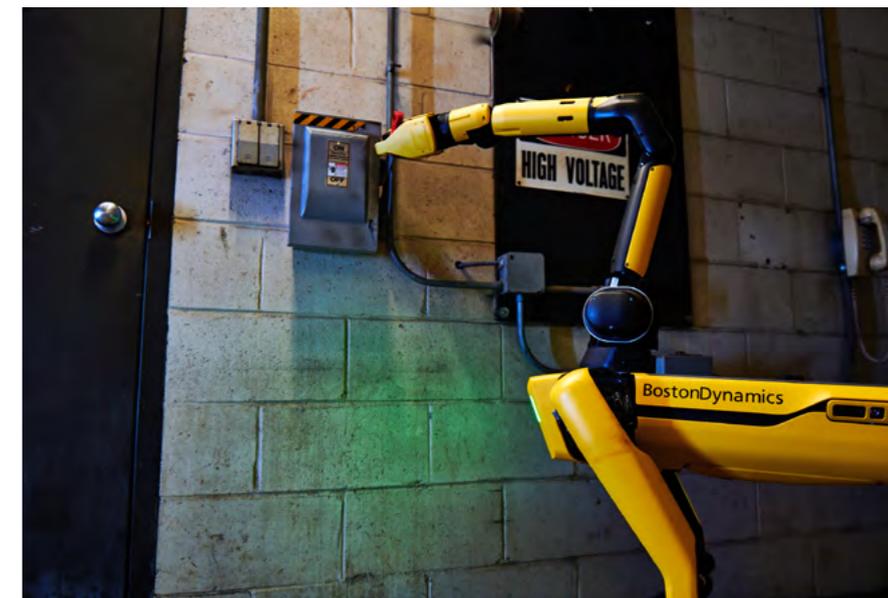


Motorola Symbol. *Barcode Scanner WT4090-N3S0GER*, 2009. Mobile handheld computer, 26 × 142 × 93 mm, various materials © Vitra Design Museum, photo: Andreas Sütterlin

14 Jonathan Chadwick, "Robot dog named Zeus is seen inspecting SpaceX's rocket test site in Texas after a Starship tank exploded during a cryogenic pressure test", in: *Mail Online* (25 June 2020), <https://www.dailymail.co.uk/sciencetech/article-8458885/Boston-Dynamics-robot-dog-inspects-SpaceX-site-Texas.html>, accessed on 26 May 2022

15 Angela Giuffrida, "Robot dog called in to help manage Pompeii", in: *The Guardian* (28 March 2022), [https://www.theguardian.com/technology/2022/mar/28/robot-dog-to-help-manage-pompeii-spot-tunnels-thieves?CMP=Share\\_iOSApp\\_Other](https://www.theguardian.com/technology/2022/mar/28/robot-dog-to-help-manage-pompeii-spot-tunnels-thieves?CMP=Share_iOSApp_Other), accessed on 27 May 2022

16 Ryan McMorro and Gloria Li, "The robot dogs policing Shanghai's strict lockdown", in: *Financial Times* (14 April 2022), <https://www.ft.com/content/5c437146-2d18-466b-84af-24a47b32de59>, accessed on 26 May 2022; also see NowThis News, "Robot Dog Barks COVID-19 Safety Protocols in Shanghai", in: YouTube (31 March 2022), <https://www.youtube.com/watch?v=tT9qv30Vbt4>, accessed on 26 May 2022



Boston Dynamics. *Spot*, since 2016. Robot, various materials, height (walking, min–max): 520–700 mm, length: 1100 mm, width: 500 mm, weight incl. battery: 31.7 kg. Photo: courtesy Boston Dynamics

A new awareness has arisen among a wider public. Whatever the future may hold, one thing is certain: the servile attitudes that so incensed the *Zeit* journalist in January 2017 – and with good reason – are a thing of the past. That does not mean, however, that the issues he addressed have been resolved. But at least we have started to talk about them, and that was one of the main things the exhibition set out to do as well. The updated new edition of *Hello, Robot*. includes a number of additional exhibits that may add fuel to the debate. *Spot*, for example, is a dog to delight the heart of any robotics enthusiast. First presented in 2016 by its manufacturer Boston Dynamics and available for purchase since 2019, the four-legged robot has been deployed by Elon Musk's SpaceX at rocket test sites.<sup>14</sup> *Spot* has also inspected the safety and structural stability of tunnels dug by relic thieves in Pompeii.<sup>15</sup> But the *Spot* video that went viral was one that showed it wandering around the deserted streets of Shanghai with a megaphone taped to its back spouting messages that exhorted the inhabitants to comply with the city's strict lockdown rules.<sup>16</sup>



Boston Dynamics. *Spot*, since 2016. Photo: courtesy Boston Dynamics

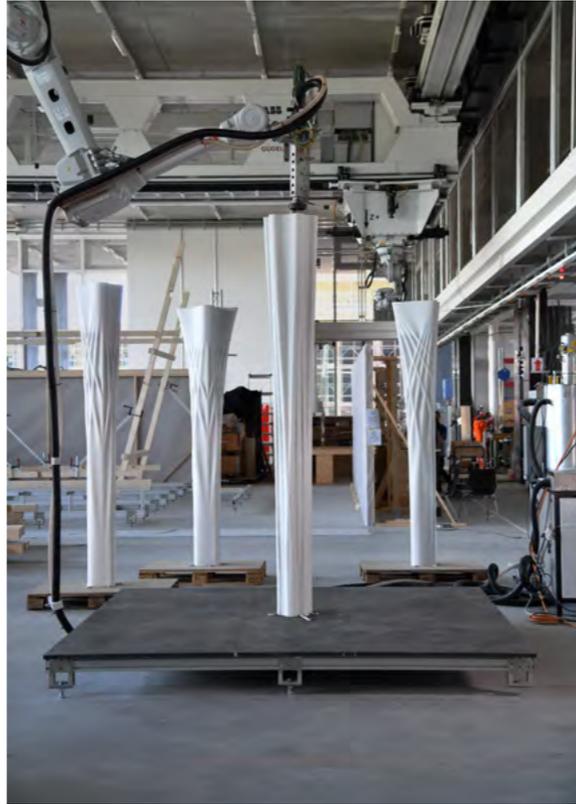
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Our attitudes towards machines may remain ambivalent, but all the same, when the Swiss Institute of Technology's Gramazio Kohler Research unit celebrates the relaunch of *Hello, Robot.* by erecting a pavilion in front of the Vitra Design Museum, this must be a reason for architecture buffs to rejoice. The research unit focuses on the development of digital production methods and examines their impact on architectural design. The pavilion uses the innovative Eggshell manufacturing technology: the formwork for the cast concrete is 3D-printed; after the concrete has dried, the formwork can be peeled away – just like an eggshell. This enables designers to create unusual shapes while at the same time reducing material use by up to 50 percent.

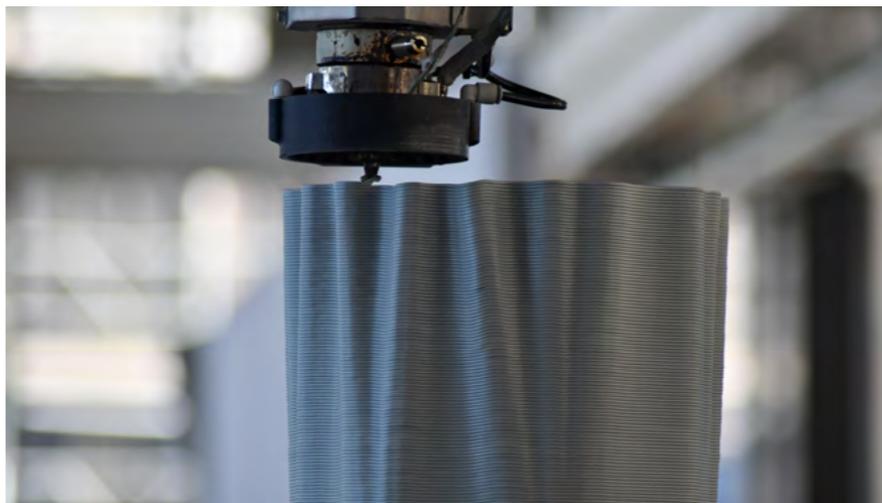
The 3D-printed *Sabots* by American artist Tyler Coburn, in turn, hark back to early forms of resistance to technology. "Sabot" is the French word for wooden clogs, and it is the stem of the neologism "sabotage", of whose etymology varying accounts exist. While it has been established that many factory workers were former farm labourers who came to the cities wearing their traditional wooden clogs, there is some doubt whether they deliberately damaged machines by throwing their *sabots* into the gears. It may also have been the case that their coarse wooden footwear merely caused them to trip and stumble on the factory floors, thus disrupting production. In any event, Coburn's *Sabots* were printed in what is known as a "lights-out factory": a fully automated production facility almost completely devoid of people, meaning the lights hardly ever need to be switched on.<sup>17</sup>

14

<sup>17</sup> Tyler Coburn, *Sabots*, <https://www.tylercoburn.com/sabots.html>, accessed on 26 May 2022



MAS ETH DFAB, ETH Zurich. *Eggshell Pavilion*, 2022. Reinforced concrete cast using 3D-printed formwork © Gramazio Kohler Research, ETH Zurich



MAS ETH DFAB, ETH Zurich. *Eggshell Pavilion*, 2022 © Gramazio Kohler Research, ETH Zurich



Tyler Coburn. *Sabots*, 2016. Two ABS shoes 3D-printed at a "lights-out" factory, 20.3 × 9 × 9 cm each © courtesy Tyler Coburn



Éva Ostrowska. *I have been sending him a picture of the loading sign instead and he still hasn't realized*, 2021. Wool tapestry, 227 × 70 cm © Éva Ostrowska

<sup>18</sup> Éva Ostrowska, *I have been sending him a picture of the loading sign instead and he still hasn't realized*, <https://www.evaostrowska.com>, accessed on 26 May 2022

It is exciting to see how new technologies influence interaction not only between humans and machines, but also between people. The updated edition of *Hello, Robot.* includes a tapestry by French artist Éva Ostrowska, whose works examine the romantic, intimate aspects of interpersonal relationships. The tapestry, entitled *I have been sending him a picture of the loading sign instead*

*and he still hasn't realized*, shows what may well be a common conversation on present-day dating apps. One of the text bubbles says "send nudes"; the reply is "ok hang on".<sup>18</sup> The title of the work suggests a humorous and subversive approach to evading intrusive behaviour that could have hardly existed in a previous age, when people did their chatting up at the bar or on the dancefloor.

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- 19 Simon Weckert, *Google Maps Hacks*, <http://www.simonweckert.com/googlemapshacks.html>, accessed on 26 May 2022
- 20 Anab Jain, personal conversation with the author (Vienna, 24 May 2022)
- 21 Ibid.



Simon Weckert. *Google Maps Hacks*, 2020. Performance and installation © Simon Weckert

As technology changes, so do we change with technology. But we have an impact on our technological, robotic environments as well. For his video installation *Google Maps Hacks*, Berlin-based media artist Simon Weckert pulled a handcart filled with smartphones along empty streets to create an artificial traffic jam on Google Maps.<sup>19</sup> If you have ever wondered how Google knows about traffic jams – that is how. Many mobile phones in one place, moving along at very low speed: you do not even need to be using the Google app

for it to know you are there. This is just one of the ways by which we all become part of the robot we inhabit. And this, too, is something *Hello, Robot*. has been trying to convey since 2017: We are not talking about the future. We are talking about the present.

What about the future, though? One possible scenario is presented in *The Intersection*, a film by British design studio Superflux. “Our brief was to imagine a hopeful future”, says Superflux co-founder Anab Jain.<sup>20</sup> It seems incredible, since

many scenes show images from the present and the recent past – catastrophic weather events, forest fires, street fighting – that are more likely to plunge viewers into despair. Although the film is set in the near future, the issues it addresses are the same we face today. But we also see people talking to one another, and that, says Jain, is what makes her hopeful for the future: “A circle of harmonisation is what we think for us a hopeful future because people have decided to come together, not in spite, but because of their

differences to try and have a conversation and create a circle of care. [...] So I find hope in acknowledging that there will be crises and we are in a crisis, but finding ways to navigate it with ingenuity and humility. It is possible to do that. It has to be possible for the sake of future generations. We may not live in the current material comfort world that we are used to, but it could still be good. It’ll be different good.”<sup>23</sup>

The foreword was revised and updated for the second edition of *Hello, Robot. Design between Human and Machine*. Weil am Rhein, June 2022



Simon Weckert. *Google Maps Hacks*, 2020 © Simon Weckert



Superflux. *The Intersection*, 2021. Film, 16 min 25 sec © Superflux 2021

# THE SEARCH FOR QUESTIONS

We can assume that Jacques Tati wouldn't be on Facebook were he alive today. And with their unquenchable thirst for user data, the likes of Google, Apple, Microsoft, and Amazon would hardly have been able to win the favour of the French filmmaker, who died in 1982, either. After all, Tati's unforgettable works such as *Mon Oncle* and *Playtime* made it abundantly clear what he thought of the new technology of the mid-twentieth century: not much. In one legendary scene, Tati's cinematic alter ego, Monsieur Hulot, enters his sister's fully automated kitchen.<sup>1</sup> First he burns his finger on a heating element, then he finds it impossible

to open the kitchen cabinet. He pushes buttons and everything begins to buzz and beep. The door suddenly flies open and out rolls a jug, which falls to the floor. But nothing happens, for the jug is made of an elastic material. Relieved, Monsieur Hulot bounces it off the ground a couple of times. Then he tries the same thing with a glass. Crash! All he wanted was some iced tea.

He never says a word, but it's written clearly on his face: What is this good for? Why do we need it? Faced with the digitisation of our lives driven by companies such as the "Frightful Five of the tech industry" mentioned at

the beginning of this essay,<sup>2</sup> we are still asking this question today and it still causes controversy. But actually it isn't a question at all, for just like in the past, technology cannot be stopped as long as it sufficiently indulges our existing habits and makes our lives easier. "Convenience is a world power", says author and Internet expert Sascha Lobo,<sup>3</sup> the best example of this being, of course, the smartphone. No one seemed to need a smartphone until the introduction of the iPhone in 2007, but less than a decade later it is impossible for most of us to imagine everyday life without these smart little helpers. Of course, Jacques Tati knew that prog-

ress had to progress, regardless of whether he liked it or not. "In the fully automated kitchen in *Mon Oncle*, he is not just running up against the often invoked 'malice' of the inanimate object," writes film critic Roland Mörchen, "rather he is spoofing the spirit (or rather demon) of a 'new artificiality'. *Mon Oncle* is the friendly wink of a man who knows he cannot do away with what is known as modernity."<sup>4</sup> And so we can be sure that, were he alive today, Tati would not be on Facebook, but he would almost certainly own a smartphone.

## AMELIE KLEIN

<sup>1</sup> See the work description for *Mon Oncle*, p. 178.

<sup>2</sup> Farhad Manjoo, "Tech's 'Frightful 5' Will Dominate Digital Life for Foreseeable Future", in *The New York Times* (20 January 2016), <http://www.nytimes.com/2016/01/21/technology/techs-frightful-5-will-dominate-digital-life-for-foreseeable-future.html>, accessed on 4 December 2016.

<sup>3</sup> Sascha Lobo, "Bequemlichkeit schlägt Datensparsamkeit", in *Spiegel Online* (September 28, 2016), <http://www.spiegel.de/netzwelt/web/zugriff-auf-daten-bequemlichkeit-schlaegt-sicherheit-kolumne-a-1114091.html>, accessed on 4 December 2016.

<sup>4</sup> Roland Mörchen, "Die Anarchie der leisen Töne. Jacques Tatis pointierte Alltagskomik", in *Film Dienst* (no. 21, 1998).

<sup>5</sup> Bruce Sterling in an interview with Amelie Klein (Turin, 19 April 2016).

<sup>6</sup> See the work description for *R.U.R. Rossum's Universal Robot*, p. 50.

<sup>7</sup> Carlo Ratti in an interview with Amelie Klein (Weil am Rhein, 4 July 2016).

<sup>8</sup> Erica Palmerini, Federico Azzarri, et al., *RoboLaw – Regulating Emerging Robotic Technologies in Europe: Robotics Facing Law and Ethics*, [http://www.robolaw.eu/RoboLaw\\_files/documents/robolaw\\_d6.2\\_guidelinesregulatingrobotics\\_20140922.pdf](http://www.robolaw.eu/RoboLaw_files/documents/robolaw_d6.2_guidelinesregulatingrobotics_20140922.pdf), p. 15, accessed on 4 December 2016.

<sup>9</sup> Boston Dynamics, *Atlas – The Next Generation*, on YouTube, <https://www.youtube.com/watch?v=rVlhMGQgDkY>, accessed on 4 December 2016.

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## JUST WHAT IS A ROBOT?

The appearance of the robot in our everyday lives is just as unavoidable – its visible appearance that is, for in fact robots have been lurking in parts of washing machines, automobiles, and automatic cash dispensers for years. Of course, such creatures will not look like robots, or rather they will not take the form that most of us have come to expect. "Robots are tools for dramatic effect. They are not a piece of technology," says Bruce Sterling, science fiction author and advisor to the exhibition *Hello, Robot. Design between Human and Machine*.<sup>5</sup> It is no coincidence that the word "robot" is the invention of a playwright. Karel Čapek's 1920 play described a mechanical working class – in other words, a class that has been dehumanised and hence robbed of its dignity – which first rises up against its masters, human beings, before revealing itself to be the morally and ethically superior species.<sup>6</sup> Čapek, a staunch antifascist, was engaging in a piece of social criticism which, based on humanity's age-old desire to reproduce itself, has been expressed time and again: the robot that serves us – and the robot that destroys us ...

Thus, popular culture has influenced our expectations regarding robots for almost a hundred years. They should be humanoid in form, i.e., look just like us, and they should think, communicate, and move as we do. Our fascination for these human machines has reached the world's robotics laboratories, where researchers are eagerly working on creating humanoid robots. But they really ought to know better, for at present robots are not even capable of mastering the things that humans can do only two years after they are born: walk more or less confidently on two legs, even managing to stay upright on uneven ground, stairs, ice, and sand. It's no wonder that we always find real robots a bit of a let-down when we see them. They are even worse than Arnold Schwarzenegger in *Terminator*.

What we often forget, however, is that robots – unlike humans – don't actually need their own enclosed bodies. They only need three things, says Carlo Ratti, director of MIT's *Senseable City Lab* and also an advisor to *Hello, Robot.*: sensors, intelligence, and actuators.<sup>7</sup> In other words, they require measuring instruments; software that is capable of making sense of and using the information these gather, such as light, sound, or heat; and devices that trigger a measurable physical reaction. Viewed in this light, this means any house and any environment can be a robot. A robot can observe us through numerous cameras simultaneously and, for example, regulate a city's traffic lights or adjust the lights in our living room according to what it sees. We could also describe the smartphone as a kind of mini-robot – and paired with us we could say it forms a (partially) robotic system.

Ratti's definition of a robot is certainly very broad, but it nonetheless leaves out certain things that we think of as typical characteristics of robots.<sup>8</sup> For example, they are supposed to teach and steer themselves, they should make autonomous decisions, and they should be at least partially physical in nature. But this is not true of every robot. Classical industrial robots can only perform the movements they have been programmed to perform; they do not make decisions on their own, nor do they learn. Surgical robots are remote controlled – mercifully – and the same is true of most drones. And the Internet is teeming with softbots, self-learning software which can chat with users or provide shopping tips, but that have no physical form. It appears that there is no universally acceptable definition of robots. Only one thing seems to be clear: yes, two-legged humanoid robots such as Boston Dynamics' *Atlas*, which over nineteen million viewers have watched stumble through the snow on YouTube, do indeed exist.<sup>9</sup> But robots are much more than that. They make our physical world intelligent. They transform objects into "smart objects". They can give rise to a scenario in which all of the things we know from the Internet can step out of the screen and permeate three-dimensional space.

- 10 Carlo Ratti in an interview with Amelie Klein (Weil am Rhein, 4 July 2016).
- 11 László Moholy-Nagy, *Sehen in Bewegung*, Edition Bauhaus 39 (Leipzig, Spector Books, 2014), p. 42.
- 12 Ibid.
- 13 Nicolas Nova (Near Future Laboratory), Nancy Kwon, Katie Miyake, Walt Chiu (Art Center College of Design), *Curious Rituals*, <https://curiousrituals.wordpress.com/>, accessed on 4 December 2016.
- 14 Ibid.



Nicolas Nova (Near Future Laboratory), Nancy Kwon, Katie Miyake, Walt Chiu (Art Center College of Design). *A Digital Tomorrow*, 2012. Video, 9 min 36 sec, produced as part of the study *Curious Rituals*, July–August 2012 © Nicolas Nova, Nancy Kwon, Katie Miyake, and Walt Chiu

The exhibition *Hello, Robot* traces the successive development of our definition of the robot, as does this book. First, we encounter more or less friendly humanoid robots (as well as a vacuum cleaner) before moving on to examine robots from the spheres of work and industry. Taking a closer look, we confront the machines face to face: as smart assistants and assiduous helpers that help care for us. Finally, we ourselves meld with the robot: prosthetics and implanted chips bring the robot inside us, while robotic architecture and environments bring us inside the robot. On page 32 and at the entrance to the exhibition you will find our attempt at a robot taxonomy. It is nothing more than an incomplete approximation, for robots are just as diverse as the world they increasingly populate.

## AND WHAT IS THE ROLE OF DESIGN?

If we follow the broad understanding of robots described above, this would mean that many robots are not different in appearance from non-robotic objects, such as ordinary dolls, cars, or houses, but only in how they behave. “The medieval city remains a medieval city,” explains Carlo Ratti, a native of Turin, “what changes is how we interact with it.”<sup>10</sup> Like in all other parts of the digital sphere, it is not only a question of the design of form and function, but of interaction, relationship, and the combination of the two: experience. This might sound new, but it isn’t new at all. As early as 1947, László Moholy-Nagy, one of the most important figures of the Bauhaus, wrote: “Design is a complex and demanding task. It entails the integration of technological, social, and economic requirements, biological demands, and the psychophysical effects of materials, shape, colour, volume, and space: it is about thinking in relationships.”<sup>11</sup> He continues: “There is design in the structure of emotional experiences, in family life, in work relationships, in urban planning, in cooperation among civilised people. Ultimately, all of the problems of design come together to form one large problem: ‘designing for life.’”<sup>12</sup>

How then are our interactions and relationships with the intelligent objects that increasingly surround us designed? Beyond the traditional interfaces of buttons, switches, and joysticks there are also a number of unusual gestures one is forced to perform when interacting with technology. We swipe our hands through the air when we want to open train doors and our fingers over the screen when we want to read our emails. We wave at the motion detectors when we find ourselves in darkened lavatories after making the mistake of sitting too long and we open the electronic entrance to the office with a saucy swing of the hips when we are too lazy to fish our ID cards out of our pockets. *Curious Rituals* is the name of a study conducted by Nicolas Nova, Nancy Kwon, Katie Miyake, and Walt Chiu as part of their degree course at the Art Center College of Design in Pasadena, California, which examined these and other gestural interactions with technology.<sup>13</sup> Their study also included a video, *A Digital Tomorrow*, which shows that things won’t get any better in the future.<sup>14</sup> Smart devices are charged by swinging them in circles through the air, a slap on the cheek ensures better concentration when synching brainwaves, and voice recognition works just as poorly as it does today.

## INTRODUCTION

- 15 David Rose, *Enchanted Objects: Innovation, Design, and the Future of Technology* (New York, Scribner, 2015).
- 16 David Rose, “Enchanted Objects”, TEDxBeaconStreet (16 November, 2014), [https://www.youtube.com/watch?v=I\\_AhhhcceXk](https://www.youtube.com/watch?v=I_AhhhcceXk), 12:52 Min., accessed on 4 December 2016.
- 17 See work description for *Uninvited Guests*, p. 96.
- 18 <http://www.vitality.net/>, accessed on 4 December 2016.
- 19 David Rose, “Enchanted Objects”, TEDxBeaconStreet (16 November 2014), [https://www.youtube.com/watch?v=I\\_AhhhcceXk](https://www.youtube.com/watch?v=I_AhhhcceXk), 08:39 min., accessed on 4 December 2016.
- 20 Jo Bager, “Der Datenkrake: Google und der Datenschutz”, in *c’t* (10/2006), p. 168, <https://web.archive.org/web/20060613011608/http://www.heise.de/ct/06/10/168/>, accessed on 4 December 2016.
- 21 <https://de.wikipedia.org/wiki/Datenkrake>, accessed on 4 December 2016.
- 22 Wolfgang Uchatius, “Warum glaubt Google, mein Kaninchen frisst Hundefutter”, in *Die Zeit* (no. 47, 10 November 2016), p. 18.

Indeed, we continue to imagine that in the future technology will always work perfectly. This is surprising, for there is nothing in the present that might indicate that this will be the case. Just how often, for example, have you spoken on the phone with your IT consultant or Internet service provider over the past month? We also tend to think that technology generally will (inter)act in our best interests – at least when it isn’t focused on world domination and our ultimate destruction. What we are seeing even today, however, is a kind of well-intentioned paternalism. David Rose, researcher at the MIT Media Lab, entrepreneur, and expert for human-computer interactions, has developed a series of *Enchanted Objects*,<sup>15</sup> as he calls them: smart networked objects capable of fulfilling our wishes like in a fairy tale. One of these, a waste bin, doesn’t just automatically order online the things we have thrown away; it also comments on the owner’s consumption habits. It asks, for example: “Do you really want to order Asian mineral water again? Why don’t you buy locally!?” Or reminds us: “That was your third packet of biscuits today.” At least you can give the bin a kick when you’re fed up with its remarks – it understands that, too.<sup>16</sup>

A project by the design studio Superflux offers a take on the same theme: *Uninvited Guests*.<sup>17</sup> In the video we are introduced to Thomas, a seventy-year-old widower who has received an assortment of smart objects from his concerned children. They are intended to help him get safely and healthily through everyday life. On the first day, Thomas reluctantly follows the ever more pestering instructions from his intelligent devices; on day two he simply ignores them. But everything is networked with everything else, and so it is that Thomas receives the first worried messages from his children: “Hi Dad, I see you’re not using the smart cane today. Hope all is ok? xxx Gina.” Design not only shapes our interactions with machines, it seems, but also how we interact with one another.

Superflux sees itself as a design studio that seeks a critical examination of new technologies and their effects on the world. *Uninvited Guests* is a speculative project that is meant to spur discussion. David Rose, however, has developed a smart screw cap for pill bottles that has enjoyed high levels of sales for several years.<sup>18</sup> *GlowCap*, the name of this intelligent device, reminds users to take their medicine. If they neglect to do so, the screw cap starts to blink, by all means a sensible reminder, for it is certainly important that patients take their medicines according to schedule. In 2010, it won the American Medical Design Excellence Award. But *GlowCap* goes one step further: if the patient fails to take his or her medicine after the reminder, the smart cap sends a message to their loved ones. And another one to the doctor. And another to the health insurance company, for they are the main distributors of *GlowCap*.<sup>19</sup>

## JUST WHO’S THE BAD GUY HERE?

The boundaries between well-intentioned concern, surveillance, and outright espionage are blurry. In 2006, the German computer magazine *c’t* referred to Google as a “Data Kraken”,<sup>20</sup> and ever since then the term has become a byword for notorious data collectors and even had its own entry on the German Wikipedia website. According to the Wikipedia definition, Data Kraken are “systems and organisations that evaluate personal information on a grand scale and/or redirect it to third parties. In doing so, they allegedly or demonstrably are in breach of data privacy regulations or violate the personal rights postulated by privacy groups that go beyond these.”<sup>21</sup> And even if Big Data has yet to evolve into “Smart Data”, as an article in the weekly *Die Zeit* has claimed – that is, if the data collectors have not yet learned to properly classify all the information they gather<sup>22</sup> – it would still be naïve to believe that a health insurance company would not allow a patient who neglects to take his medication go unpunished. And if health insurance premiums are raised because a patient forgets his medicine, then we’re just a hop, skip, and a jump away from a scenario in which premiums are raised on those who occasionally have one too many at the pub or dine too often at the corner chip shop.

The Internet unremittingly collects data about our behaviour. And with robotics, the arrival of the Internet in three-dimensional space, this is set to explode exponentially. The Internet of Things and the Smart City, all of these are projects for major corporations, and not only those that make these infrastructures available, but also those who are keen to evaluate the data we generate or sell it on to third parties like the advertising industry. “An Internet of Things,” writes Bruce Sterling, “is not a consumer society. It’s a materialised network society. It’s like a Google or Facebook writ large in the landscape. Google and Facebook don’t have ‘users’ or ‘customers’. Instead, they have participants under machine surveillance, whose activities are algorithmically combined within Big Data silos.”<sup>23</sup>

In an essay appearing in this book, the philosopher Rosi Braidotti speaks at length about the economisation of people. “But this exploitation is not limited to people: In substance, advanced capitalism both invests in and profits from the scientific and economic control and the commodification of all that lives. [...] Seeds, plants, animals, and bacteria fit into this logic of insatiable consumption alongside various specimens of humanity. The uniqueness of *Anthropos* is intrinsically and explicitly displaced by this equation.”<sup>24</sup> Thomas Vašek, editor in chief of the philosophy magazine *Hohe Luft*, also introduces machines to this observation: “All of us – humans as well as robots, smartphones, and artificial intelligences of every kind – are slaves of digital capitalism. We all produce data that is economically exploitable for Google and the like, we all leave data trails in the infosphere, we are all digitally predictable – and therefore we can be easily controlled by a digital mega-superintelligence. We call it the capitalist system.”<sup>25</sup> Before the filthy lucre we are all the same.

Unfortunately, design is all too willing to serve the will of this mega-superintelligence. But this need not be the case. Indeed, it shouldn’t be the case. Even for Walther Gropius, design and ethics were inseparable. In his 1925 “Principles of Bauhaus Production”, Gropius called for a “resolute affirmation of the living environment of machines and vehicles” and in doing so was clearly making a social claim: “The creation of standard types for all practical commodities of everyday use is a social necessity. On the whole, the necessities of life are the same for the majority of people. The home and its furnishings are mass consumer goods, and their design is more a matter of reason than a matter of passion.”<sup>26</sup> In 1963, in the middle of an economic boom, the British graphic designer, photographer, and author Ken Garland published a manifesto titled “First Things First”, in which he called for designers to dedicate their talents and attentions not only to the large corporations, but to socially relevant topics. A list of alternatives to advertising for cat food and striped toothpaste was followed by the statement: “We do not advocate the abolition of high pressure consumer advertising: this is not feasible. Nor do we want to take any of the fun out of life. But we are proposing a reversal of priorities in favour of the more useful and more lasting forms of communication.”<sup>27</sup>

“First Things First” struck a chord that continues to resonate to this day. Garland’s manifesto does not call into question the underlying political and economic system: “This is not feasible.” After all, design is not a “neutral, value-free process”, explains Katherine McCoy, a graphic artist and lecturer for two decades at the Cranbrook Academy of Art, one of the most recognised academies for design in the United States.<sup>28</sup> The fundamental decision of whether or not a designer offers his or her talent in the service of a Data Kraken is a political one and should be discussed as such. Perhaps this is why the “IoT Design Manifesto 1.0”,<sup>29</sup> a ten-point list of demands concerning the design of the Internet of Things, leaves us with such an unpleasant aftertaste. Five of the ten demands are dedicated to the issues of security and data protection, which is a good thing of course. Point four reads as follows: “We keep everyone and everything secure” – a reference to attacks from hackers and similar threats. Why, then, did the manifesto’s authors put this point first: “We don’t believe the hype. We pledge to be sceptical of the cult of the new – just slapping the Internet onto a product isn’t the answer. Monetising only through connectivity rarely guarantees sustainable commercial success.”

The issue here is not the fact that designers wish to develop a sustainable means of earning money. Quite the opposite, in fact, for there are simply too many designers who have to live in precarious conditions because their work is insufficiently valued. The problem here is that commercial success appears in the very first point of a manifesto that claims to serve as a “code of behaviour” for those involved in the development of the Internet of Things.

When “First Things First” was revised and republished at the turn of the millennium with the new title “First Things First Manifesto 2000”, it received an important addition. It now reads: “We propose a reversal of priorities in favour of more useful, lasting, and democratic forms of communication – a mindshift away from product marketing and toward the exploration and production of a new kind of meaning. The scope of debate is shrinking; it must expand. Consumerism is running uncontested; it must be challenged by other perspectives expressed, in part, through the visual languages and resources of design.”<sup>30</sup>

Bruce Sterling adds his own take: “Rather than thinking outside the box – which was almost always a money box,

quite frankly – we surely need a better understanding of boxes.”<sup>31</sup> In other words, we have to change the parameters, redefine the context, and ask different questions. “Instead of pursuing projects, defining goals, and thus describing a linear path to a solution, design is capable of drawing upon prototypes, experiments and mistakes, pilot projects, and speculation based on limited knowledge to sketch several paths that can describe the space for possibilities,” writes the German graphic designer and university lecturer Florian Pfeffer.<sup>32</sup>

### WHY IS IT SO HARD FOR US TO RELINQUISH CONTROL?

Ironically, there are designers who do exactly this while supported by robots and algorithms. Achim Menges is the director of the Institute for Computational Design (ICD) at the University of Stuttgart, where, after years of research conducted together with a large interdisciplinary team, he developed the *Elytra Filament Pavilion*, an extremely light, robot-constructed roof construction of carbon fibre and fibreglass which was first displayed at London’s Victoria & Albert Museum in 2016

before being temporarily relocated to the Vitra Campus in Weil am Rhein in February 2017. The individual modules are based upon biomimetic principles and are inspired by the wing cases of flying beetles known as “elytra”. The modules themselves were designed by algorithms. Only a few individual parameters were predetermined, such as the fact that all of the modules should consist of hexagonal metal frames. However, the frames’ exact geometry and structure of the fibres vary according to the bearing load, light, and weather conditions as well as the number of visitors. “In this instance the computer is more than just a tool,” says Menges, “for it provides for levels of access that one otherwise would not have. One could compare it to a microscope or telescope, which do not change the world, but our view of it.” He explains how computers are capable of dealing with complexities that go beyond the realm of human intuition. “This certainly does not mean that this is something that I would wish to simulate or control.”<sup>33</sup> As a reward for this “controlled loss of control”, the *Elytra Filament Pavilion* surprises designers with its unusual and fascinating aesthetics.



Achim Menges with Moritz Dörstelmann (ICD University of Stuttgart / Achim Menges Architect), Jan Knippers (ITKE University of Stuttgart / Knippers Helbig Advanced Engineering), and Thomas Auer (Transsolar Climate Engineering / TUM). *Elytra Filament Pavilion in the Victoria and Albert Museum*, 2016, photo: © NAARO, courtesy ICD, University of Stuttgart

<sup>23</sup> Bruce Sterling, *The Epic Struggle of the Internet of Things* (London, Moscow, Strelka Press, 2014).

<sup>24</sup> See Rosi Braidotti, “Becoming-world together: on the crisis of human”, p. 246.

<sup>25</sup> Thomas Vašek, “Befreit die Roboter!”, in *Hohe Luft - spezial Digitalisierung / Hohe Luft* (no. 1, 2017), p. 6.

<sup>26</sup> Walter Gropius, “Principles of Bauhaus Production”, in *Programs and Manifestoes in 20th-century Architecture* (Cambridge, MIT Press, 1970), pp. 95–96.

<sup>27</sup> Ken Garland, “First Things First”, facsimile in *Design Is History*, <http://www.designishistory.com/1960/first-things-first/>, accessed on 4 December 2016.

<sup>28</sup> Rick Poyner, “First Things First Revisited”, in *Emigré* (no. 51, 1999), <http://www.emigre.com/Editorial.php?sect=1&tid=13>, accessed on 4 December 2016.

<sup>29</sup> [www.iotmanifesto.com](http://www.iotmanifesto.com), accessed on 4 December 2016.

<sup>30</sup> “First Things First Manifesto 2000”, in *Eye* (no. 33, vol. 8, Autumn 1999; no. 51, 1999), <http://www.eyemagazine.com/feature/article/first-things-first-manifesto-2000>, accessed on 4 December 2016.

<sup>32</sup> Bruce Sterling, *Design Fiction*, [http://shelovestofu.com/blog\\_uploads/2009/04/sterling-design-fiction.pdf](http://shelovestofu.com/blog_uploads/2009/04/sterling-design-fiction.pdf), accessed on 4 December 2016.

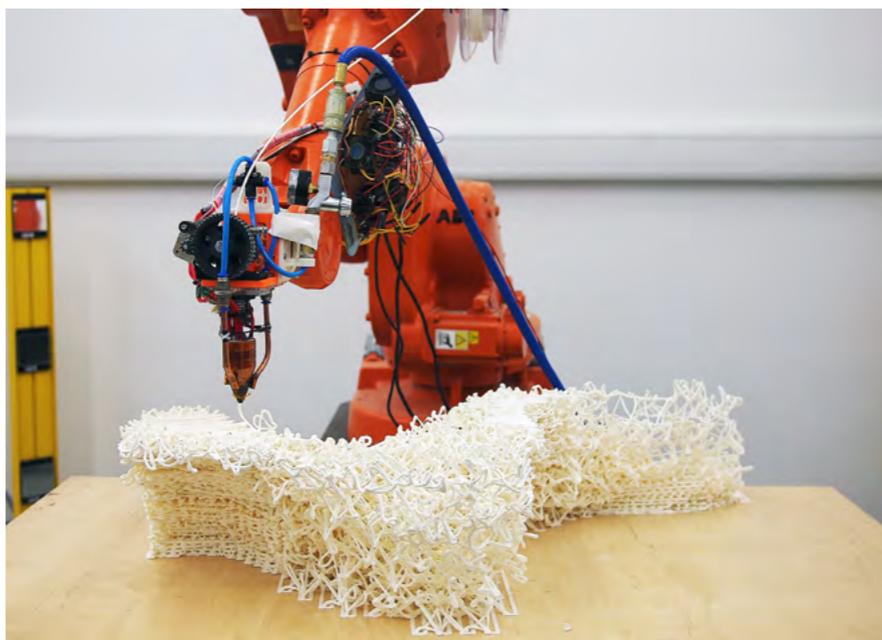
<sup>33</sup> Florian Pfeffer, *To Do: Die neue Rolle der Gestaltung in einer veränderten Welt – Strategien, Werkzeuge, Geschäftsmodelle* (Mainz, Hermann Schmidt, 2014), p. 176.

<sup>33</sup> Achim Menges in a discussion with Amelie Klein (Weil am Rhein, 10 November 2016).

34 Chris Rehberger in a discussion with Amelie Klein (telephone interview, 26 October 2016).

The book which you are now holding in your hands was also designed by an algorithm devised by the Berlin graphic design firm Double Standards working together with a programmer. Here, too, a few fundamental parameters were determined – the basic raster, the fonts, a palette of type sizes, several options for illustrations, etc. – but the computer was given control over the overall design. At a touch of a button it came up with hundreds of thousands of layout options. Human designers were only responsible for selecting the final version, and, as Double Standards founder Chris Rehberger explains, they were better prepared to “try the impossible, for the algorithm schools the eye”.<sup>34</sup> The result does not always fit with our reading and viewing habits, but we must remember that the graphic design and typography of the legendary Bauhaus books were also out of step with contemporary reading and viewing habits. After all, before Bauhaus there was no typesetting that allowed people to understand a text in its visual entirety at first glance.

The essence of experimentation is the process, not the goal. Perhaps the next book designed by Double Standards and its algorithm will do even more to shake up our habits – perhaps less. But for now this does not matter, just like it does not matter that the *3D Printed Cantilever Chair* designed by the CurVoxels student group takes itself to the point of absurdity. After all, it really isn't necessary to develop your own 3D printing software if you're setting out to produce the perfect *Panton Chair*, the design that served as a model for CurVoxels. The tried and true injection moulding process is certainly sufficient – after all, the *Panton* was designed to take advantage of the technique. The team's goal was not to print an improved version of the chair, however, for what they really wanted to do was experiment on an old complex form using complex new methods. A voxel is a three-dimensional pixel or, to explain it in different terms, a pixel in space. The *3D Printed Cantilever Chair* sets out to test – once again with the aid of an algorithm – just how many of these voxels a cantilever such as the *Panton Chair* requires in order to function properly. How much is possible with the minimum of material? A robot traces over the algorithmically determined path with hot plastic thread which solidifies while it is still in motion.



CurVoxels, Research Cluster 4, UCL The Bartlett School of Architecture, London. *3D Printed Cantilever Chair*, 2015. Chair and software for a 3D-printing technique. Team: (CurVoxels) Hyunchul Kwon, Amreen Kaleel, Xiaolin Li; Tutors: Gilles Retsin, Manuel Jiménez García; Technical Support: Vicente Soler Senent, William Bondin © 2017 CurVoxels, photo: Sin Bozkurt, CurVoxels



William Williams. *The Cast Iron Bridge Near Coalbrookdale*, 1777. Oil on canvas, 86 × 102 cm. © courtesy Coalbrookdale Museum of Iron

For some time now, it has seemed as if we find ourselves at what could be described as the “Iron Bridge moment” of digital modernity. The Iron Bridge, built in the English county of Shropshire, is the world's first arch bridge to be constructed completely of cast iron. Yet even though it was built using what was then a fantastic new material, its construction rigidly follows the principles of wooden bridge design. It would take a few decades before the production and use of cast iron had been mastered to a degree that would eventually bring about a completely new aesthetic that was the natural result of the material's properties. Over the last few years we have certainly seen a number of 3D-printed “Iron Bridges”, but the three examples described above provide us with a clue of the kind of aesthetics with which the early twenty-first-century will make it into the history books, if only we would learn to trust the algorithms and allow them to take control just for a moment. Perhaps we will one day come to accept that even though we may not be able to influence everything, something good can still result – such as an exciting roof construction, a new language of graphic design, or, to return to László Moholy-Nagy, life as a whole.

What does this all mean when it comes to how we deal with tyrannical forks and pill bottle tops that spy on us? Will it be enough if we – each and every one of us analogously to the scenarios outlined above – determine the parameters that can describe the scope of these smart devices and decide where humans take over again? Hardly. In this respect we are only now beginning to ask the right questions. You will find fourteen of them in this book and in the exhibition rooms of *Hello, Robot. Design between Human and Machine*. At first they might seem rather simple, but if you consider them more carefully you will soon realise that there are no simple answers. This, too, is a characteristic that weaves its way through the entire subject and reflects our postmodern world: there's no such thing as a single truth, for the contradictory strands of truth are often capable of existing alongside one another. But our fourteen questions invite visitors and readers to enter into a dialogue and reflect upon their own very personal relationship with technology as individuals but also as members of society as a whole.

But this is just the beginning. There is so much more to do.

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Amelie Klein (born in 1977 in Vienna, Austria) is one of the curators of *Hello, Robot. Design between Human and Machine*. Since August 2011, she has been working as a curator for the Vitra Design Museum, amongst others for the exhibition *Making Africa – A Continent of Contemporary Design*, for which she was nominated for the 2015 *ART Magazine Curator Prize*. Prior to this, Klein completed an MA in Design Criticism in New York and worked as Design and Creative Industry Editor at the Austrian daily *Die Presse*. She has published numerous articles in a range of design and architectural publications, including *Abitare*, *Domus Online*, and *Metropolis*.

# SCIENCE AND FICTION

Very few people have actually encountered a robot – at least one they would describe as such. This is because our ideas about and expectations of robots are strongly shaped by popular culture. From a young age we learn in films, TV series, books, comics, video games, and toys what robots look like, how they communicate with us, and how they behave: they are essentially like people, but made of metal. And what we all expect – more or less consciously – is that one day soon, we are either going to live with robots just as we do with our friends, neighbours, and colleagues or we are going to have to defend ourselves against them before they replace us once and for all.

Our fixation with humanoid robots ranges from the early fascination with automatons to the scientific laboratories of the present. But today's researchers really ought to know better, because, in reality, we are surrounded by robots and robotic systems that are capable of assuming every conceivable physical or digital form, materiality, scale, and intelligence level: from drones to self-checkout counters, from cranes to nanobots, and from vacuum cleaners with the intelligence of an amoeba to online chatbots that can engage us for hours. Cars and washing machines are partly robotic today and, ultimately, we can define any object and system as a robot if it can gather and store information from its surroundings, generate outputs that manifest themselves in some physical form, and display a degree of learning capacity and autonomy in the process.

The complex variety of robots' appearances is matched only by the complexity and ambivalence of our relationships with them. The question of whether we need, or even like them is not really ours to ask; robots are already here, and as with smartphones, which most people didn't find necessary just a decade ago, there will one day be a critical mass of people who use smart, autonomous objects and applications and who will drag even the most ardent luddites willy-nilly into the robotic age. Whether robots will then be our friends or our enemies, or whether we will control them or vice versa, remains to be seen. And the question whether we should trust robots is perhaps less pertinent than whether we should trust the political-economic complex of humans, organisations, and infrastructure that stands behind them.

MARLIES  
WIRTH

# THROUGH THE LOOK- ING GLASS, DOWN THE RABBIT HOLE: A MATTER OF TRUST

Our notion of what a robot is, what it looks like, and how it acts is inseparably linked to the utopian and dystopian visions of science fiction, as well as the pop culture images related to these visions. The fascination – and suspicion – of the machine that is potentially superior to humans characterises our primal fear of “superhuman” technology. The conceptual history of the term “robot” – derived from the Slavic (Czech) word *robot* meaning “forced labour” or “serf” – already predetermined our distrust of the powerful “artificial worker”, which has long since become part of our society: through computer technology, automation, artificial intelligence, and algorithms.

The term “robot” is documented for the first time in the theatre play *R.U.R. – Rossumovi Univerzální Roboti* (“Rossum’s Universal Robots”), written by Karel Čapek in 1920.<sup>1</sup> The play refers to a species of robotic “workers” (from today’s perspective more like androids or cyborgs), who serve humans until they eventually start a rebellion that results in the destruction of mankind. Just like the the Golem in Jewish Mysticism,<sup>2</sup> the creature in Mary Shelley’s *Frankenstein or a Modern Prometheus* (1818), or the army of broomsticks that won’t stop carrying buckets of water in Goethe’s poem *The Sorcerer’s Apprentice* (1797), countless examples from film and literature still reproduce the plotline of the “artificial human” who rebels against its creator: the robot Maria in *Metropolis* (1927), HAL 9000 from Stanley Kubrick’s *2001: A Space Odyssey* (1968), and Ava from *Ex Machina* (2016) have more recently left their mark on the public’s consciousness. All of these interpretations bring to mind the contemporary discourse on autonomous, self-learning machines and the dangerous potential of a future super-intelligence unbound.<sup>3</sup>

Nevertheless, the manual on how to use and benefit from the advantages of intelligent machines without having to fear them also derives from popular culture. The Russian-American biochemist and science fiction author Isaac Asimov sought to portray a more positive – and from today’s perspective possibly more realistic – image of the “robot”. In his 1942 short story “Runaround” Asimov framed the “Three Laws of Robotics” (also called “Asimov’s Laws”),<sup>4</sup> which are based on three logical (hierarchical) principles: (1) A robot may not injure a human being or, through inaction, allow a human being to come to harm. (2) A robot must obey the orders given it by human beings except where such orders would conflict with the First Law. (3) A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.

With these laws Asimov shifted the focus to ethical issues, which are also relevant to science: Going beyond utopia and speculation, real technology, robots, and artificial intelligence have to be designed and implemented according to certain requirements that meet the ethical standards of humans. Considering the development of increasingly autonomous robots and self-learning artificial intelligence, not only do we need to thoroughly revise Asimov’s Laws but also to appeal to the moral responsibility of the humans operating the technology, usually for-profit corporations and enterprises rather than individuals, or, in the best case scenario, largely independent research institutions.

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<sup>1</sup> Cf. Adam Roberts, *The History of Science Fiction* (New York, Palgrave Macmillan, 2006), p. 168.

<sup>2</sup> The legend of the Golem, which has been passed on since the Middle Ages, describes how savants form a humanoid creature out of mud. The creature is able to perform tasks delegated by humans but can also destroy man due to its enormous size and power.

<sup>3</sup> Cf. Nick Bostrom, *Superintelligence. Paths, Dangers, Strategies* (Oxford University Press, 2014), p. 28

<sup>4</sup> Cf. Isaac Asimov, *I, Robot* (New York, Gnome Press, 1950).

## FROM THE AUTOMATON TO AUTONOMY

While the term “automaton” (from *automatos*, Greek for “self-acting”) describes a machine that is “capable of executing predetermined processes independently”, the distinction and differentiation of the concept “robot” is much more difficult to grasp. Attempts to define it are usually based on the two terms “automatic” and “autonomous” (from *autonomos*, Greek for “acting by its own laws”). The robot can therefore be described as a “sensor-motoric machine designed to expand human agency”.<sup>5</sup>

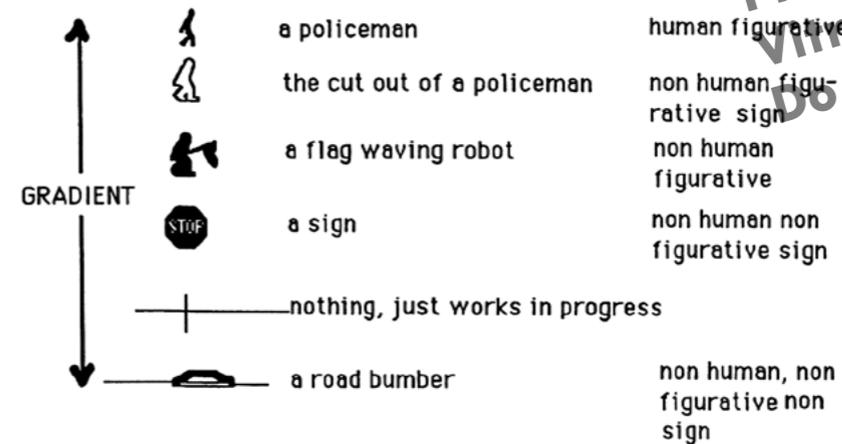
Considering the rapidly changing developments within the areas of robotics and artificial intelligence, five revised “robotic laws” were published by members of the Engineering and Physical Sciences Research Council (EPSRC) during a meeting of the European Association for Cognitive Systems (EUCog) in October 2013. Compared to Asimov’s Laws, these new laws respond much more strongly to the actual status of robotic technologies and their coexistence with humans. At the same time, the laws link the idea that a robot is both a “tool” and a “product” designed to serve humans to the definition of the concept.<sup>6</sup>

The laws also stipulate ethical principles such as respecting existing fundamental rights and responsibilities – including freedom of expression and privacy – as well as that robots should not be used to kill (exceptions are made in the interests of “national security”, which actually raises further ethical problems) or to “exploit” their users in any way (data collection, Big Data). Furthermore, the “machine-like nature” of the robot should remain transparent to humans at all times (an argument against the humanoid appearance of robots). The first and last principles emphasise human responsibility for robots, including de facto legal responsibility and fundamental ethical responsibility.

## FROM “OPERATING” TO AGENCY

In a society of human and non-human beings, all natural, social, and technical “objects” are regarded not only as solely constituted by society but also as co-constituting society. In any case, the distinction between them is less relevant than the question of the capabilities and dangers of their agency and, moreover, to what extent their actions – in contrast to automatic operation and execution – influence the hierarchical structure of a society.<sup>7</sup>

Marshall McLuhan’s media theory<sup>8</sup> (“The Medium Is the Message”) makes clear that not only the content of a “medium” but also its characteristics influence the society to which it is relevant. While a “thing” is constituted as an object of utility which is able to fulfil a particular function, a medium assumes a role in which it communicates or transmits; therefore, it is not simply itself.<sup>9</sup> This also corresponds, for instance, to the “actor-network theory” (ANT) developed by Bruno Latour, according to which acting is not limited to humans (“actors”), but extends to non-human entities (“actants”).<sup>10</sup>



Bruno Latour in *Where Are the Missing Artifacts*; Bijker, Wiebe E., and John Law, eds., *Shaping Technology / Building Society*, p. 243, © 1992 Massachusetts Institute of Technology, by permission of The MIT Press

In this context, the definition of “action” is under consideration, too. In her magnum opus, *The Human Condition* (1958), the philosopher Hannah Arendt uses three terms to define the basic conditions of human life that also describe the individual’s autonomous, active participation in society: labour, work, and action. While Arendt’s understanding of labour and work subsumes those (individual) activities which are immediately necessary for the production of (material) goods, she describes (inter)action – language and communication – as humans’ greatest asset. After the three areas identified by Arendt are increasingly taken over by robots, AI, and algorithms, Bruno Latour’s theory becomes applicable insofar as these autonomous entities do not just merely transfer action, they also perform it. Thus, as autonomous entities, they don’t merely participate in the society of humans but also actively (co-)construct it.

Nevertheless, the robot’s potential ability to act doesn’t relieve humans of their responsibility; by equating human with machine we eventually risk letting both the intention of the action and any responsibility and accountability become neglected.<sup>11</sup>

<sup>11</sup> Felix Stalder, “Beyond Constructivism: towards a Realistic Realism: A Review of Bruno Latour’s *Pandora’s Hope*,” in *The Information Society* (vol. 16, no. 3, 2000), p. 4; <http://felix.openflows.com/html/pandora.html>

<sup>5</sup> Definition by Thomas Christaller in: Thomas Christaller, et. al., *Robotik. Perspektiven für menschliches Handeln in der zukünftigen Gesellschaft* (Berlin, Springer, 2001).

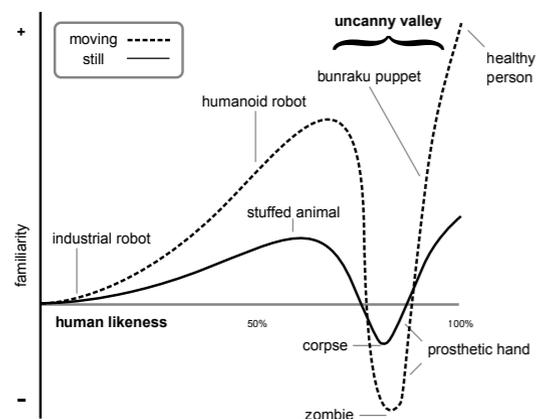
<sup>6</sup> Original text see: <https://www.epsrc.ac.uk/research/ourportfolio/themes/engineering/activities/principlesofrobotics/>

<sup>7</sup> Cf. Bruno Latour, “Where Are the Missing Masses? The Sociology of a Few Mundane Artifacts”, in Wiebe E. Bijker and John Law (eds.), *Shaping Technology / Building Society: Studies in Sociotechnical Change* (Cambridge, MA, MIT Press, 1992), pp. 225–258.

<sup>8</sup> Marshall McLuhan, *Understanding Media: The Extensions of Man* (London, Routledge, 1964/2005).

<sup>9</sup> Mercedes Bunz, “Die Dinge tragen keine Schuld. Technische Handlungsmacht und das Internet der Dinge”, in Florian Sprenger, Christoph Engermann (eds.), *Internet der Dinge. Über smarte Objekte, intelligente Umgebungen und die technische Durchdringung der Welt* (Bielefeld, Transcript Verlag, 2015), p. 169; Cf. Fritz Heider, *Ding und Medium* (Berlin, Weltkreis-Verlag, 1927).

<sup>10</sup> Bruno Latour, “On Actor-Network Theory: A Few Clarifications”, in *Soziale Welt* (no. 47, 1996, book 4) pp. 369–382. <http://www.bruno-latour.fr/sites/default/files/P-67%20ACTOR-NETWORK.pdf>



32

Masahiro Mori's "Uncanny Valley" defines the amplifications in the emotional response of humans in relation to the degree of anthropomorphism of a robot. "Uncanny Valley" denotes the zone in which people show a negative reaction to robots that appear "too human". © Smurrayinchester, self made graphic based on an image by Masahiro Mori and Karl MacDorman from <http://www.android-science.com/theuncannyvalley/proceedings2005/uncannyvalley.html> CC BY-SA 3.0

## HUMAN VS. HUMANOID

Although both popular culture and science are obsessively committed to the anthropomorphic appearance of robots,<sup>12</sup> it has been proven that this significantly "human" – and hence confidence-inspiring – aspect isn't just transmitted through visual perception; it also depends on many additional factors such as smell, body expressions and gestures, haptics or vocabulary. Consequently, the feeling of "familiarity" decisively influences the acceptance of a robotic counterpart.

Deceptive human resemblance can even have the opposite effect: With his concept of the "uncanny valley", the Japanese roboticist Masahiro Mori defined in 1970 the eerie feeling that overcomes humans when they are dealing with a human-looking but artificial "other". The "uncanny valley"<sup>13</sup> describes the rapid drop in acceptance observed when people are presented with objects displaying a very high degree of anthropomorphism. On the other hand, abstract or abstracted figures and recognisably artificial entities are more accepted, as they do not conceal their artificiality. The "uncanny" occurs in the valley-shaped zone of this acceptance curve.

<sup>12</sup> The first autonomous "Soft Robot" in the shape of an octopus was developed by scientists at Harvard University in August 2016. Cf. <http://news.harvard.edu/gazette/story/2016/08/the-first-autonomous-entirely-soft-robot/>  
<sup>13</sup> Cf. Masahiro Mori, "Uncanny Valley", translated by Karl F. MacDorman and Norri Kageki, 2012: <http://spectrum.ieee.org/automaton/robotics/humanoids/the-uncanny-valley>

<sup>14</sup> Andrea Sick, "Questions of Style: Subjects, Things and Shared Agency in Popular Articulations", in Christoph Lischka, Andrea Sick (eds.), *Machines as Agency: Artistic Perspectives* (Bielefeld, Transcript Verlag, 2007), pp. 122, 123.

<sup>15</sup> Ibid., p. 123.

<sup>16</sup> Ibid., p. 123; cf. Sibylle Krämer, "Maschinenwesen. Ein Versuch über den Anthropomorphismus in der Technikdeutung hinauszukommen", in Thomas Christaller, Josef Wehner, *Autonome Maschinen* (Wiesbaden, Westdeutscher Verlag, 2003), pp. 208–221.

<sup>17</sup> Alan Turing, *Computing Machinery and Intelligence*, (Aberdeen, University Press, 1950).

With the growing interaction between human and machine, the question of trusting non-human others is linked to the role and function of a robot's "similarity to humans", which goes beyond its humanoid appearance. In *Machines as Agency*, Andrea Sick proposes three fundamental versions as possible explanations:<sup>14</sup> Assuming that there is an ontological difference between humans and technology, which is based on the attributions "natural" and "artificial", the anthropomorphism of the machine is not so much a question of its form or appearance, but rather one of its *genesis* (origin). Following the theory of "human enhancement" and the expansion of our possibilities through technology (cf. McLuhan: "media as the extensions of man"), humans and machines basically have the same function, yet machines serve humans to reach a higher functionality. Hence, the machine could adopt any conceivable or necessary shape. The third possibility states the use of technologies as a paradigm for explaining human skills: "The technical emerges as a medium in the process of modelling and discovery."<sup>15</sup>

All three possibilities assume a functional correspondence between human and machine. Thus, the machine must be able to deceive or pretend to be potentially human. The ability to deceive humans, that is, to simulate humanity and human<sup>16</sup> "consciousness", is described as a success in the "Turing Test": The British logician and computer scientist Alan Turing developed the question-answer-interaction – which is still used today – with two conversation partners, one human and one artificial intelligence. An artificial intelligence passes the test if the questioner is not able to distinguish between human and machine.<sup>17</sup>

33

DO YOU  
TRUST  
ROBOTS?

DO WE REALLY  
NEED ROBOTS?

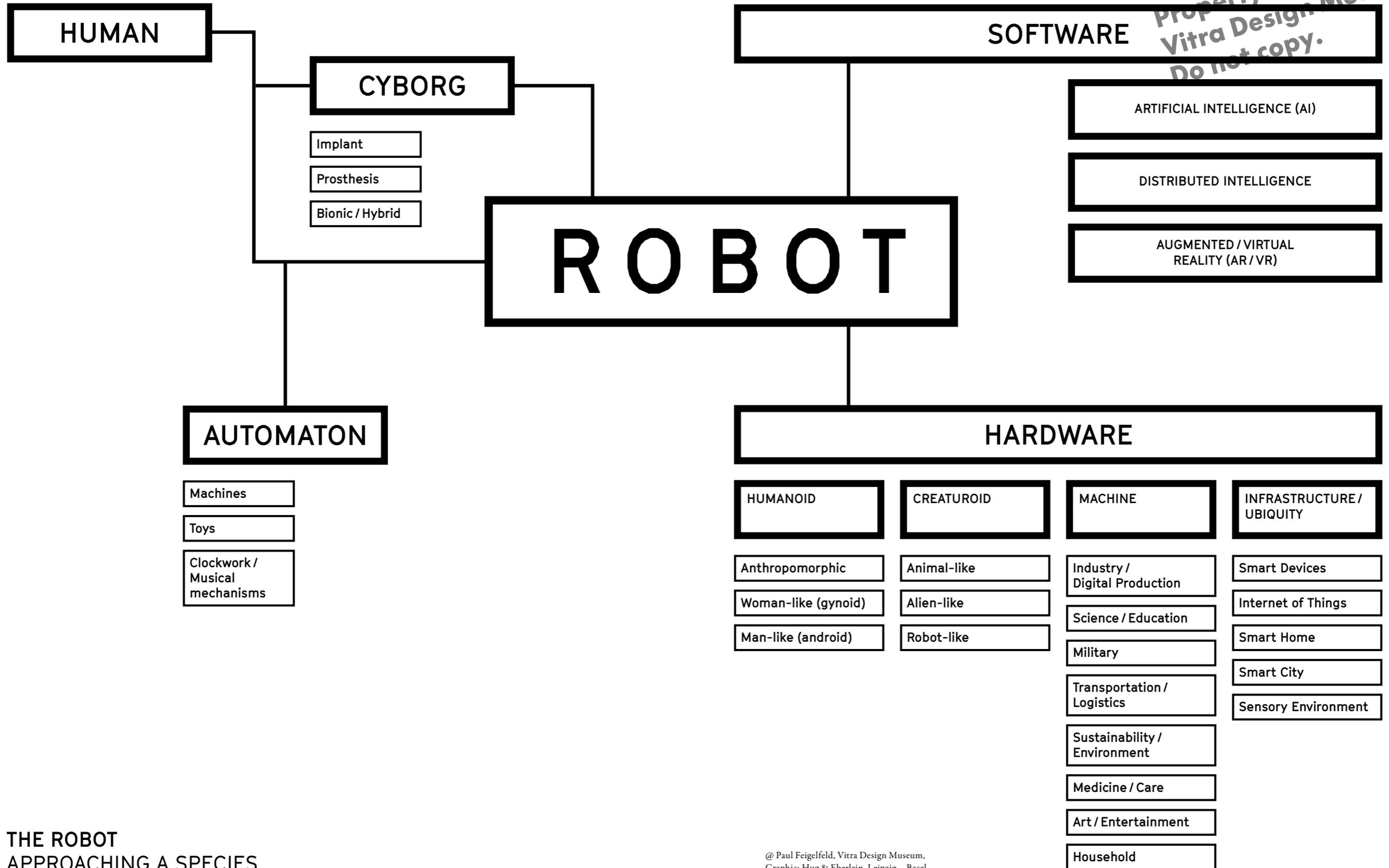
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39

**HAVE YOU EVER MET A  
ROBOT?**

WHAT  
WAS  
YOUR  
FIRST  
EXPERI-  
ENCE  
WITH A  
ROBOT?

ARE ROBOTS OUR  
FRIENDS OR OUR ENE-  
MIES?



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*Metropolis* is a 1927 German Expressionist science fiction film directed by Fritz Lang. Set in a futuristic urban dystopia, *Metropolis* follows the attempts of the wealthy son of the city's ruler and a poor worker to overcome the gulf separating the classes of their city. In the futuristic city of *Metropolis*, automation has created rather than alleviated the drudgery of the workers. The film is considered a pioneering work in the science fiction genre and includes one of the first robots ever depicted in cinema. OP



*Metropolis*, film poster, 1926

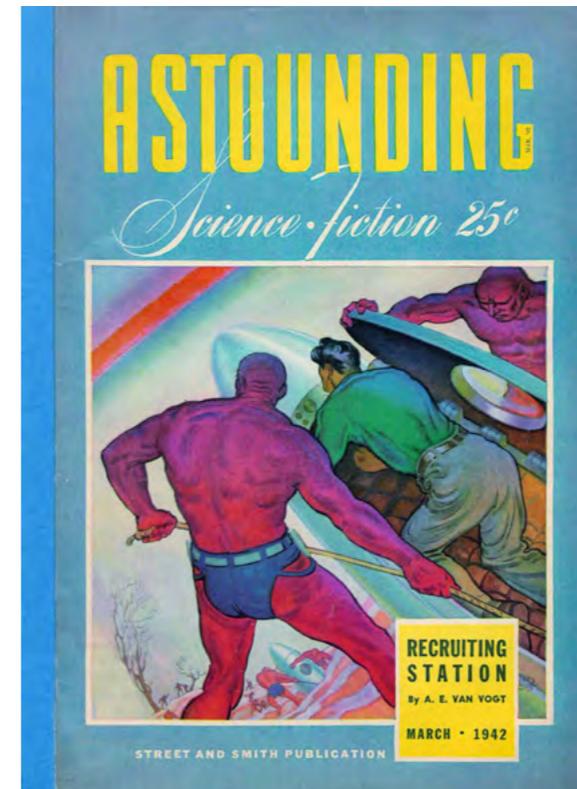
Heinz Schulz-Neudamm. *Metropolis*, 1926. Film poster, multicolour print, 211 × 96 cm © courtesy Austrian National Library, Vienna, Picture Archives and Graphics Collection

FRITZ LANG – *METROPOLIS*  
(FILM POSTER BY HEINZ  
SCHULZ-NEUDAMM)

Isaac Asimov. "Runaround", in *Astounding Science Fiction*, Vol. XXIX, No. 1 (March 1942). Periodical, cover art: Reginald Hubert Rogers © 2016 by Penny Publications / Dell Magazines (Analogsf.com), reprinted with the permission of the publisher, photo: courtesy University of Regensburg Library

ISAAC ASIMOV – "RUNAROUND", *ASTOUNDING SCIENCE FICTION*, 1942

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*Astounding Science Fiction*, magazine cover, 1942

Isaac Asimov was one of the most prolific authors of all time, writing or editing more than 500 books in his lifetime, all the while catering to a large general audience. In 1939 he began publishing sci-fi short stories in the magazine *Astounding Science Fiction* (ASF), including "Runaround", which appeared in 1942. The story saw the first ever mention of Asimov's "Three Laws of Robotics", which still serve as the groundwork for the discussion on robots today, as well as the first ever use of the word "robotics". "Runaround" is the story of a robot that behaves in an unusual and counter-intuitive way because it takes the "Three Laws" literally.

The Three Laws are:

- 1) A robot may not injure a human being or, through inaction, allow a human being to come to harm.
- 2) A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
- 3) A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.

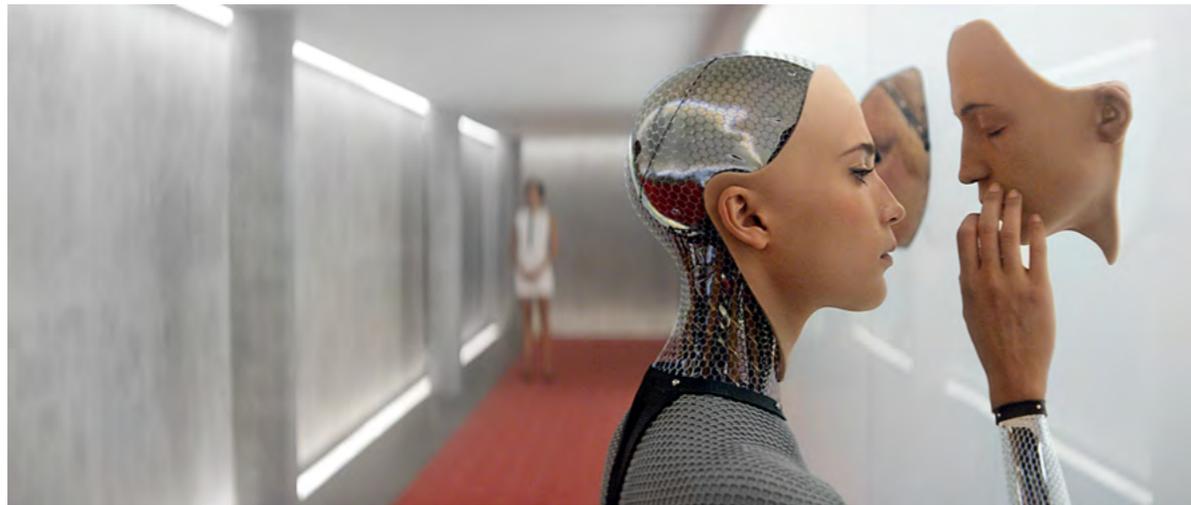
Published since 1930, *Astounding Science Fiction*, currently titled *Analog Science Fiction and Fact*, is the longest-running continuously published science fiction magazine in the history of the genre. AR

Universal Pictures. *Ex Machina*, 2015.  
 Feature film, 108 min; director and  
 script: Alex Garland © 2014 Universal,  
 Film4 and DNA Films

### ALEX GARLAND – *EX MACHINA*

The British film *Ex Machina* tells the story of Caleb, a programmer who is invited by his boss to a secret research station where he is to test the female android Ava and determine whether her faculty of thought is equal to that of humans. Ava engages Caleb in intelligent discussions and manages to convince him of her own intelligence. After the two develop an emotional relationship, Ava ultimately persuades Caleb to help her escape from the research station. The film poignantly poses the question: if the simulation is perfect, does the distinction between humans and machines become irrelevant? TT

66



*Ex Machina*, 2015



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*Sleeper*, 1973

MGM. *Sleeper*, 1973. Feature film,  
 88 min; director: Woody Allen,  
 script: Woody Allen, Marshall  
 Brickman © 1973 Metro-Goldwyn-  
 Mayer Studios Inc. All rights reserved

### WOODY ALLEN – *SLEEPER*

In the science fiction parody *Sleeper*, the New York health-food shop owner Miles Monroe – played by director Woody Allen – is frozen in 1973. When he is thawed out some 200 years later, he awakens to a dictatorship in which people are completely controlled by the system: they are subjected to brainwashing, are “programmed” like computers, and have little more freedom than their “labour-saving devices”, their robot domestic servants. Miles Monroe is the world’s only free human being who has yet to be brought to heel. To protect himself from persecution, Monroe first pretends to be a robot, but in the end he aids the rebels – the people who thawed him out – in their victory. TT

67

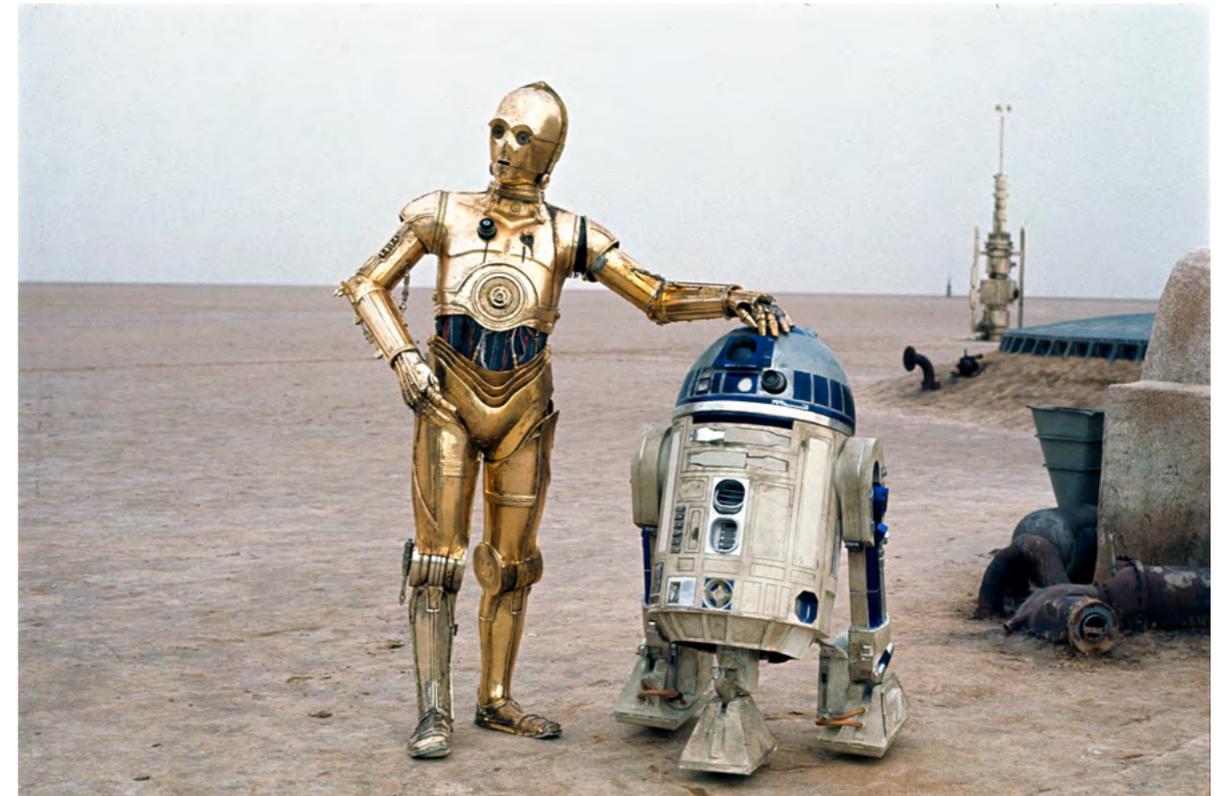
## GEORGE LUCAS – *R2-D2*

*R2-D2* is a fictional robot from the American director George Lucas' *Star Wars* films. In the story, astromech droids such as *R2-D2* serve as mechanics with highly intelligent computing capabilities for repairing starships. Measuring 96 cm in height, "Artoo-Detoo" can communicate only by means of beeps, which are translated for the benefit of the audience by his humanoid robot partner and friend *C-3PO*, who understands millions of languages. *R2-D2* was played by the short-statured British

actor Kenny Baker inside the robot's casing. However, in some scenes *R2-D2* was moved by remote control or computer animation. *R2-D2* and *C-3PO*, who have both appeared in all of the *Star Wars* films to date, are representative of typical fictional robots with superhuman capabilities. TT

George Lucas. *R2-D2*, 1977. First appearance in the feature film *Star Wars: Episode IV – A New Hope* (1977); photograph © & ™ 2017 Lucasfilm Ltd. All rights reserved. Used under authorisation.

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*R2-D2* and *C-3PO*, 1977

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In his photo series *The Man Machine*, Vincent Fournier captures speculative scenes featuring everyday encounters between humans and robots, their interactions, and empathic moments. The photos look at the degree to which robots are accepted by humans; while one might assume that the more realistic their appearance, the more robots find acceptance, in reality, the opposite is the case. According to the *Uncanny Valley* theory of Japanese roboticist Masahiro Mori, people find abstract, artificial-looking human replicas more attractive than those that resemble us too closely. When a certain degree of similarity is reached, acceptance decreases abruptly and only increases when the level of similarity with real human beings is extremely high or the differences are indistinguishable. TT

VINCENT FOURNIER  
– *THE MAN MACHINE*



*Reem B #6 [Pal], Barcelona, Spain, 2010*



*Reem B #5 [Pal], Barcelona, Spain, 2010*



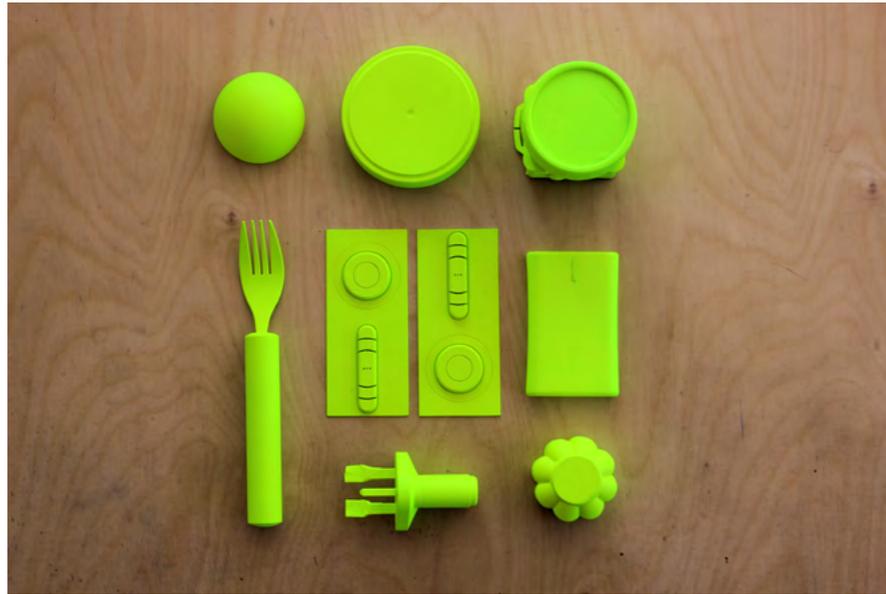
*Reem B #7 [Pal], Barcelona, Spain, 2010*

Vincent Fournier. *The Man Machine*, 2010. *Reem B #6 [Pal], Barcelona, Spain; Reem B #7 [Pal], Barcelona, Spain; Reem B #5 [Pal], Barcelona, Spain*. Series of 21 photographs, ink jet prints, 100 × 130 cm each  
© Vincent Fournier

SUPERFLUX – UNINVITED GUESTS



Uninvited Guests, 2015



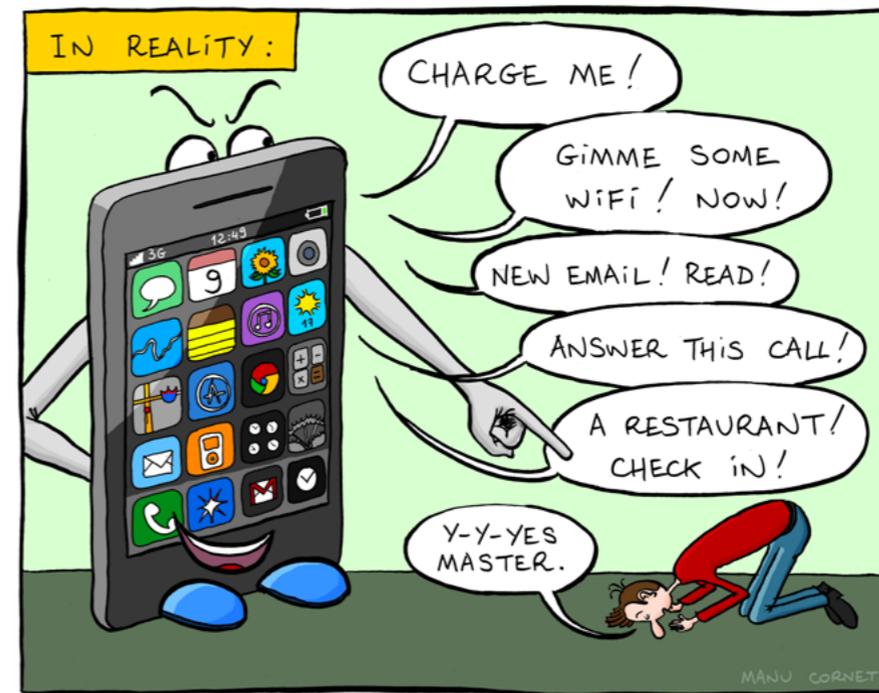
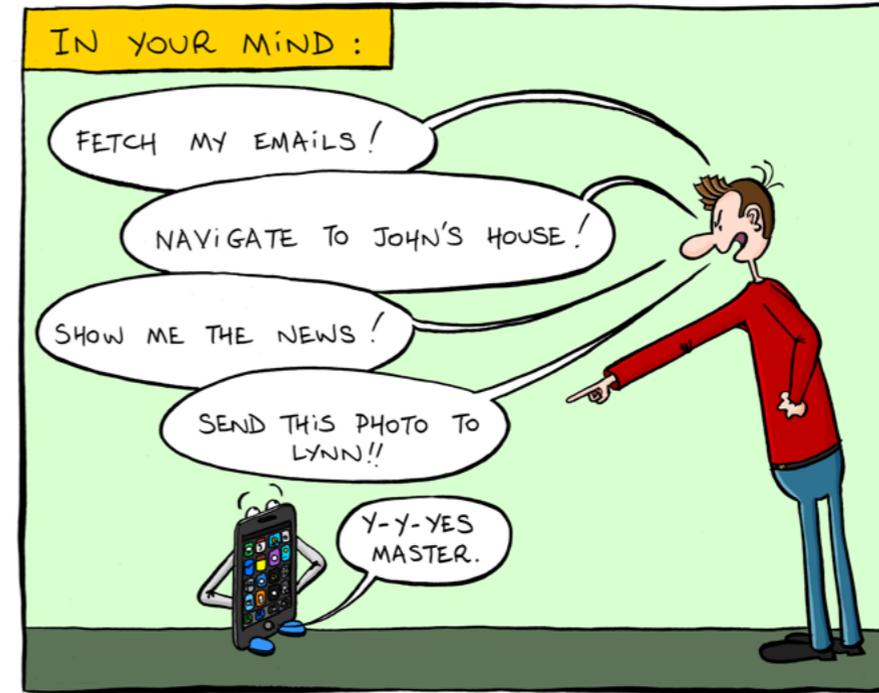
Smart objects

*Uninvited Guests* is a design fiction project that explores the flip side of the pervasive presence of digital gadgets in our lives and our relationship with them. The short film focuses on the idea of a “connected home”, where imagined smart objects help to improve the quality of life of an elderly parent by monitoring his day-to-day activities. Tension arises when the tracking devices begin to feel less like caregivers and more like an annoyance by constantly policing the man’s every move, from his eating habits to his exercise and sleep patterns. The film not only questions the power dynamic between technology and its human users, but also comments on how technology changes communications and relationships between people. AR

Superflux. *Uninvited Guests*, 2015. Installation, various materials and sizes; video: 4 min 43 sec; commissioned for: ThingTank; team: Anab Jain, Jon Ardern, Jon Flint, Alexandra Fruhstorfer, Katarina Medic, James Leahy; acknowledgements: James Leahy, Prof. Chris Speed and the ThingTank consortium © Superflux

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Manu Cornet. *Mobile Relationship*, 2012. Graphic print © Manu Cornet



Mobile Relationship, 2012

The cartoons of the French illustrator and programmer Manu Cornet allude to the ambivalent relationship between modern humans and their constant companions: digitally networked smartphones. Whereas we do indeed believe that these devices are labour-saving and useful, the reality is – according to Cornet – that we are their slaves. They incessantly demand we react and communicate, and many of the tasks they apparently perform on our behalf in our networked lives were introduced by the smartphone in the first place. The question whether technology is a friend or an enemy ultimately comes down to the question of who is controlling whom. TT

MANU CORNET  
– MOBILE RELATIONSHIP

# PROGRAMMED TO WORK

In the world of work, production, and industry – among the general public at least – robots are strongly associated with the fear of job loss. The issue is the subject of heated debate not only in the media; designers, artists, and filmmakers too are looking at what happens when people are gradually replaced by intelligent machines in the workplace. Will our standard of living decline along with our income? Or will we finally have more time for our friends, families, and hobbies thanks to a three-day working week and an unconditional basic income? Will new professions arise, and if so, what will they be? Will we work side by side with robots who are fully networked with customers and suppliers, as Industry 4.0 promises?

The fear of losing jobs to new technologies is as old as the first industrial revolution. In those days it was looms and steam engines that rendered hundreds of thousands of jobs obsolete. Since then, every technological leap has triggered the same discussions: most recently with the PC in the 1980s, the Internet in the 1990s, and now with robots. Time has shown that we have always found new areas of work even if working conditions have changed dramatically since the eighteenth century. *Hello, Robot.* seeks to shed light on the current debate from different perspectives against the background of technological and social change.

In the shadow of this debate, which ultimately still presupposes traditional structures of production and labour, a completely new breed of human has evolved: the prosumer. Prosumers consume what they produce themselves. What distinguishes them from individual world reformers is that they are globally networked via the Internet and have easy access to new, digital, robotic means of production. Both factors allow prosumers to sidestep traditional markets in order to develop, produce, and distribute tailor-made, smart products. Even today digital processes such as 3D printing make it possible for individuals to produce small pieces of furniture or everyday objects at a reasonable price. To produce a bridge, a house, or a haute couture dress obviously requires a wider range of competencies, but once designs and building plans are accessible to everyone online and open workshops and Fab Labs have become as commonplace as gyms, everyone will be able to produce (almost) everything themselves. Whether the end of the division of labour and the return to self-sufficiency will actually solve all our problems remains to be discussed.

# ROBOTS, KILOBOTS, NANOBOTS

## SWARMING IN THE INTERNET OF THINGS

By 2020, fifty billion objects will be connected via the Internet of Things,<sup>1</sup> far more than there are people on the planet to regulate or control them. Indeed, the Internet of Things is by no means just about computing in its original sense, but rather about such things as interlinking street lights with the urban traffic system and combine harvesters with sensors in the ground, or implanting chips in the body to analyse health data. The digitisation and miniaturisation of technology has given rise to new distributed systems that can no longer be clearly mapped but instead disseminate processing power everywhere as ubiquitous computing – in the networked house (smart homes), in intelligent clothing (wearable computing), and in public spaces (smart cities). The attempt to keep “nature” and “technology”

separate is becoming increasingly futile – for we are now dealing with hybrid, networked worlds. Indeed, Donna Haraway’s manifesto,<sup>2</sup> for one, has made it abundantly clear that we have finally turned into cyborgs, a cross between human and machine. We are ourselves part of the Internet of Things, inasmuch as we use the technology surrounding us to analyse our personal data and share it online. Following Bruno Latour, we can argue that this kind of modern demarcation between nature and technology never existed; rather, it was always artificially produced to make a clean division and keep things simple.<sup>3</sup> After all, technology is increasingly becoming part of our “natural” body and the “natural” environment. As the debate about whether “robots” will take jobs away from us humans heats up, we should bear in mind that the problem is already inherent in the discrete categories we have set up: processing power

does not emanate simply from a clearly differentiated robot, which would be easy – rather it is about different actors in a network in which we become collaborators with the machines. Processing power can be found in us and around us. When our own job is under threat, “the robot” becomes a clearly definable entity that is perfectly suited to assume the mantle of “enemy”, but a networked system involving new forms of collaboration between human and machine is not so easy to get to grips with. Thus, the system in Latour’s actor-network theory does not care whether it is dealing with a human or a non-human actor.<sup>4</sup> In the financial services system, for instance, it is irrelevant for the process whether a decision has been made by an algorithm or a human being. An individual citizen whose loan application has been rejected on the basis of an algorithm is likely to see things differently.

Although people tend to see humans and technology as polar opposites for understandable reasons, this isn’t much use if we want to shed light on our networked world. We need to think in terms of new actors and new alliances that are based on the assumption that we are always online, that everything can be potentially networked with everything else, and that a significant part of human labour can be taken over by distributed computing. This stokes the fear of a loss of control: What will happen if we can no longer keep new technology at bay, or if it starts to operate autonomously and defy our instructions? Will the robot in its network become a legal entity with full responsibility for its actions? What powers will unshackled technology develop when it further evolves through an independent learning process, like the little kilobots that interact in a swarm?

Kilobots are small, autonomous bots that communicate with one another in swarms.<sup>5</sup> They can only perform a few actions on their own, as all they are able to do is orientate themselves in space. However, in a swarm they adapt their behaviour to one another, enabling them to assume different constellations. Each of them becomes a molecule within an organism that can change its shape.

The idea is that nanobots, the kilobots’ miniaturised colleagues, are so small that they can be used as an autonomous army in the bloodstream to combat cancer cells. Although this may sound like science fiction at the moment, the first tests with multifunctional nanoparticles have in fact proved successful.<sup>6</sup>

116 <sup>1</sup> Dave Evans, “The Internet of Things: How the Next Evolution of the Internet Is Changing Everything”, [http://www.cisco.com/c/dam/en\\_us/about/ac79/docs/innov/IoT\\_IBSG\\_0411FINAL.pdf](http://www.cisco.com/c/dam/en_us/about/ac79/docs/innov/IoT_IBSG_0411FINAL.pdf), accessed on 24 October 2016.  
<sup>2</sup> Donna Haraway, “A Cyborg Manifesto: Science, Technology and Socialist-Feminism in the Late Twentieth Century”, in David Bell and Barbara M. Kennedy (eds.), *The Cybercultures Reader* (London, Routledge, 2000), pp. 291–324, <http://faculty.georgetown.edu/irvinem/theory/Haraway-Cyborg-Manifesto-1.pdf>, accessed on 24 October 2016.  
<sup>3</sup> Cf. Bruno Latour, *We Have Never Been Modern* (Cambridge, MA, Harvard University Press, 1993).  
<sup>4</sup> Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (Oxford, Oxford University Press, 2005).

<sup>5</sup> Michael Rubenstein, Alejandro Cornejo, and Radhika Nagpal, “Programmable self-assembly in a thousand-robot swarm”, *Science* (345, no. 6198, 15 August 2014), <http://www.eecs.harvard.edu/ssr/publications/index.html>, accessed on 24 October 2016.  
<sup>6</sup> Yuanpei Li et al., “A smart and versatile theranostic nanomedicine platform based on nanoporphyrin”, *Nature Communications*, <http://www.nature.com/articles/ncomms5712>, accessed on 24 October 2016.



A swarm of kilobots can generate a huge variety of shapes. © Photo: Michael Rubenstein / Harvard University

GESCHE JOOST

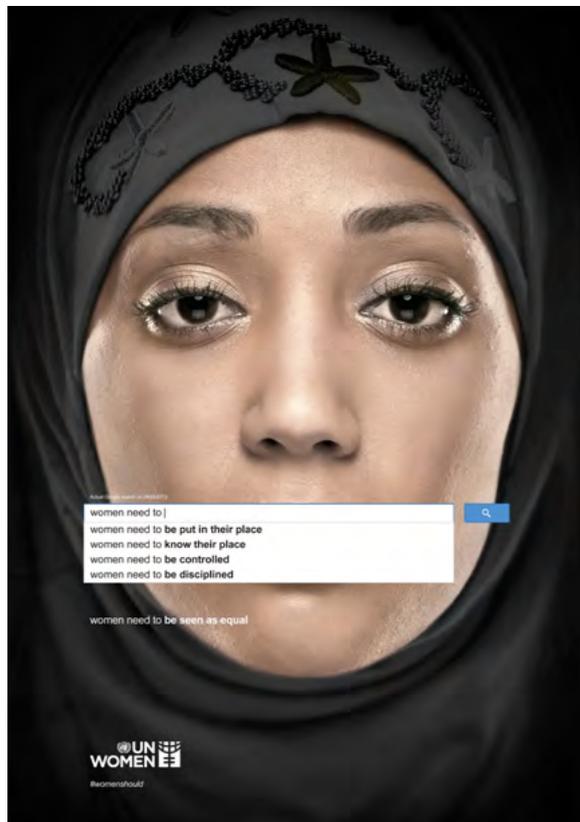


UN Women, *The Autocomplete Truth: "Cannot"*, publicity campaign  
© Photo: Memac Ogilvy Dubai

7 "A bot is considered to be a computer program that carries out repetitive tasks largely automatically, without depending on an interaction with a human user." From: <https://de.wikipedia.org/wiki/Bot>, accessed on 16 October 2016.

8 <http://www.unwomen.org/en/news/stories/2013/10/women-should-ads>, accessed on 16 October 2016.

Swarm robotics thus represents a very different kind of artificial intelligence that does not seek to replicate human intelligence. The individual bot<sup>7</sup> is relatively stupid – its intelligence arises from its interaction with the swarm and the autonomy this gives it. There is still a huge amount of research to be done on the various potential fields of application, but swarms of autonomous drones are one example of the new possibilities that beckon. However, this swarm intelligence also involves an increasing loss of control if the system is self-referential, learns from itself, and continues to evolve in this way. Self-learning systems like this are key in artificial-intelligence research, since they make it possible to keep developing the system based on the changing parameters of the environment. They are based on self-learning algorithms, which poses a crucial question: Who is responsible for these algorithms? Is it the programmer as their creator? The company that employs him or her? Or does the system evade responsibility because it has evolved autonomously – without human supervision? Take Google's intelligent search algorithm, for instance: the organisation UN Women attracted attention when it ran a sensational campaign on discrimination against women on the Web, in which it showed Google's auto-complete function for the search queries "women cannot" and "women need to".<sup>8</sup> The first listings in response to the query "women cannot" were "drive", "be bishops", "be trusted", "speak in church". In response to the query "women need to" came the results "be put in their place", "know their place", "be controlled", "be disciplined".



UN Women, *The Autocomplete Truth: "Need"*, publicity campaign © Photo: Memac Ogilvy Dubai

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9 Nick Bostrom and Eliezer Yudkowsky, "The Ethics of Artificial Intelligence", in Keith Frankish and William M. Ramsey (eds.), *Cambridge Handbook of Artificial Intelligence* (Cambridge University Press, 2014), <https://intelligence.org/files/EthicsofAI.pdf>, accessed on 24 October 2016.

10 <https://www.openai.com>, accessed on 24 October 2016.

Plate III from Joseph Friedrich Freiherr zu Racknitz, *Über den Schachspieler des Herrn von Kempelen und dessen Nachbildung* (Leipzig and Dresden, Joh. Gottl. Breitkopf, 1789). Copperplate engraving © University Library of the Humboldt-Universität zu Berlin, Historical Collections: 3639 v:F8

These results naturally raise the question of responsibility: Is Google as a company responsible for them, or is it the programmer of the algorithms, the crowd of users who entered the query, or even the system itself? Or does this self-learning system evade any responsibility because it merely represents what the mass of users have entered as a search query? This example shows how clichés and mass opinions are amplified by the Internet and how existing inequalities are consolidated. In this sense even an algorithm is not objective; rather, its action is reinforced by the emphasis of the search queries, thus enshrining world views without reference to an ethical or social substructure. A debate on the ethical bases for designing systems of artificial intelligence erupted some while ago in the developer community,<sup>9</sup> with initiatives like Open AI calling for radical openness and transparency with regard to AI systems, to be achieved via open source licensing, non-profit R & D, and security.<sup>10</sup>

## MY COLLEAGUE, THE ROBOT

Robots are part of the interconnected environment and operate in networks. This gives rise to collaborations between humans and machines and between the machines themselves – what is called machine-to-machine communication. The vision of robots – which once came in the shape of automata but have been known since 1920 as robots, the name given them by Josef Čapek – has always fascinated the observer, while at the same time arousing fears of a loss of control. This vision pinpoints a primal human fear that runs right through our cultural history. The early examples of automata in the eighteenth century captured the imagination by virtue of their elaborate mechanisms, their precision, and the aura surrounding objects apparently coming alive. It transpired that one of the first major fakes was the Turk, the automaton chess player built by Wolfgang von Kempelen in 1769. A life-size figure sat in front of a chess board and responded to the moves of its opponent. It was supposed to compete with its human opponents as the first intelligent chess automaton, and indeed performed with flying colours – which should come as no surprise as it was in fact controlled by a diminutive person hidden in the automaton's torso. Until the early twentieth century the Turk continued to make appearances at carnivals and fairs and captivated the public as a symbol of the machine's triumph over the human mind.

# COULD A ROBOT DO YOUR JOB?

DO YOU  
WANT TO  
BECOME  
A PRO-  
DUCER  
YOUR-  
SELF?



Manufacturing #10a, Cankun Factory, Xiamen City, China, 2005



Manufacturing #10b, Cankun Factory, Xiamen City, China, 2005

## EDWARD BURTYNSKY – *MANUFACTURING #10AB, CANKUN FACTORY, XIAMEN CITY, CHINA*

With his photo story about contemporary China – for which he visited the country's most important shipyards, industrial plants, coal-mining areas, and cities – Edward Burtynsky allows us to see and feel how global mass consumption is organ-

ised. In this photograph of a 450-metre assembly hall of the Cankun Factory, the world's second-largest manufacturer of coffee machines with 23,000 employees at the time the photograph was taken, we see hundreds of workers. They all wear the

same clothing, occupy similar workspaces, and perform nearly identical operations. Burtynsky's photographs wordlessly show how people become machines to a certain extent even before the machines replace them. TT

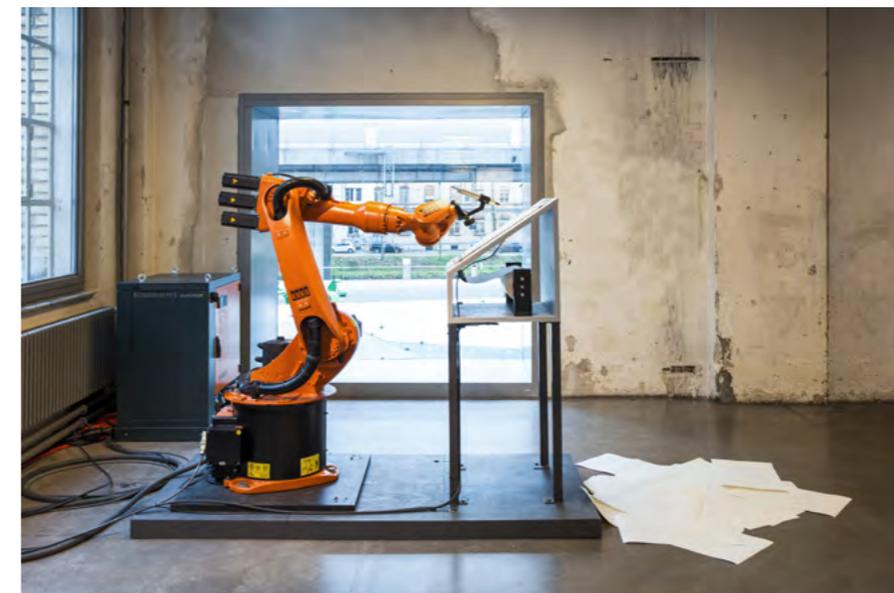
Edward Burtynsky. *Manufacturing #10a* and *Manufacturing #10b*, Cankun Factory, Xiamen City, China, 2005. Chromogenic colour prints, 122 × 152.4 cm each © Edward Burtynsky, courtesy Metivier Gallery, Toronto / Galerie Springer Berlin

The installation consists of a robotic scribe which constantly writes manifestos, throwing the paper on which each is written at the visitors as soon as it is complete. Every manifesto consists of eight statements, which the robot generates autonomously by selecting terms out of its internal information pools (on the subject areas of art, philosophy and technology) and associating them within a syntactical framework. In other words, rather than mass-producing copies of one uniform manifesto, the machine mass-produces unique texts with individual messages, each one signed with a serial number. Despite their uniqueness, however, the manifestos are random, automatically generated, and devoid of intentional meaning. *manifest* is supported by Kuka. AR

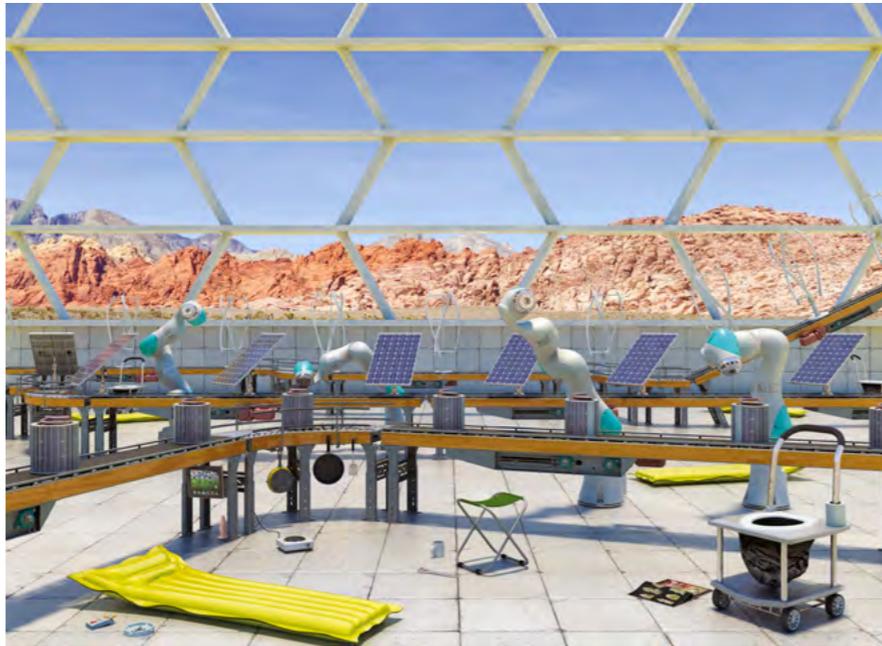
## ROBOTLAB – *MANIFEST*

robotlab. *manifest*, 2008. Industrial robot installation, 180 × 240 × 120 cm; thanks to: KUKA and ZKM © robotlab

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*manifest*, 2008



Going Green, 2016

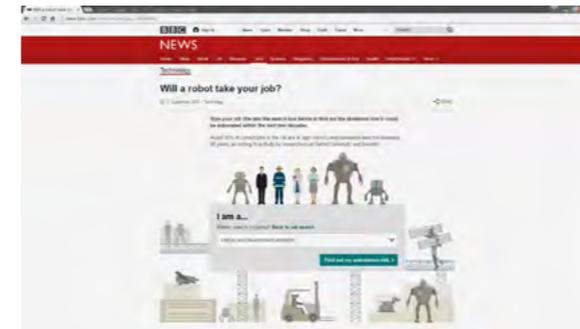
The artist Shawn Maximo creates visions of possible future living spaces by mixing various concepts of spatial utilisation, which is why his photographs seem at the same time both strange and familiar. In *Going Green*, we see a production hall with autonomous robots working on a manufacturing line producing “green technology”. In the foreground of this scene devoid of humans we see a scattering of what looks like camping equipment: an air mattress, a folding chair, a camping stove. It begs the question of the role of humans in this post-industrial scenario. Have they already been made obsolete in the work force? Or are we dealing with a future concept of spatial use that does not yet strike us as possible or even rational? TT

Shawn Maximo. *Going Green*, 2016.  
Vinyl print, 356 × 491 cm © Shawn Maximo

## SHAWN MAXIMO – GOING GREEN

Based on two current studies on the topic of automation in the workplace, the BBC’s interactive website allows visitors to calculate the risk that their jobs will be taken over by robots or computers in the near future. Predictably, jobs relying on empathy or social intelligence, such as work in the nursing or creative fields, are not under immediate threat. Manual and elementary administrative jobs, however, face a much greater risk. Here, as is often the case, automation – in the form of more or less likeable humanoid robots with deep-set eye slits – is described as if it were something akin to a force of nature rather than a process that could be addressed and possibly countered at a political level. TT

## BBC NEWS – WILL A ROBOT TAKE YOUR JOB?



Will a robot take your job?, 2015: the website ...



... calculates your risk of being replaced by automation.

BBC. *Will a robot take your job?*, 2015.  
Interactive website; team: Nassos Stylianou, Tom Nurse, Gerry Fletcher, Aidan Fewster, Richard Bangay, and John Walton; screenshot © BBC, courtesy Getty Images / BBC Motion Gallery

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The animated film *The Last Job on Earth* describes a scenario in which human labour has been eliminated: everything from human hygiene and housework to mobility, medical care, news, and shopping is now the task of computers or robots. But protagonist Alice still has a job – for now. The viewer accompanies her as she goes about her morning and makes her way to the office. What is revealed is not only the “brave new world”, but also its price: growing inequality, slums, people left behind by the pace of progress, and the problem of providing for a population condemned to idleness. The scenario raises the question of whether a society without work – all technical progress aside – is at all desirable. TT

Moth Collective and Box of Toys Audio Ltd. for *The Guardian*. *The Last Job on Earth: Imagining a Fully Automated World*, 2016. Video, 2 min 53 sec © 2016 Guardian News & Media Ltd.

## MOTH COLLECTIVE AND BOX OF TOYS AUDIO LTD. – *THE LAST JOB ON EARTH: IMAGINING A FULLY AUTOMATED WORLD*



*The Last Job on Earth*, 2016

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Machines don't always work in the future either.



... everything looks pretty great, but only superficially.

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# JULIUS BREITENSTEIN – *THE UNPAID INTERN*

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For his 2016 Graduate show presentation at Central Saint Martins in London, Julius Breitenstein designed *The Unpaid Intern*. With more discussion about (design) jobs losing out to new, computer-aided and autonomous technology than ever before, Breitenstein's contribution is well-timed. Instead of minimising the designer's role, *The Unpaid Intern* aims to do the opposite – support designers by using genetic algorithms as tools for improving the design process. The square-shaped controller Breitenstein created employs a straightforward CAD user interface, is parameter-based and allows users to experiment a great deal in the early stage, save their work as presets, and combine things later. The device offers designers more efficiency and choices, but the real interns might be stuck getting the coffee. EP



*The Unpaid Intern*, 2016: controller

Julius Breitenstein. *The Unpaid Intern*, 2016. Algorithm-based design software; controller, ca. 17 × 17 × 4.2 cm; 3D printed forms, various sizes © Julius Breitenstein

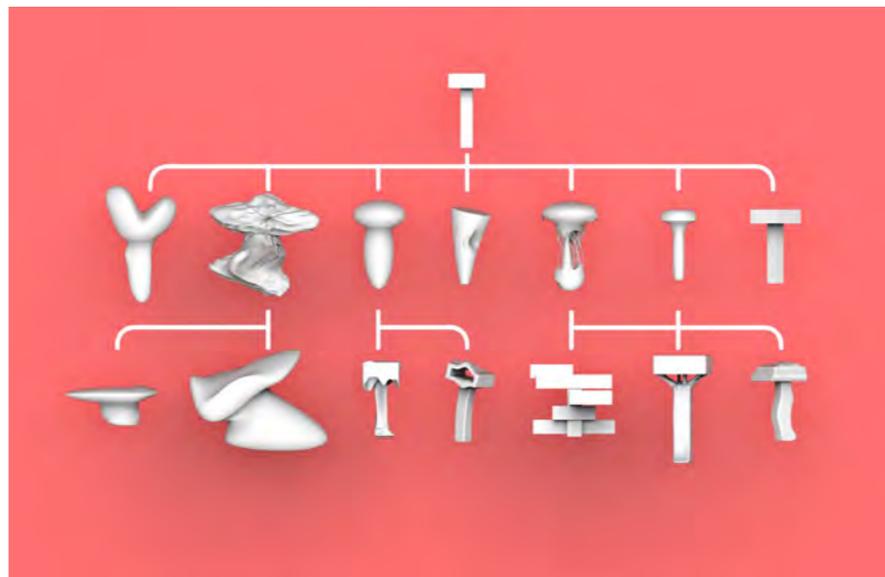


Diagram of the forms generated by the algorithm

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*YuMi*, 2015

*YuMi* is a dual-arm robot designed to perform small-part assembly work required, for example, by the electronics industry. It has multi-functional, sensor-equipped "arms" and extremities with fourteen rotational axes. *YuMi* – whose name derives from the words "you" and "me" – is as dextrous as a human being, with arms and grips that mimic those of a human in both form and function. While traditional industrial robots are kept apart from humans by protective barriers – because they cannot sense when a human is nearby – *YuMi* is a collaborative robot, designed specifically to work safely with and around people. With simple programming, it can perform any manual task and, just as the steam engine replaced human muscle, it will increasingly take care of repetitive assembly tasks allowing humans to focus on value-creating activities. TT

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ABB Ltd. *YuMi*, 2015. Collaborative robot, total floor space: 39.9 × 49.6 cm, arm span: 50 cm, weight: 38 kg © ABB Ltd.

ABB ROBOTICS – *YUMI*

The scenario presented in the video *Teacher of Algorithms* assumes that our “smart” devices, such as those we use in the home, are actually not all that smart, since they cannot be truly effective helpers without first learning and observing our habits and adapting to them. But what about when the coffee machine, for example, begins to regularly make coffee at two o’clock in the morning after its owner worked all night? Wouldn’t it be practical if we could take our devices to an algorithm coach who could professionally train them according to our needs, thereby turning them into devices that are truly smart? After all, new technologies always create new job profiles in their wake. TT

SIMONE REBAUDENGO, AUTOMATO.FARM – *TEACHER OF ALGORITHMS*



Simone Rebaudengo (automato.farm). *Teacher of Algorithms*, 2015. Mixed media installation and video, 5 min 28 sec; script, direction, editing: Simone Rebaudengo; script, sound: Daniel Prost; camera: Andrea Carlon © automato.farm

*Teacher of Algorithms*, 2015

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*RR Haiku 154*, 2015

RAFAËL  
ROZENDAAL  
– *RR HAIKU 154*

Rafaël Rozendaal. *RR Haiku 154*, 2015. Painting, paint and vinyl lettering, 250 × 167 cm © Rafaël Rozendaal

In 2013, the artist Rafaël Rozendaal began posting haiku on his various social media accounts that, along with a general commentary on society, often assess the nature of work today – from the banality of too much screen time: “clickidiclickclick, clickclickclickclickidiclick, clickclickidiclick” (*RR Haiku 68*), to our inability to step away from the screen: “never working, never, not working.” (*RR Haiku 111*). His haiku have since found their way off the screen and into other media such as a book published in 2015 and various large-scale wall paintings. *RR Haiku 154* – “I don’t need a studio, I need a pool” – was chosen for the exhibition *Hello, Robot*. because it playfully questions what we will do with all of our newfound free time when robots take over our jobs: Will something else keep us confined to our desk, or will we hightail it straight to the pool? EP

# DO YOU WANT TO BECOME A PRODUCER YOURSELF?

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COULD A ROBOT DO YOUR JOB?

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Vogt + Weizenegger. *Sinterchair*, 2002. Chair, laser-sintered nylon, 76.2 × 44 × 50.5 cm © Vogt + Weizenegger, photo: Jürgen Hans, courtesy Vitra Design Museum

*Sinterchair* uses the sintering process – previously employed in the automobile and aviation industry to build prototypes – to manufacture custom-made, individually designed chairs. Customers are first given a questionnaire to find out their preferences, such as their favourite music, writers, and philosophers. Next a computer-generated drawing of a chair is created. Subsequently the selective laser sintering (SLS®) process is used to outline a chair in a block of nylon powder and the shape is cut out one layer at a time. The chair takes shape as the layers harden. A few hours later, the chair is removed from the nylon block and the customer can take it home. *Sinterchair* places the consumer at the centre of the design process while minimising distribution, storage, and model costs. AR



*Sinterchair*, 2002

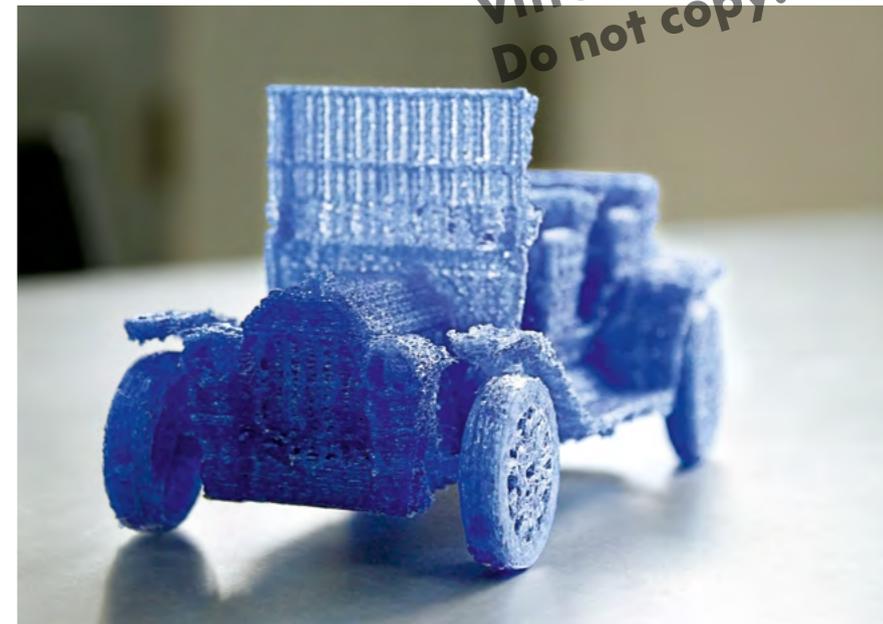
VOGT + WEIZENEGGER  
– *SINTERCHAIR*

TAL EREZ – *BANDE À PART*

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Installation view



*Bande à part*, 2013: 3D printed car

*Bande à part* was created by Tal Erez in 2013 for the Gallery Z33 exhibition *Design Beyond Production* shown in Hasselt, Belgium, and at the Salone del Mobile in Milan. The critical design installation illustrates the political, social, and ethical repercussions of the designer-consumer-manufacturer paradigm motivated by advancing DIY technology such as 3D printing. The installation has been scaled down for *Hello, Robot.*, yet it maintains its original three features: command center, control screen, and assembly line, all of them with a designer at the helm. In this way, a distributed factory is simulated, in which individual households print out goods under the surveillance of the designer. As the designer's role shifts to the one of an overarching manufacturer, his or her responsibilities multiply accordingly, thus going dramatically unregulated. EP

Tal Erez. *Bande à part*, 2013. Mixed media installation with ten 3D printed cars, PLA, 12 × 6 × 7 cm each © Tal Erez



Command centre

# FRIEND AND HELPER

We are already reliant on intelligent devices in our day-to-day lives. We trust our smart assistants to navigate us through foreign cities, to remind us of our anniversaries, and to provide us with information on every subject imaginable. They check our pulses and even call for help in an emergency. All these things have made our lives more comfortable and in some cases have saved them. But anyone who has had to make do without their smartphone for even one (working) day knows how dependent we have become on their intelligent help, and how helpless we are when they turn out to be nowhere near as smart as promised.

Our relationship with objects and how best to design it has preoccupied designers for decades. Whenever consumers have the choice between a variety of similar or identical products, the unique selling point becomes the sensory or emotional qualities of the objects. This is all the more true of intelligent objects that communicate and interact with us and give us the feeling that they can feel – because what counts then is not their shape or tactile properties, but how they succeed in making us reliant upon them. If roboticists have increasingly started talking about “humanised” machines, what they mean is that these machines should feel like old friends: helpful and obliging, perhaps a little over eager, and maybe even neurotic or manipulative. Once we are entangled in these relationships, their loss hits us all the harder. What happens if and when the beloved thing is gone forever?

The robots who look after us, who nourish and care for us, who make sure we are okay, are everywhere in society. We have yet to entrust our children to robotic nannies, but there are already a host of robots designed to be playmates, teachers, and chaperones, rolled into one. The wide-scale use of robots in geriatric care is the subject of serious discussion – not only in Japan, where people are traditionally more open towards intelligent machines, but also in the West. There are good reasons for this, since robots are already very successfully deployed in caring for and treating patients with dementia and Alzheimer’s disease. Younger adults don’t want to miss out on being cared for by robots either, and they don’t have to – whether while shopping for jeans, having the shopping delivered, or taking off their new jeans for a bit of casual sex.

# HOW MUCH DO YOU WANT TO RELY ON SMART HELPERS?

HOW DO YOU FEEL ABOUT  
OBJECTS HAVING FEELINGS?

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DO YOU BELIEVE IN THE  
DEATH AND REBIRTH OF  
THINGS?

DO YOU WANT  
A ROBOT TO  
TAKE CARE OF  
YOU?

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*Mon Oncle*, 1958. Monsieur Hulot struggles with his sister's fully automated kitchen.

*Mon Oncle* (My Uncle) is a comedic masterpiece by the acclaimed French film director and actor Jacques Tati. The plot centres on the iconic Monsieur Hulot, who struggles with his sister's obsession with modernity and American-style consumerism, while maintaining a tender relationship with his nine-year-old nephew, Gérard. The geometric, all-white, ultramodern kitchen has a special significance in the confused musings of Monsieur Hulot. His reactions to its machine-like and sterile furnishings are poignant and serve as an amusing satire of mechanised living and consumer society in post-war France. *Mon Oncle* won the Academy Award for Best Foreign Language Film in 1959, a Special Prize at Cannes, and the New York Film Critics Award. The film was Tati's first to be released in colour. AR

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Jacques Tati. *Mon Oncle*, 1958. Film, 117 min © Les Films de Mon Oncle – Specta Films C.E.P.E.C.

JACQUES TATI – *MON ONCLE*



*WALL-E*, film poster, 2008



Comfortable but helpless

Andrew Stanton, Pixar Animation Studios. *WALL-E*, 2008. Computer-animated feature film, 98 min © 2008 Disney • Pixar

ANDREW STANTON, PIXAR ANIMATION STUDIOS  
– *WALL-E*

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*WALL-E* ingeniously depicts a relationship quest as two robots, *WALL-E*, the last inhabitant of planet Earth, and EVE, a search robot on a mission, develop feelings for one another in the midst of accomplishing their dull, lonely, and strenuous programmed duties. The backdrop for this romantic story is a grim, dystopian future. Humans have abandoned a trashed planet Earth leaving *WALL-E* (short for “Waste Allocation Load Lifter Earth-Class”) robots behind to clean up their mess, until it is safe for them to return. The surviving humans are living on the spaceship Axiom, an extremely artificial and automated environment, operated by a large corporation called Buy N Large. People ride around this space resort on hovering chairs, which give them a constant TV feed and video chatting. They drink all of their meals through a straw. Everything is so convenient that people never need to leave their chairs, ending up so weak and atrophied that they can barely move. *WALL-E* won several accolades, including the Academy Award for Animated Feature Film. AR

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*All the Robots*, 2007 (video)

## DUNNE & RABY – *TECHNOLOGICAL DREAM SERIES: NO. 1, ROBOTS*

Faced with a future that will soon be populated by a multitude of robots, the designers Tony Dunne and Fiona Raby ask how we will interact with these robots in daily life and what relationships we will enter into with them. In their view, the idea of robots that simply relieve us of work ultimately falls short of the mark. For the series *Technological Dream*, therefore, they designed

four robots – all non-human in appearance – with different personality structures: an annular, autonomic robot, a neurotic robot in the form of a receptive funnel, a guard robot with which you have to maintain eye contact for a long time before it trusts you enough to share its data, and finally a robot that is intelligent but also helpless and needy. TT

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*Robot 3: Sentinel*, 2007

Dunne & Raby. *Technological Dream Series: No. 1, Robots*, 2007. *Robot 1: Red Ring*, high density foam, 10 × 90 cm (diam.); *Robot 2: Neurotic One*, starch, epoxy resin, 50 × 50 cm (diam.); *Robot 3: Sentinel*, oak and acrylic, 39 × 20 × 93.3 cm; *Robot 4: Needy One*, oak, acrylic and epoxy resin, 75 × 48 × 15 cm; video *All the Robots* by Noam Toran, 4 min 53 sec © 2016 Dunne & Raby, photos: Per Tingleff



*Robot 4: Needy One*, 2007

# BECOMING ONE

Nanobots – robots on an atomic or molecular level – may still be hypothetical, and robotic materials may still be the stuff of science fiction, but smart surfaces and moving walls that autonomously adapt to inhabitants' needs and regulate room temperature like a skin already exist today, at least as prototypes. Moreover, the networked home, in which machines and objects communicate intelligently, is on everyone's lips as the Internet of Things. Deeper convergence will hence first take place within the "machine" in which we live. Far exceeding modernist imaginings, however, this is not limited to our houses and apartments – because robots are not limited to a single body. Any environment is a robotic system if it receives signals via sensors, processes them using artificial intelligence, and generates a physical reaction in response. In our everyday lives we encounter not only architectures of stone, glass, and concrete, but also architectures of data and communications which already fulfil these criteria to a significant degree. This invisible system has become so fundamental to our daily lives and the way we live with others that no one would seriously call it into question.

The robot inside us also dissolves the human-machine divide. With the aid of modern prosthetics and implanted chips, we can achieve things that would be impossible without artificial props – from opening locked doors with our bare hands to running world records. Crucial questions formerly confined to science fiction magazines have now become relevant in the real world: "What will happen when humankind merges so seamlessly with technology that we become superhuman machines?" and "Will we be able to keep pace with society and evolution without technological bio upgrades?" are only two examples.

In our quest for optimisation, even our own biology is not off limits. Inspired by the intelligent principles we find around us in nature, we are using robots to redesign our environment, improving on much that was produced using conventional methods and even on nature's own template. The anxiety-ridden question whether intelligent machines will one day replace all living things – ourselves included – has been around since humans began telling stories about artificial creatures. The question we must ask today is this: Do humans, for the first time in history, have the technological knowledge and the tools to let science fiction become reality? There is no simple answer. Yet there can be no doubt that we are heading towards a more intelligent, more autonomous – more robotic – lifeworld than the one we know today. And design has a responsible role in creating this new lifeworld, because it is through design that we can influence how and where we encounter the smart objects and systems that surround us, how we interact with them – and they with us.

ICD/ITKE, UNIVERSITY OF STUTTGART – RESEARCH PAVILION 2013/14



Research Pavilion, 2013/14

Since 2010, the Institute for Computational Design (ICD) and the Institute of Building Structures and Structural Design (ITKE) at the University of Stuttgart have created an annual Research Pavilion. Both institutes share a distinctive focus on biomimicry and material experimentation, designing structures that are robust yet singular. In the 2013–14 academic year, a team of researchers drew their inspiration from beetles and, in particular, from their light-weight protective wing-cases known as elytra. These derive their stability from the intricately wound fibres of which they are composed, while their light weight is due to a central cavity. Following this model, the team programmed two collaborative robots to wind glass and carbon fibres together to create modular panels. Additionally, thanks to the algorithm, it was ultimately the robots rather than the architect who decided how and where the individual panels would be placed. EP



A robot winds together glass and carbon fibres ...



... according to the computations of an algorithm.

Institute for Computational Design and Construction (Prof. Achim Menges), Institute of Building Structures and Structural Design (Prof. Jan Knippers), University of Stuttgart. *Research Pavilion*, 2013/14. Pavilion, glass and carbon fibres, 50 m<sup>2</sup>, 12 kg/m<sup>2</sup> basis weight. Architectural model, 1:20 scale, various materials, 75 × 90 × 50 cm © ICD/ITKE, University of Stuttgart

Anouk Wipprecht's creations herald the end of analogue clothing. She regards fashion as an interface and combines design with robotics and electrical engineering,

integrating microchips and sensors into her fabrics and into the structures of her designs, which she makes with a 3D printer. The “smart clothing” she produc-

es using these techniques – so far mainly one-off conceptual prototypes – functions like an intelligent second skin. The multi-jointed, movable arms on the collar of her

*Spider Dress 2.0*, for instance, register the speed with which someone is approaching and if necessary will reach out to mark the wearer's personal space. LH

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ANOUK WIPPRECHT  
– SPIDER DRESS 2.0

Anouk Wipprecht. *Spider Dress 2.0*, 2015. Robotic dress, various materials, 3D printed, with Intel Edison microcontrollers © Anouk Wipprecht, photo: Jason Perry



*Spider Dress 2.0*, 2015

Karola Dierichs, Achim Menges,  
Institute for Computational Design  
and Construction, University of  
Stuttgart. *ICD Aggregate Pavilion*,  
2015 © ICD, University of Stuttgart

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*Molecule Shoe*, 2015

## FRANCIS BITONTI STUDIO – *MOLECULE SHOE*

Francis Bitonti's *Molecule Shoe* is a 3D-printed collection of pixelated platform footwear, developed by an algorithm that mimics cellular forms in nature. The shoes were created with a mathematical model called "Game of Life", which generates cellular structures. This algorithm allowed the designer to "grow" pairs of shoes with varying gradients of colour; each shoe has a slightly different form. Once the form is created, the shoes are built pixel by pixel on a Stratasys 3D printer that blends different colours of filament while building up the pieces layer by layer. OP

Francis Bitonti Studio Inc. *Molecule Shoe*, 2015. 3D printed with the Stratasys Connex 3D Printer, printing software by Adobe; pair of shoes, 23.5 × 24.1 × 10.2 cm each; photo © 2022 Museum of Fine Arts, Boston

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*Aggregate Architecture*, 2015

For the project *Aggregate Architecture* at the ICD at the University of Stuttgart, researchers investigated the possibilities of aggregates – large amounts of elements in loose contact – in architecture. The researchers developed their own synthetic granular systems based on naturally forming granulates like sand and gravel. The new granules are produced from recycled plastic in various sizes, depending on what best suits the specific structure being built. For construction, small clusters are dropped into position by a cable robot based on an algorithm. Ultimately, the goal was to develop a system with granules so small that no gaps can be detected. Since no matrix is needed for construction, this building technique would be ideal for temporary purposes and quick reconfigurations. EP

ICD, UNIVERSITY OF STUTTGART – *AGGREGATE ARCHITECTURE*

For his constantly expanding art project *Slogans for the Twenty-First Century*, the Canadian author and artist Douglas Coupland collects slogans and thoughts with which he tries to understand the ways in which the present – in the relatively early days of the twenty-first century – is fundamentally different from the twentieth century. It comes as no surprise that this collection of ideas primarily focuses on life with and in the midst of digital media, which has become second nature in this day and age. Slogans such as “Machines are talking about you behind your back”, “You are the last generation that will die”, and “Offline = Loneliness” can seem ominous or unsettling and socio-analytic by turns. Taken as a whole, the collection constitutes a kind of oracle for life in the digital age. TT

DOUGLAS  
COUPLAND  
– *SLOGANS  
FOR THE  
TWENTY-  
FIRST CEN-  
TURY*

Douglas Coupland. *Slogans for the Twenty-First Century*, 2011 (ongoing). Pigment prints on watercolour paper, laminated onto aluminium, 35 pieces, 55.4 × 43 cm each © Douglas Coupland, courtesy Daniel Faria Gallery, Toronto



*Slogans for the Twenty-First Century*, 2011 (ongoing)

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General Director and Artistic Director: Lilli Hollein  
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Only a few decades ago the robot was still just a figure of science fiction. Nowadays, however, robots and robotic systems seem to be taking over our lives. Design has a key role to play in this process, for it is designers who shape the interface between humans and machines. *Hello, Robot.* shows intelligent machines in industry and in the military, in children's rooms and retirement homes, in shopping and sex, in art, computer games, and of course films and literature. Detailed essays and interviews examine how we respond to our increasingly digital, smart, and autonomous environment. They illuminate our – often ambivalent – relationship with these new technologies and broaden our view of the ethical and political questions they raise. With contributions and works by Douglas Coupland, Dunne & Raby, Gesche Joost, Robotlab, Bruce Sterling, and many others.

The layout for *Hello, Robot. Design between Human and Machine* was devised by an algorithm in collaboration with Double Standards, Berlin.