

# Intelligent technological tattoos.

## Science, Art and Technology on and under the skin

Catarina Pombo Nabais<sup>1</sup>

“The most profound in man is the skin.”  
Paul Valéry

This article explores the most recent kind of tattoos: the intelligent technological tattoos. These tech-tattoos have the capacity of sensing, measuring, analysing and emitting data about the body's biochemistry through signs and colours inscribed in and on the skin, depending if they are done in the body with conductive ink or if they are worn on the skin. Even if still temporary — because conductivity is lost through skin's natural resistance —, tech-tattoo aims at becoming a daily device.

What if we could transform our skin into the most intelligent, smart, interactive technological device? What if our skin would be able to exhibit all kinds of internal data about our body's biochemistry and nervous system? What if our skin, our thin and fragile surface, was the most profound and powerful part of our body?

The skin is the biggest organ of the body. It is the body's frontier, its physical limit and delimitation, its surface, its border. The skin functions as a membrane-wall of protection as well as an opaque boundary concealing the body from the outside. But the skin is also what exposes the body to the exterior world, what opens up the body, connecting it with the outside. Thus, paradoxically, the skin is at the same time what encloses and what opens up the body. For centuries, the only way to see the interior of the body, underneath the skin, was by anatomical interventions done to dead corpses. Only recently, medicine was able to overcome the opacity of the skin by using technologies such as X-ray, Ultra-sound, Computed tomography (CT) or magnetic resonance imaging (MRI), among many others. Nowadays, another big step is being done. What was available only through medical exams may now be easily shared by technological tattoo which emits data through signs and

colours inscribed in and on the skin. Through tech-tattoo, skin becomes the body's biggest exposure. The enclosed mysterious body is now transformed in pure transparency as if body becomes naked.

### To be or not to be human. That is the question.

Nowadays, it is interesting to realize that one of the most ancient practices of body inscription such as tattooing<sup>2</sup> becomes a recent area of research in science and technology. Many laboratories have taken tattooing into the world of artificial intelligence. Close to a science-fiction scenario, tech-tattoo is now on the way of becoming the most intelligent body device, transforming humans into cyborgs. Made of nanotech electronic components such as electro-conductive ink or fabric tape, bio-sensors, curvy wires, thermo-chromic ink, and sometimes also imitation gold leaf metal inscribed over the skin, technological tattoo is exponentially expanding. Even if still temporary because conductivity is lost through skin's natural resistance, tech-tattoo aims at becoming a permanent bio-smart device.

There are two kinds of tech-tattoos nowadays. One is inscribed in the skin, as a traditional tattoo but with a special ink that is linked to Wi-Fi devices. A recent yet already famous example is a tattoo which can reproduce a sound that is previously memorized in the drawing.

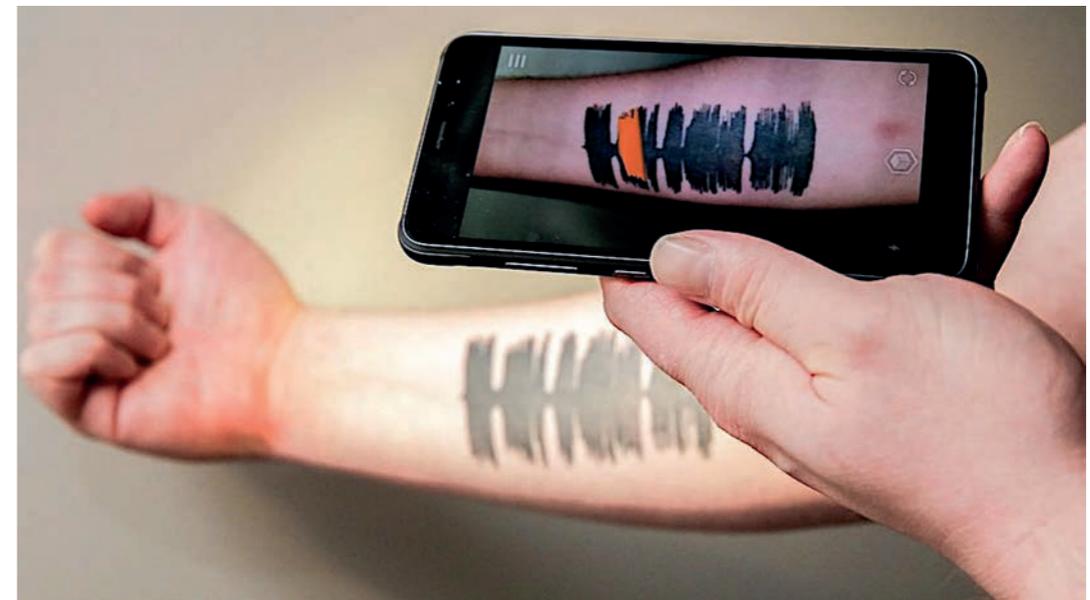


Fig. 1. In the *Skin Motion* website, there are some recommendations about the *Soundwave tattoo*: it should be no larger than 6 inches or 150 mm to be fully captured by the camera on the phone, it should be done in a flat surface such as the inner-forearm and it should be placed where one can easily hold the phone to play the tattoo back with the *Skin Motion* app. Image credit: Sarah Tew/CNET.<sup>3</sup>

First, an audio clip is uploaded in the website of *Skin Motion* company and then a certified artist will grave it in the skin as a traditional tattoo but with a conductive ink which is connected to the *Skin Motion* app. The way this app scans the tattoo is similar to some apps that scan QR codes. It is called the *Soundwave Tattoo*<sup>TM</sup> and it was invented in April 2017, by the tattoo artist Nate Siggard, who shared his invention in a video on Facebook that immediately went viral (over 150 million views during the first month). He then created the *Skin Motion* company, specialized in what he expresses as “personalized Augmented Reality Tattoos.”<sup>4</sup> (Fig. 1.) The other kind is a tattoo that is glued over the skin and disappears by washing like the fake tattoos that some kids use. Titled *Duo skin*, *Double Skin* or *Tech Tat*,<sup>5</sup> this temporary tech-tattoo belongs to a new generation of flexible nano materials. The future perspective is that they will become a daily life's device (Fig. 2).

Due to the fast-technological evolution and to their cheap and easy process of fabrication, tech-tattoos are being appropriate for an enormous range of concrete purposes having direct impact in daily life. They may have utilitarian purposes such as providing a payment system,

tracking individuals in space, or giving instructions to the Wi-Fi devices to which the tattooed subject may be connected. Or they may have a deeper bio-medical-political dimension when, e.g. they make possible measuring the body's temperature, the heart beats, the level of alcohol or the blood pressure, supervising fitness, computing sleep patterns, in a word, monitoring vital, bio-metric data.

There are at least two main methodologies for producing smart tattoos: synthetic biology and nanotechnology. Synthetic biology operates skin genetic manipulation. It may produce a cell that gets coloured when it detects biochemistry changes in the body, thus rendering the tattoo visible and coloured. Nanotechnology manipulates matter on the nano scale (1-100 nano meters). Instead of using solid pigment particles like in standard tattoos, nanotechnology uses hollow microcapsules which can be filled with diverse materials, depending on the tattoo function.

All these technological advances on smart tattoos, are used for military purposes by detecting poisons in the air, by discovering pathogens in soldiers or by recognizing when soldiers are stressed or hurt. Tech-tattoo has already and

will have further in the future a great value in medical uses. One example: Harvard Medical School and MIT have been developing a project called "Dermal Abyss." This project aims at identifying the levels of glucose and sodium in the blood to help in diabetes medical care. In this case, tattoo is made with a smart ink that contains colorimetric and fluorescent biosensors which transforms the skin into a colour sign emitter of biochemical changes in the body. Depending on blood glucose, sodium or pH levels, the skin emits various shades of colours. It can become pink or purple depending on the pH level, it can go from blue to brown depending on blood glucose, or even fluorescent under ultraviolet light depending on sodium level (Fig. 3).

Another example: Carson Burns, a researcher in molecular nanotechnology at the University of Colorado, is developing a tattoo that goes from invisible to coloured spots when the skin is overexposed to sun light and to UV rays. Powered by solar energy, this tech-tattoo has in its micro particles an UV sensitive colour changing dye. Working as an alert, appearing only when the skin is overexposed to UV radiation, this tattoo may help in the sunburn or cancer prevention (Fig. 4).

**To be or not to be surveilled. That is the other question.**

Technological tattoo is incredibly expanding. However, it is important to notice that the investment being done in this kind of technology



Fig. 2. Tech-tattoo made with one-atom size, two-dimensional single layer of graphene. Contrary to regular temporary tattoos, graphene tattoo is almost transparent. Image credit: Shideh Kabiri Ameri, Deji Akinwande, et al.

from international companies allied with research centres and science laboratories makes the biopolitical power of tech-tattoo very clear. In a control society as we already live in, tech-tattoo is a big step into the reinforcement of individual's control. With tech-tattoos, data emission on individuals' lives is done, not just from the cell phone but from bio-nano-sensors of a body artificial device. The cell phone — which is already a smart tool — is able to spread lots of information about our movements, GPS location, tastes, social milieus, number of daily steps, etc. But the tech-tattoo with its bio-nano-sensors goes deeply by informing about the diseases, the genetics, the very chemistry of each individual. And in

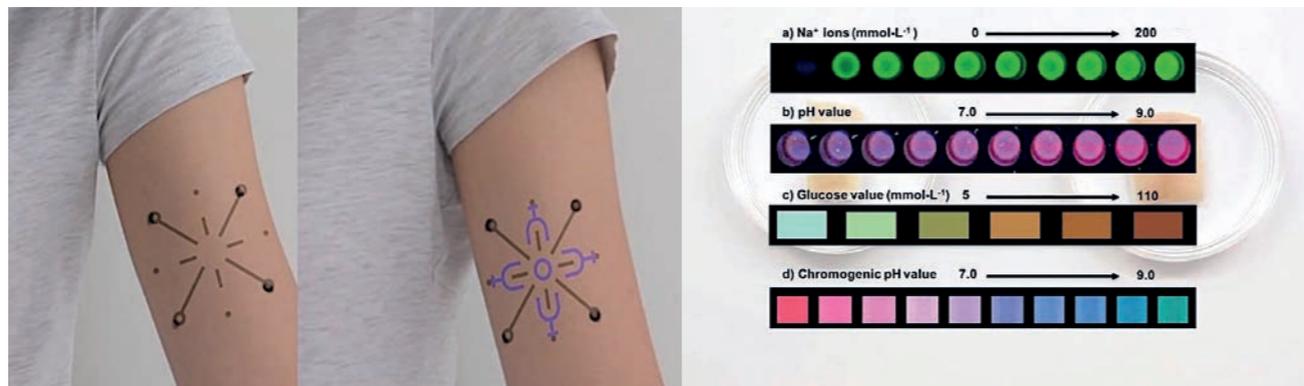


Fig 3. On the left, *Dermal Abyss* tattoo. On the right, *Dermal Abyss* colour palette. Both photos are from Nan Jiang, postdoctoral fellow at the School of Engineering and Applied Sciences at Harvard University, who has been working at Harvard Medical School undertaking research on nano biotechnology and biosensors for the *Dermal Abyss* project.



Fig. 4. When UV ray light illuminates the skin (on the right), two blue spots appear on the skin (on the left). Both images are taken from TED talk by Carlson Burns.<sup>6</sup>

providing all this multitude of inner, intimate data, tech-tattoo is in total, instantaneous, and permanent connection with the control technologies around us. Besides emitting data, tech-tattoo is also capable of sensing, measuring, and analysing data. Therefore, we may say that "bio-wearable" tech-tattoo turns the body into a digital cyborg exempted from privacy and, moreover, it transforms the body into a bio-tech surface, a smart and quantifiable canvas. Tech-tattoo is thus a truly control device, which can be easily used by power structures.

In "Post-Scriptum on Control Societies" (1990), Gilles Deleuze analyses the shift from the disciplinary society, which extends from the 18<sup>th</sup> century to the last decades of the 20<sup>th</sup> century,

to the control society. This shift happens with the emergence of a diffuse world-capitalism aligned with digital devices able to control individuals in their personal activities and consumption habits. In disciplinary societies described by Michel Foucault,<sup>8</sup> all activities were framed in specific architectonic buildings (schools, hospitals, fabrics, etc.) where individuals were fixed in space and time and could be controlled by central structures. Time and space dictated life, in a transcendent mode. Now, in control societies, individuals become digital nomads. No matter where and when, they are flowing in a global web, subjected to an immanent control.

Deleuze seems to be terribly prescient. In the early 90s, two years before Tom Barnes Lee's



Fig. 5. Software company *Chaotic Moon* has developed a tech-tattoo that is implanted into a person's arm, capable of registering the financial and medical information of the tattooed individual. According to *Chaotic Moon's* hardware creative technologist, Eric Schneider, "with the tech tattoo you can carry all your information on your skin and when you want your credit card information or your ID, you can pull that up automatically through the system."<sup>7</sup> Image credit: www.emergeinteractive.com.

creation of the World Wide Web, Deleuze stresses that the subject produced by a control society is a navigator (a surfer) in a global floating world: “The disciplinary man was a discontinuous producer of energy, but the subject of control is undulating, in orbit, in a continuous network. Everywhere surfing has already replaced the old sports.”<sup>9</sup>

Now, the body is no longer an independent and autonomous entity, living almost anonymously, as it used to be in disciplinary societies. In control societies, the body becomes an entity within the global digital world. It is part of an infinite database of power structures which, through digital devices, have a perfect and total command of the individual’s life, even if only while taking a walk in the street. Modern body has become the locus of constant social management, a satellite unit or — precisely by means of tech-tattoo — even a control device in itself.

Unlike Jeremy Bentham’s Panopticon, with a centralized focal point from which the disciplined activity of individuals is monitored, in control society, a diffuse, widespread, and decoded matrix of information controls the individuals’ body and behaviour all the time and everywhere. The “Panopticon” becomes a “Superpanopticon”: more subtle, invisible, close and so intimate that it turns to be almost indifferent. We know that we are being watched, but we are not forced to be in a specific place. On the contrary, we are encouraged to move and not to worry about being watched. This normalization of surveillance has become immanent to the modern body and will become even more internalized with the spread of tech-tattoo.

<sup>1</sup> PhD in Philosophy from the University of Paris 8 (2007), researcher at the Faculdade de Ciências da

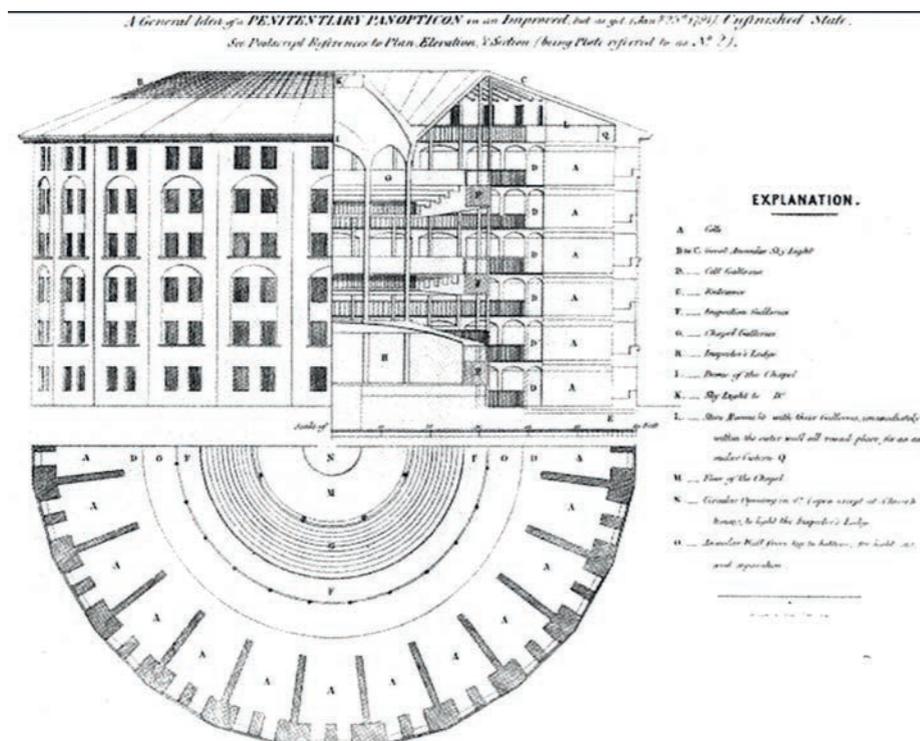


Fig. 6. Image of the Panopticon elaborated by Jeremy Bentham in 1791 in his work *Panopticon; Or, The Inspection-House*.<sup>10</sup>

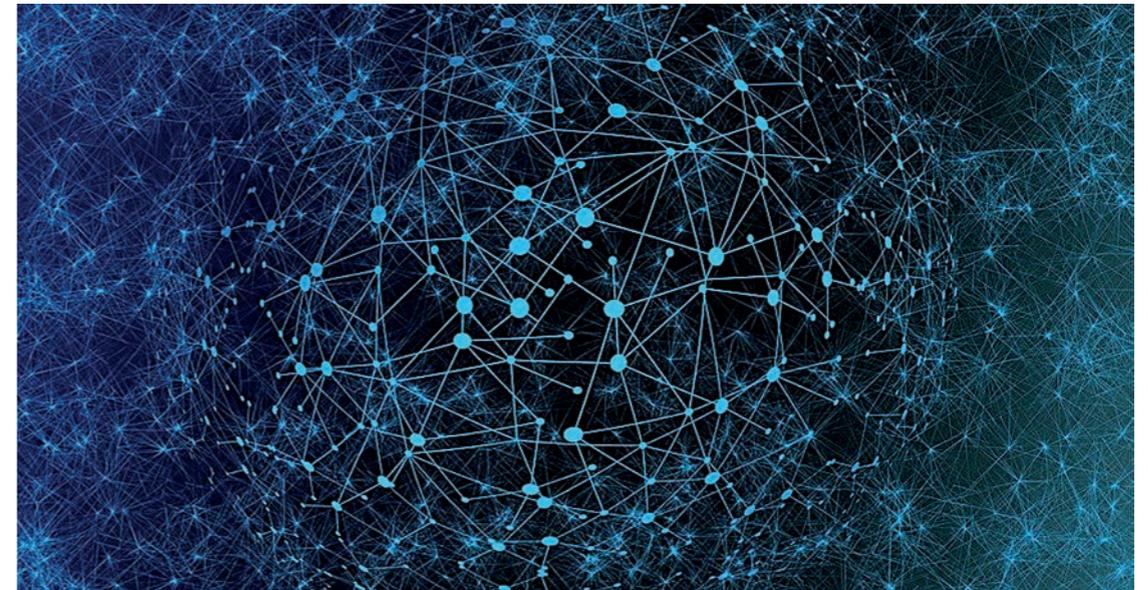


Fig. 7. Iconic representation of the web. Image credit: <https://pixabay.com/>

Universidade de Lisboa, Departamento de História e Filosofia das Ciências. Integrated member of the Centro de Filosofia das Ciências, Universidade de Lisboa, Campo Grande 1749-016 Lisboa, Portugal. Email: ccnabais@fc.ul.pt.

This work is financed by national funds through FCT – Fundação para a Ciência e a Tecnologia, I.P., within the scope of the Norma Transitória – DL57/2016/CP1479/CT0067 and the Norma Transitória – DL57/2016/CP1479/CT0065.

<sup>2</sup> The most ancient tattooed body dates from 5000 years ago, but tattoos are known to be practiced since the Upper Paleolithic period (10-30 000 years ago). Cf. C. TALIAFERRO & M. ODDEN, “Tattoos and the tattooing arts in perspective: an overview and some preliminary observations,” in R. ARP (ed.), *Tattoos: philosophy for everyone: I Ink, Therefore I Am*, Oxford, John Wiley & Sons, 2012, 4. For a more detailed analysis of tattoo throughout history and its meanings, see my article “The most profound is the skin – the power of tattoos,” in D. HONORATO, A. GIANNAKOULOPOULOS (eds), *Taboo-Transgression-Transcendence in Art & Science, Proceedings of the 10<sup>th</sup> Interdisciplinary Conference and Audiovisual Arts Festival, Department of Audio & Visual Arts – Ionian University of Corfu, Greece*, Corfu, Ionian University Press, 2017, 128-148.

<sup>3</sup> In B. VAN GELDER, A. NUNES, “Skin Motion app turns my tattoo into sound waves,” <https://www.cnet.com/news/skin-motion-app-soundwave-tattoo-i-tried-it/>

<sup>4</sup> In *Skin Motion. Tattoos brought to life*, <https://skin-motion.com/soundwave-tattoos/>.

<sup>5</sup> In *Chaotic Moon*, <https://www.youtube.com/watch?v=9i-FuTaqD4fM&t=29s>.

<sup>6</sup> See TED talk by Carlson Burns:

[https://www.ted.com/talks/carson\\_burns\\_could\\_a\\_tattoo\\_help\\_you\\_stay\\_healthy/transcript#t-403948](https://www.ted.com/talks/carson_burns_could_a_tattoo_help_you_stay_healthy/transcript#t-403948). For further information, see J. L. BUTTERFIELD, S. P. KEYSER, K. V. DIKSHIT, H. KWON, M. I. KOSTER, and C. J. BRUNS, “Solar Freckles: Long-Term Photochromic Tattoos for Intra-dermal Ultraviolet Radiometry,” in *ACS Nano* 14(10), 2020, 13619–13628, <https://pubs.acs.org/doi/10.1021/acsnano.0c05723>.

<sup>7</sup> In <https://newyork.cbslocal.com/2016/01/29/tech-tattoos-chaotic-moon/>.

<sup>8</sup> See M. FOUCAULT, *Discipline and Punish. The Birth of Prison*, trans. A. SHERIDAN, New York, Vintage Books, 1995.

<sup>9</sup> G. DELEUZE, “Post-scriptum sur les sociétés de contrôle,” in *Pourparlers*, Paris, Minuit, 1990, 244.

<sup>10</sup> In J. BOWRING (ed.), *The Works of Jeremy Bentham*, Edinburgh, William Tait, 1838-1843, vol. 4, 172.