Human-Machine Co-Living

The issue 67 of **diid** solicits reflections on the contemporary relationships between Design and Technologies; it investigates according to which directions has the design culture been confronted in recent years with the world of technical artifacts, deeply changed in relation to the evolution of areas such as digital electronics, robotics and AI. Post-human thinking has had a strong influence in stimulating research towards a conjugation between human and machine, where the contamination between the two dimensions is no longer seen as a threat but as a chance for co-existence and transformation.
With the confluence of mechanics and AI, nowadays the world of robotics comes to be particularly attractive to design; the research of robotics faces new limits through the development of complex devices capable of a wide range of tactile, visual, sound, and olfactory sensibilities. A deeply collaborative dimension between human and machine is perhaps the most "natural" promise for technological innovation, that will certainly have an impact on the future identity of design and on its creative processes.

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The dichotomous, almost dystopian scenario that we face when we look at the current framework of technological development poses increasingly pressing questions for what regards the relationship that we, as a human kind, have with the digitised automation of our lives. Internet, robotics, data cloud computing and artificial intelligence are tools widely used in our society, however, we are not yet able to really get into this innovation and while we are looking for solutions, we do not live without a certain sense of inadequacy: we exploit innovation but got to come partly dependent on it, up to the point of producing social effects, sometimes even harmful.
The intelligent human-machine relationship becomes a topic for further investigation when applied to the field of design and artefacts production, whereas in traditionally passive technological environments humans work actively, determining conscious choices: the introductions of artificial intelligence determines a habits shift because it transforms the values in the field, it upsets them.
Starting from principles and methods in some of the scenarios in which design traditionally acts, i.e. production, multidisciplinary connective relations, designed innovation, the application of collaborative strategies between human and artificial intelligence is hypothesized.
It is therefore suggested an experiment useful to bring out the potential of the relationship between human beings and machines in place of the predisposition of rules of conduct that fix the roles by freezing them in the recipients and determining in fact the failure.
The output scenario offers food for thought on values, power relations, connections and on how much local action is complementary to a global complexity that can no longer be evaded; there, design in its bidirectional relations between subjects and components, provides on field experimental solutions, working closely to the subjects directly involved.

[robotics, human-machine co-living, artificial intelligence, open design, design by components]

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Technological scenario

Talking about technological evolution in 2019 inevitably means to risk repeating what is already known and openly accepted by all human communities with access to the digital world. In fact, in June 2019, there were more than 4.4 billion Internet users worldwide, more than 2 billion of which just in Asia, where the penetration rate is still only 53.6%, compared to 87.7% in Europe, which has 727 million users connected to the World Wide Web (Internet World Stats data, checked on September 1st, 2019). That this data is significant at first glance seems quite obvious, but it is interesting to linger, even if only momentarily – this is not the subject under discussion – on the penetration, that is the density of use in the populations taken into consideration: it seems at least interesting that in Asia, where almost all the production of digital devices of any kind has been concentrated for decades, the level of digitalization of people is still so low. Whether it depends on cultural rather than economic or social issues, or more likely on a complex combination of them is of little importance; what matters is the fact that these populations are more excluded than Western populations from the phenomena discussed below, leaving it to others to determine the phenomena related to the pervasive adoption of advanced technological solutions.
The life of this multitude of connected people depends to a large extent, and not entirely consciously, on the information that travels on the Internet: such information represents a new precious resource, whose nature, quantity and economic value are impossible to estimate and exploit in their entirety and complexity by individuals, but also by important international stakeholders, even when they are main actors in the production and management of the data itself. This, unlike clean water, breathable air or oil, is not only renewable but is constantly growing in quantity, density, complexity and completeness.
Such a picture, highly articulated in itself, is enriched with further variables by virtue (some say through guilt) of three crucial innovation phenomena represented by the so-called Internet of Things (IoT), pervasive robotics and Artificial Intelligence (AI).
The first one, consisting in the ability of the Internet to transmit digital informations that can bidirectionally become physical and then turn back into digital, produces effects on a range of aspects of human life still far to be defined and yet in continuous evolution (Brynjolfsson & McAfee, 2016). Referring to the world of design and the production of artefacts, for example, the only possibility of elaborating solutions, sharing them online for prototyping thousands of kilometres away, digitizing them to verify their validity and finally sending them back to the source is not only a process innovation but also a disruptive conceptual one: we stop thinking locally but we do not even go through the concept of design globalisation, since local nodes become part of a larger and more complex system, of process and method, without however getting lost in it. We will go back to the concept later on, defining its contours better and above all trying to understand its implications in the field of Design, but not only.
The second path, on the other hand, naturally stems from the centuries-old expertise

developed in the automation sector; in fact it is the result of the industrial revolution itself, where machines that carry out work in place of humans have always been seen as an alternative pole and opposed to the human being, in a pair that is undoubtedly profitable but also intrinsically harbinger of critical dynamics. This is so true that over time, and since the dawn of industrialisation, it has determined a deep and widespread cultural transformation in all the places of civilisation where industrial production has been located, or at least the effects have been introduced, in terms of the use of artefacts, economic and social effects. Literature and cinema have always found fertile ground in this scenario on which to produce entire new production genres.

The third is a further level of evolution that now characterises our technological evolvement and that finds its own specificity within the contrast with one of the most peculiar characteristics of the human being: intelligence. Ours is natural, biological, analogical, while the one of machines is artificial, technological and digital. In fact, whether Kurzweil is right or not about the *Singularity* he evokes (2005), what is clear is that the interconnections between human beings and machines are now settled, pervasive and irreversible.

To better understand this last piece of the techno-evolutionary puzzle that we are building, it is obviously necessary not to limit ourselves to imagining the machines that we can think of in anthropomorphic terms: mobile phones are intelligent machines, as are cars, many household appliances, more and more household objects, security systems and also, obviously, the entirety of industrial production, logistical, administrative and management systems. Our behaviour is indeed, and more than evidently already transformed and taken for granted, where, for example, the perception of those who speak to a non-physical digital system instead of a real person is seen in a radically different way than it would have been thirty years ago. Or again, we normally accept and live experiences of interaction with automated systems of booking, financial management or even health care, going so far as to accept that a machine is what determines and carries out therapy or treatment activities on us instead of a human doctor.

Therefore, talking about machines considered as isolated devices that perform a task is now conceptually misleading, if not wrong, since even the smallest system, integrated with others, is the node (neuron?) of a network of complex artificial intelligences, endowed not only with processing capacity – and decision – but also with motor skills (Tegmark, 2017). The definition of intelligence becomes more difficult, since the artificial one can perform much faster than ours, not even being so far from being endowed with evolved cognitive powers, such as to potentially overcome the concept of limit imposed by the *Turing test*, contrary to what Aleksandar Todorović stated (2015). In fact, whether we are right or not while we think that it is not possible for an artificial intelligence to overcome the human one, it becomes irrelevant if we think about the history of human evolution in relation to technology: when a technology has had an impact on society and has been implemented by humanity, it has always evolved in unexpected ways and faster than its creators might have thought.

This does not mean, evidently, that a disruptive and pervasive innovation is definitive: what is happening to the personal transport sector, but not only, is a powerful example, where the internal combustion engine is seeing its definitive, albeit slow, decommissioning approaching, after almost two centuries of absolute dominance over any other form of propulsion.

Anyway, taking into account the evolutionary potential of artificial intelligence, we can assume that very soon in the future the integration between human beings and machines will be such as to produce effects of socialisation (and also empathy) such as to make the relationship between the two intellectual domains, comparable with the human-human one. After all, watching any of the promotional videos of the *Atlas* project of Boston Dynamics is enough to understand that we are not far from suffering for machines or being afraid of them.

It is precisely with regard to this aspect that the concept of slavery evoked by Ingold (1993) in relation to human activity towards the landscape, as consolidated by the previous considerations of Tapper (1988) regarding domestication in the agricultural sector, comes to our aid.

Human-machine co-living is therefore a complex field, whose boundaries are not only not yet defined but are increasingly difficult to handle.

Evolution of behaviours

Starting from the assumptions of Ingold and Tapper we can try, through a strong simplification, an exercise of logic that leads us to better understand the extent of the evolution of human behaviour, towards the semi-sentient digital counterpart.

In fact, the environment in which we have been working for years is now made up of instruments-machines that could be compared to a flock of animals, or plants, raised and cultivated by us, that need care, food and a protected home that leads them to produce the welfare that we expect from their proliferation.

In this sense, there is clearly a passive natural environment, in which an active sentient subject operates, which dominates and controls actions, parameters and strategies with respect to what it deems more appropriate to happen.

The introduction of artificial intelligence determines a radical change within this configuration.

First of all, we are still in a condition of instrumentality, where the passive environment is made up of machines instead of animals and plants; this was the case with the steam weaving machines of the late nineteenth century (Deane, 1965). However, increasingly intelligent devices, therefore independent in their operative choices, introduce new variables in the human-machine relationship. So it happens that the environment is no longer completely passive: strategies, methods and actions are increasingly managed independently by machines, which automate like the aforementioned steam engines but by making decisions, based on algorithms, whose results depend on the amount of data in the cloud, something that humans being could not manage by themselves.

Data, then, but not only. What is about to become disruptive is the ability of machines to process this data in unexpected ways. In fact, we are already in this condition: for example, driving applications are able to collect information in real time, check travel times based on the type of road, traffic, roadworks, accidents or detours impossible to be seen by humans, and then propose alternative routes to choose from. It is still up to us to choose, even if the independent driving horizon suggested by the SAE J3016 standard (Thrun, 2010) already establishes a moment, both regulatory and evolutionary, in which the choices will be made in total autonomy by machines. In essence, we will be able to load our children aboard totally autonomous vehicles, that will take them to school without our direct control.

Forwarding this scenario, the same distinction between human and artificial intelligence may falter, whereas the boundaries between the two will become so blurred that they will no longer be perceptible, making the *Turing test* completely irrelevant.

An alternative way

Within this scenario, it is clear how important the role of Design is, especially in its specific ability to generate those virtuous connections that are typical of natural systems. In the attempt to find possible ways to guide us to a viable solution, we can, as designers, try to think about an alternative path.

With this objective in mind it is possible to draw inspiration from scenarios, also in evolution, to which we are closer and more similar in terms of experience; in this field the innovative production systems, the new logic of design and implementation of products and solutions with an approach to sharing and the use of digital technologies in new design spaces and communities can provide us with profitable speculative margin.

We are referring specifically to the world of digital manufacturing, which through the methodologies offered by Open Source Design, the communities of Makers and FabLabs, allows us to outline different paradigms within the relationship between human beings and technology (Anderson, 2012).

What emerges relevant in this context is the type of relationships that exists between the subjects and the languages/rules they use while engaging design and production processes.

We are talking about a population of heterogeneous independent designers and planners, or groups of them, who develop projects in an open way, putting themselves in a bi-directional relationship with other entities, not only equal but also belonging to different environments, such as companies, public administrations, professionals even apparently far from design.

These communities also find fertile ground in the open approach provided by the Open Source strategies, which are operationally declined by the alternative ways of attributing intellectual rights offered by the Creative Commons license system. Therefore, communities of designers act locally with production systems and within networks of skills and responsibilities contained into local territory, however connected to the global network to which other similar communities and third parties who act on a larger scale, such as large companies, up to entire nations, such as Iceland and the United States can access (Smith *et al.,* 2015).

The interesting aspect is precisely the ability to develop local nodes, locally active, which, however, are globally connected to determine innovation, transmit knowledge and implement shared solutions that are not redundant and are more effective/efficient. This operative mode, completely different but not in contrast with the strategies of globalisation (leading to the proliferation of macro-infrastructures requiring top-down control), offers the possibility of being adapted also to different areas, thus consisting in a possible solution to the dilemma produced by the human-machine coexistence, which is not only believable but also feasible.

Co-Living, possible?

Exploiting the idea of designing systems from its components (Jones, 2014) is certainly not new, but it does offer interesting hints in this specific case.

If we analyse the mechanisms determining the processes in the world of open digital manufacturing, we can say that local decisions, taken by a variety of actors with shared interests, are probably the most effective ones: although the largest system is complex and difficult to predict, its sub-units are less so. On the contrary, acting at an exclusively global level has harmful effects on the individual constituent units, as highlighted, for example, in the case of market globalisation (Christensen & Kowalczyk, 2017).

In order to increase cognitive ergonomics and affordability for the end user, each subsystem (component) must therefore have a self-sufficient life cycle, with explicit functions that make its purpose recognisable. A great advantage of this modular organisation is that improvements in the structure of a function can be integrated into the whole system without having to weaken or, worse, wiping out the value of any other part.

To be part of a larger system, these components must also be connected, which means that they must interface, communicate with each other with a shared communication code. This is obviously possible thanks to data transfer through the Internet, but above all thanks to the widespread development of Cloud Computing and Data Management services now available to anyone who needs to process information, either their own or from third parties. We must obviously take into account the fact that high connectivity leads to difficulties in centralised control and in predicting causes and effects, leading to the need to localise decisions as much as possible.

There is little chance of finding a single optimal solution for the entire width of the system; much of the information and current implementation takes place on a local scale, which requires a decentralised approach. While in simple and stable systems the homogeneity of inputs is favoured over a more problematic diversity, in complex social systems heterogeneity is incredibly more valuable, increasing both the range of current information and the solutions generated. The ability to configure sequences or arrays of functions to handle complex tasks in different and evolving scenarios, together with the feedback provided by monitoring the condition of the environment, gives users a much greater ability to engage.

A useful experimental example that can help verify this hypothesis is the *Robotics-as-a-Service Framework*, a cloud computing service model that allows you to seamlessly integrate robots and embedded devices in Web and cloud computing environments. As a service-oriented architecture for robotic applications, a RaaS unit has the environmental potential to decouple the production of economic value from the consumption of energy and resources. It includes feature execution services, a directory of discovery and publishing services, and service clients for direct user access. This platform allows to manage the components of robotics both as an increasingly granular integration of the control over automated tasks, and as part of a widely aware set that emerges from their connectivity (Mori, 2014). In this scenario, the Participatory Design for Service Robotics is an example of how integration between humans and machines is possible even in critical scenarios such as agricultural production.

The involvement of users, both human and non-human, is ultimately the decisive direction that leads to a new structure, potentially useful to solve the human-machine dichotomy: the active, conscious, self-determined involvement of people who act/interact with machines requires in fact that their own human nature, only partially configurable, however deeply unpredictable even when guided by logic, to be the engine of the relationship with AI; this can have the ability to calculate, predict, configure useful and complementary to human nature.

Faced with a social, environmental and political crisis that does not arise from human-technological crisis but that sinks its effects into it, finding itself in the separation of human action and social responsibility from the sphere of our direct involvement with the non-human environment, it is certainly necessary to reverse the trend and change priorities.

A designed system of product and service components follows the principle of purpose seeking. As Jones further explains in his article on systemic design principles, the principle of purpose provides a comprehensive view of problematic space. The diversity of solutions provided by a modular configuration of many functionalities, which the system provides in the form of services, guarantees a balance between fixed purposes and is what Jones calls creative framing.

Ultimately, therefore, we can formulate the idea that human beings and sentient machines can co-exist to the extent that we can provide them with a structure of complex relationships, in which each one of us has the opportunity to express its contribution to innovation through a network of output-input-output iterative connections between components, biological and digital, whose specific characteristics will help to generate the drive for innovation necessary for the evolution of organisms of whatever nature they are or will be.

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AUTOMI

ROBOT
tutto meccanica

ANDROIDE
tutto meccanica
+ rivestito di
pelle umana

REPLICANTI
organismo sintetico
costruito da
tessuti organici
artificiali ← insieme di organi risultanti di interventi genetici

CYBOR ← BIONICO
ibrido di
macchina e
organismo

ALIENO

artificializzazione
antropocentrismo

TORALDO DI FRANCIA

"Dobbiamo deciderci a riconoscere che è legge biologica — dunque naturale — che i topi siano topicentrici, i gatti gattocentrici, gli uomini antropocentrici. Guai se fosse diversamente, nessuna specie si sarebbe salvata dalla estinzione"

"dispregiatori del corpo"
Nietzsche

MINSKY

DE KERCKHOVE

MORAVEC

BIONICA scienza "che studia gli organismi viventi per costruire modelli teorici e pratiche che ne simulino le funzioni tipiche"
Langevin

RADAR

PIPISTRELLO

Referees list

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01 Tomás Maldonado, Notes on the theme of artificialization of the body. The quote by Giuliano Toraldo di Francia is used in *Cultura, democrazia, ambiente. Saggi sul mutamento*, Feltrinelli, Milano 1990, p. 86. Courtesy Archivio Maldonado, Milano.

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