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## DESIGN & TECHNOLOGICAL DEVELOPMENT

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# Personal Digital Trails: toward a Convenient Design of Products and Services Employing Digital Data

The developments of digital technologies (IoTs) and of systems based on Artificial Intelligence data interpretation, open new domains for the design of interactive and responsive products and environments. The spreading of technologies for automation in domestic and work environments, and the evolution of the access modalities to digital information and services, allow the collection of data concerning the behaviors of individuals and communities. The developments of AI and technologies such as those concerning speech recognition, natural language processing, and gestural interaction, reduce the cognitive efforts of the interaction with digital products, so encouraging their ubiquitous use [1], and increasing the continuous (conscious and unconscious) exchange of personal data with the internet. In the physical/digital world that we are building, we are constantly producing personal data that are collected and elaborated in the internet with several finalities. We produce data carrying a cell phone, driving a car, using most payment systems, exchanging digital messages, activating appliances, googling for information, accessing a care center for healing or performing several other activities. We argue that the correct management of personal data is a delicate and critical task, also requiring dedicated thinking, and the definition of convenient design principles about personal needs in terms of privacy, safety, security and freedom.

This paper reports some results of a research investigating the criticalities and potentialities of personal data in interaction design. The paper reports a mapping of the main issues currently related to the treatment of personal data in design, based on the critical analysis of some selected case studies of interactive products and services. The document also discusses the role of storytelling and of literary Science Fiction in the design oriented discussion of technology based scenarios, and on the anticipation of the consequences of design choices in the project of innovative solutions. The final goal is the definition of design principles and methodology suggestions, orienting the development of desirable solutions, with respect to the user needs of awareness and control of the destiny of personal information.

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**Abstract:** The developments of digital technologies (IoTs) and of systems based on Artificial Intelligence data interpretation, open new domains for the design of interactive and responsive products and environments. The spreading of technologies for automation in domestic and work environments, and the evolution of the access modalities to digital information and services, allow the collection of data concerning the behaviors of individuals and communities. The developments of AI and technologies such as those concerning speech recognition, natural language processing, and gestural interaction, reduce the cognitive efforts of the interaction with digital products, so encouraging their ubiquitous use (Pavlovic et al., 1997), and increasing the continuous (conscious and unconscious) exchange of personal data with the internet. In the physical/digital world that we are building, we are constantly producing personal data that are collected and elaborated in the internet with several finalities. We produce data carrying a cell phone, driving a car, using most payment systems, exchanging digital messages, activating appliances, googling for information, accessing a care center for healing or performing several other activities. We argue that the correct management of personal data is a delicate and critical task, also requiring dedicated thinking, and the definition of convenient design principles about personal needs in terms of privacy, safety, security and freedom.

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## Introduction

We live in an era where data are considered as “the new raw material” (Maude, 2012) to create and personalize services according to people’s information. Personal data are a side product of digital devices and information on the web; on the other hand, the collected data enable the creation of innovative services and systems, and of new modalities for interaction. Personal data are produced

using digital devices in daily activities, such as travelling, shopping, working, getting information, accessing news, and so on. These data provide valuable knowledge about social and individual behaviors, useful in fields such as health care and prevention, energy management, public transportation, good production, distribution planning. Data can be employed in product and service design, to personalize functionalities, or simply to make more fluid and meaningful the interactive experience of users. Technologies such as IoTs – Internet of Things, cloud computing and machine learning (Ruparelia, 2016 – Alpaydin, 2016), allow the creation of responsive environments, managing indoor and outdoor facilities and systems). Wearable devices measure and record personal biological parameters, enabling new awareness of self. In the whole, the ability to collect, store and manipulate data appears as an important and unprecedented progress of human knowledge, and as one of the key factors for the construction of sustainable and convenient future systems. Indeed, the development of digital solutions involving in some way personal data is fast and ubiquitous, with great impacts on social organizations and services. Given the dimensions and the importance of the changes induced by the digital revolution, we consider as mandatory the development of a critical thinking on the effects of digitalization of services and systems in the community of designers. The present paper reports some results produced in a wider research focused on personal digital data a matter of design. We are investigating the potentials of personal data as a new material for the creation of suitable and desirable products and services, and also the critical aspects of dealing with them. In this paper, we focus on utopic/dystopic scenarios that are connected to the use of digital technologies, and on the potential critical consequences connected to the collection and use of personal data. Authors such as Light and Watson (Light et al, 2005 – Watson, 2015), pointed out the importance of considering and suitably manage aspects such as privacy, safety and security in the design process of digital services and connected products. Furthermore, they indicated as a potential risk the effects of social engineering in connection with statistical elaboration of data, and with the personalization of services and information based on classification of individuals based on stereotyped references. In our research, we aim to provide a more articulated and detailed mapping of the inherent risks connected to the use of personal data in digital services and products. Our approach is mainly based on three different activities of collection and analysis based on:

- relevant case studies of commercial solutions available on the market;
- utopic/dystopic scenarios presented through past and recent storytelling (literature, science fiction movies and romances);
- real events, as presented on newspapers, demonstrating the critical consequences of a design not adequately managing personal data.

In this paper, we present a first map of critical issues (dystopias) connected to digitalization, mainly based on commercial case study analysis and on utopic/dystopic scenarios extracted by video and literature storytelling and releated possible design principles to enhance awareness in both designers and users on the use of personal information.

## Personal data as a matter of design

The progressive digitalization of information is producing the gathering of massive amounts of data. Part of them are about people, their activities and behaviors. Some are directly created and collected by devices and sensors, while other information can be extrapolated by data crossing and analysis.
In our research, we classified personal data into different categories, the main ones are listed below:

- **social data for personal identity - name,** age, sex, address, nationality, education degrees and other data identifying and describing individuals;

- **access/property data –** signatures, credit card, passport, driving license, professional identification cards, electronic keys, insurance, and other data connected to permits and belongings;
- **biodata** – voice, finger prints, facial and body features, hart bitrate, retina, …
- **behavioral data and personal preferences.**

Data tracking can be actively enabled by the users while voluntarily logging information into devices, platforms, and apps, but data can also be passively created by the use of devices and sensors performing automatic detection of presence, or collecting biodata. Smart objects can use personal information as a signature to identify the users, and to allow or deny task completion and accesses. As an instance, Apple's Touch ID, uses biodata as fingerprints while Samsung's Iris uses retina and facial recognition to log the owner into personal devices' services. Door lock systems can use biodata to allow or deny access to specific locations (e.g. ML10 Fingerprint Door Lock). Devices track biodata also to solve problems, identify glitches, or encourage habits, so allowing people to analyze tasks and receive useful feedbacks that can affect the execution of the activities themselves (Neff & Nafus, 2016). Calories counters (e.g. Nutrino) allow the user to manually log information about food consumption and fitness, so producing detailed description of user's dietary habits. Fitness sensors as Beast Sensor, automatically detect powerlifting performances, and track single activities so giving information to optimize them. Personal health monitors are also shifting from being reactive to being proactive. The constant monitoring of bio-parameters, giving insights and alerts, is narrowing the gap between rich and poor "blurring the line between home and clinic and how regulation affects the relationship between medical practice and self-care" (Neff & Nafus, 2016). Connected appliances can also use personal data to tailor services: the processing of data about personal information and user behaviors is employed for the setting of the environmental parameters. Voluntary data-sharing helps the research on cure of diseases; systems for the detection of presence support reduction of energy consumption. The solutions presently available demonstrate only a part of the creative potentials of new technologies, and we can expect further developments in the future. As an instance, we can consider the promising contribution of smart materials: reactive materials can change shape, colors, opacity according to user's data, making people aware of specific information using the object's surface as (Chen X & Oliveira, 2014). In most cases, the data collected by the connected objects we use are post-processed in the cloud by a remote server. Potentially, the cross-examination of data of an individual can produce a fairly accurate description of his/her physical and mental characteristics, and a capability to predict and influence behaviors. Continuous detection, monitoring and feedbacks about real-time information can perturb actions as well as relationships, rising issues about privacy, safety, security and freedom. The management of personal information should therefore be considered as an issue that designers should perform with adequate awareness about the possible consequences of their choices, also considering users' fears, hopes and threats. Services that involve users' personal information must be carefully designed in terms of data flows, information access, fast and effective control capability, adequate feedbacks and communication paths in order to respect the basic user rights. To this respect, we evaluate the effectiveness of a design process in terms of resilience: a new project should increase the resilience capability of the final users, i.e. improve the freedom and comfort of action together with the opportunity of choice, with and acceptable and conscious inconvenience. (Concerning personal data, the *resilience* is considered as the ability to provide benefits that exceed whatever discomfort the use of the information may cause (Polaine, Løvlie & Reason, 2013)).

## Storytelling as a tool for innovation

In the design of technology based solutions, the creation of scenarios and their representation through video storytelling is a consolidated practice. As an instance, we can consider the video "Knowledge navigator" produced by Apple that back in 1987, foreshadowing solutions that were made (partially) available only decades later. Scenario description through storytelling is an effective way to explain innovative solutions and to illustrate their advantages and criticalities. In the past, we investigated the use of video-scenarios in interaction design through design oriented *gedankenexperiments* (Spadafora et al., 2015). In our present research about personal data, we consider storytelling as an opportunity to investigate utopic and dystopic scenarios connected to the digitalization. Besides design oriented video-scenarios, we collect and analyze situations described in storytelling presented in videos and romances. We consider storytelling as one of the most important modalities to imagine, investigate, analyze, share and discuss future evolution of the world we live in. Storytelling has been the object of research in several different disciplines. Authors such as Propp, Vogler, Campbell, Eco, Pinardi and others, proposed a structural analysis of the forms of storytelling, and investigated its social role in terms of production and diffusion of memory and knowledge. A design oriented review of scientific literature about the topic of narration is part of our research, but is out of the specific goals of the present paper. We only point out here the relevancy of methodologies supporting the creation of narrative worlds (Wolf, 2012 – Vogler, 2007 – Campbell, 1949 – Crawford, 2013). These methodologies illustrate how it is possible to employ narration as an approach toward imagination and design creativity. In the narration process, the design/storyteller ask him/herself: "What if…?" and explore evolutions and consequences of ideas and proposals. In the different genres of storytelling, we recognize the interest of science fiction, both in movies and romances. In Sci-fi, we can find the description of imaginary yet convincing possible future scenarios, while the narration plot, requiring dramatization and dynamic evolution of events, provides examples of critical consequences of events and contexts. The Sci-fi production is quite vast and articulated; complete investigation of the scenarios that it proposes is a complex task. As stated by L. Guerrini, "As a result, these products, usually classified as entertainment products, and therefore apparently simply-structured, show their highly professional contents as well as an extraordinary cultural complexity, which often encourage the appearing of new languages and social behaviors" (Guerrini, 2014). In our research, we adopted a method based on the processing of data provided by Internet Movie Database (IMDb), an online database of information related to films, television programs and video games that includes social networks mechanisms such as rating, and keyword tagging by users. With this approach we are able to 'borrow' users' sentiments as well as their association on utopian and dystopian elements, and technological threats about a single movie. Aiming to mapping the findings and relate them to the issues about current technologies, we considered Jaron Lanier's as a winning approach on the envisioning of future trends. His 'Humors of Futurism' are a categorization and summarizing of very long term trends on the future of technological politics (Lanier, 2014). We summarized information extracted from the scraping of IMDb data into eight main 'dystopias' relating them with current products, service, and system approaches and emerging social issues about the use of personal information in technological trends.

## Mapping the issues

We classify dystopias into three main categories: on self-reflection and self-perception; on machine choice and machine control; on alternative space and alternative identity. Their description includes

issues related to future technological progresses, and references to some currently available products and services.

*On self-reflection/self-perception*

**Perfect Humanity.** Technology can be seen as a mean to create a 'Perfect Humanity' through the capture and analysis of information related either to the biological characteristics of single individuals (such as genetic and biodata) or to subjective behaviors, so to identify patterns or anomalies. This aim requires data crossing to compare the data of single persons with those of other people, so to discover problems and enact actions to correct anomalies. While the utopian purpose is the improvement of life, the dystopian point of view reveals risks of discrimination: the same phenomena that we can see in communities discriminating people with visible anomalies or behaviors that deviate from the standard. The unceasing pursuit of a perfect humanity leads to exclusion, lack of freedom and to the inability of a person to hide intimate information in the contexts they live. An example of this situation can be found in the currently available applications for the tracking of eating habits. These services rely on self-tracking information uploaded by the users as food logs, and on the possibility to employ fitness devices, as wristbands, to track biodata in real time (such as hart bitrate, sweating, GPS information, and so on). These services detect our personal bio-information and make comparisons with the average data of all the users, proposing 'right goals' to pursue. Despite the potentials of these solutions to encourage convenient lifestyles, some questions arise while they are launched on the market. Who can see and use the information? How long these data will be stored and conserved? Which are the rules about privacy and private property of data? How can we guarantee the suitability of data taken as a reference? How can we guarantee that personal information will not be used against the general interests of the user?

**Pervasive Awareness.** Technologies can track our activities helping us to identify our bad or good behaviors and performances. We can track the activities by ourselves (Lupi & Posavec, 2016) or let biosensors and IoTs do this work on our behalf. The automated self-tracking can improve our efficiency and lead to behavior change, helping us to make right choices, but it can also harm the quality of our life perturbing our self-perception and the perception of other people. The creation of 'over-awareness' can lead to even higher expectation about ourselves or indicate defects, making us worry about new (and maybe useless) problems. As an example, we can consider applications for the monitoring of productivity: some can detect the number of hours user spent by the users working on the computer, categorizing them in a productivity range. But is the 'working hours' ratio useful to the user or this can lead to a distorted perception on individual productivity?

**Mnemonic.** Human brains don't have enough room to store all the facts we perceive. Brains select and store only main useful information (Kahneman, 2012). The idea of 'Mnemonic' is the dream to access information, anytime and everywhere, and to remember and keep the information thanks to the capacity of digital data storage. But the collection and storage of information in the Internet, in the objects and in the ambient leads to an annulment of the solace of oblivion due to the ubiquitous memory access. Should we always consider as a progress the fact that humans will no longer be able to forget? The content uploaded in the Internet, stays on the Internet, and we build permanent records about what we post online. We can see the risks of this approach when a sex tape of a person is uploaded online. The video will stay there, no matter what the involved person tries to do, it will remain forever online and this can ruin lives. We can easily find examples of people (specially women) that committed suicide (BBC, 2016 – Nigam, 2013) for cyberbullying.

*On machine choice/control*

**Super Monitor.** Ubiquitous and pervasive computing, geo-located information and connected cameras allow systems to massive surveil and 'sousveil' (Mann et al., 2002) people and their activities, so to increase security and safety, but also to predict events. Systems can monitor our position and video-record our movements; they can also interpret our actions, trying to detect bad intentions. These data can be used for tailored services and marketing, but from the dystopian point of view, massive control created by technologies reinforce hierarchies, erode privacy, widen inequalities of power and wealth [Lanier] due to the concentration of knowledge by specific individuals, organizations or companies. Should an home appliance understand what we are doing in our private moments to maintain us safe? (McLaughlin, 2017 - Miller, 2017). It can happen that a teenager usually goes to Target for daily shopping; one day her family receive a mail with discount and offers for pregnant girls. This is because the marketing approach of the company involve the understanding of the customers' private habit, and the recent changes in shopping habits suggest that she is pregnant (Acquisti, 2013).

**Automation Box.** On the opposite 'Pervasive awareness', the 'Automation Oblivion' represents the situation in which automatic systems and AI make humans be less worried about tasks, performances and actions, that are instead automatically performed by machines. The complete automation of activities leads not only to a lack of 'human touch' in performances, but also to machine decisions that can remain obscure to human minds. In extreme automation, users depend on software an must adapt. As an instance, we can consider automatic driving systems. Who is responsible for mistakes in automatic car driving? One of the most relevant issues at the moment is the mechanisms behind choices of AI, machine learning and neural networks. Even the programmers that built the algorithms don't have control on them and don't know how are they making choices (Knight, 2017). Artificial intelligences can make their own choices pursuing the goals they are built for, but what if to achieve these goals they have to make choices that run against us? Is easy to think that A.I. will sooner or later run out of human control because we will not understand their 'thinking' (Gibbs, 2014).

**Human Behavior Computer.** AI, machine learning, genetics, ubiquitous and pervasive computing, and robotics and Micro/Nano Robotics aim to optimize tasks and automate actions learning from humans how to face problems, and to perform actions in order to lighten humans' loads. 'Bad Humanity Bad Computer' is the dystopia in which machine behaviors reflect the worst aspects of human nature. People begin blame the technology for the changes in lifestyle but also believe that technology is an omnipotence. It points to a technological determinist perspective in terms of reification. Machine learning is based on the analysis of human behaviors and ways of thinking. In literature, the technologies learn from bad humans' behaviors, enhancing the potentiality of bad influences; they also can try to destroy us interpreting our approaches as a threat to our own survival or to the survival of others. In the real world, we can find examples of modern bad practices thinking to the cases in which blackmailers goods from retailers, menacing to publish bad reviews on their business. What if AI machines will learn from bad human behaviors?

*On alternative space/identity*

**Stargate.** Pervasive connection delete distances and the need of physical presence. We can do activities remotely thanks to ubiquitous presence of connected devices. We no longer need to be 'there' and 'then'. But the contraction of space and time can harm our interpersonal communication, relationships, and communities in two ways: degradation of communication within social groups due to the increase of time spent using technologies; misleadingly interpretation of real contexts and

spaces due to heightens of virtual space immersion (Lanier, 2014). Humans can experience lack of participation in 'real life' actions as well as a disconnection from reality leading to the perception merging of real and unreal. Technologies change the way we find friends, love and create networks. People decide to meet after chatting on dating apps; this is an opportunity to creates a bridge between people, a portal through the space. Similarly, we can control home appliance remotely using phone, and check the pets through a camera (Willman, 2017).

**Avatar.** The creation of alternative worlds using virtual, augmented and mixed realities allow humans not only to be in a different place but also to be a different person. With an alternative identity, people can be free to be somebody different to who they are in the real world. They can enhance their experience and elicit emotions in these worlds through sensors' (e.g. facial expression detection and voice recording and recognition), escaping reality. Technologies can also enable enhanced experience into the real world using robotics and Nano technologies to compensate human disabilities. So, the 'Avatar' leads to multiplication and confusion between identities allowing the creation of different digital identities, so splitting. People can date after chatting on dating apps, and even their avatar can date on virtual environment as Second Life or Ultima Online; we can talk with chat-bots that are hard to distinguish from real people. Recently an AI created a fake video of a speech by the ex-President of U.S.A Barack Obama that looks real (Vincent, 2014). Will we, humans, be able to distinguish real contents from the fakes? (Markoff & Mozur, 2015).

## Conclusion

Considering the analysis of artefacts that employ storytelling as a tool to investigate the social vision about the future of technologies, we investigated hopes and fears, utopias and dystopias, related to the use of personal information in digital systems. We are considering the 'feedback' as a key element for meaningful communication between the user and the system, and aim to discuss design principles on the use of personal data identified below.

- Transparency: Give clear information about the collection, use and management of personal information; some aspect of data management (e.g. limits and possibilities we are giving to AI and machine learning practices) must be discussed at regulatory and policy levels (Gibbs, 2014).
- Privacy: Allow the user to keep some information private, even if renouncing some feature due to the impossibility to use the data.
- Hierarchy: Make sure that the communication (e.g. alert at the overcoming of a threshold) to be proportionate to the severity and the source of the reference. The users' average must be communicated differently from a critical threshold.
- Value: Provide a level of insight added to/instead of merely showing the results of data analysis.
- Meaning: Give awareness to the user about the mnemonic aspect of active sharing content on the Internet and the real meaning of the action.
- Presence: Evaluate the tactility of the information used in virtual spaces and times to be aware of the level of "physical presence" related to them and provide awareness about the digital-self while the user is creating alternative identities due to the use of personal information.

  As designers of interactive solutions, we aim to develop a specific awareness of the main critical issues of digitalization and conscientiously make choices in the design process. We take science fiction not to discuss the future or to predict it, but to discuss the present, "the virtual reality of the present that dominant ways of thinking prevent us from seeing" (Shapiro, 2016).

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