Internet of Things

Alessandro Soro · Margot Brereton
Paul Roe *Editors*

Social Internet of Things

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Preface

The Internet of Things is here to stay. Looking backwards, it is hard to retrace the steps that led to its creation, as it embodies ideas that have been simmering for decades. The name 'Internet of Things' is generally credited to Ashton [1], and his original idea of an intelligent supply chain in which 'things' can identify themselves and communicate using networking protocols.

For example, in this vision, a yogurt pot is capable of sensing its environment and monitor its location, from when it leaves the dairy, into the delivery truck, down to the shelf of the supermarket, into our shopping bag, fridge, bin and ultimately all the way to the waste facilities. During its journey, the yogurt pot would speak to intelligent devices to check that the chain of cold wasn't broken, the product is not past expiry date, the empty jar is going to the proper recycling bin and so on.

This initial scenario is but a fraction of the current, broader vision. Today's IoT takes inspiration and borrows concepts from a variety of research initiatives, including ubiquitous computing, ambient intelligence, tangible user interfaces, mobile and ad-hoc sensor networks, wearable computing, while maintaining some important differences with each of these. One key aspect that sets the current scenario apart from the fields above is the attention that the IoT is focusing, both from industry and the general public: previous waves of research on pervasive and ubiquitous computing never seemed to particularly capture the imagination of industry and everyday users, and the Ubicomp vision always remained somehow trapped into a perpetual 'proximate future' [2], promising but never quite ripe yet.

When looking forward to the market estimates about the IoT, however, the figures dance considerably depending on who makes the forecast, but everyone seems to agree that they will be in excess of the hundreds of billions of dollars per year. The first movers among big industries are attracted by the promise of traceability, reduced waste, improved safety, and real-time monitoring and optimisation [3], and these applications are driving 10-digit investments by big actors in, e.g. health care, food supply chain, mining and logistics. Although key actors are still to emerge, the enabling technology is still evolving and services and protocols are still

fragmented, industry has invested so much that it will deliver an IoT: there is an overall sense of having passed the point of no return.

Under this broad umbrella, the IoT is expanding from the initial vision (today sometimes referred to as *Industrial Internet of Things*, IIoT) to explore the opportunities of interconnecting things of all sorts, making them capable of reasoning about the data they collect and talking to other things. Almost everything, be it a kettle, a fire hydrant, or a motorbike, can be enhanced with sensors, computing and connectivity. Perhaps, it is the tangibility of things, as they are moved around, manufactured, sold, used every day and the possibility of their connection and tracking that makes them irresistible. It is, in fact, when looking closer to the everyday users, at the mundane applications, that the IoT can potentially have the bigger impact, for better or worse. Scattered across the home, embedded in people's cars, even worn as clothes or ornaments, IoT devices can empower or become the instrument of surveillance, engage or deskill, help us to socialise or isolate us even further into our own technological bubble, depending on what standpoint we take in design [4].

Crucially, the Internet of Things we want is not likely to emerge from a technology-driven vision alone. For example, if devices are getting smarter, they don't seem to be getting much wiser. Our appliances, cars, homes and clothes, are becoming more and more nosey and chatty. Internet-connected things, including cars, smart thermostats and door locks, can (and have been) hacked to hand over control to remote attackers. If these issues can be identified and fixed, some 'features' of smart things are even more alarming. From speech activated interfaces responding to TV commercials to robot vacuum cleaners reselling the plan and arrangement of the furniture in our homes, it is becoming progressively clear that a lot of the questions that matter to end users are not central in the current IoT research and development agenda.

Open questions in this sphere move from the details of people's everyday interaction with this novel architecture, to include privacy issues, ethical values and cultural issues. For example [5], how will users control what is communicated? How will they interact with things, and how will things attract their attention? How will people make sense of the things and data? How will people communicate through things?

And delving deeper into the thorny issues, what are the implications of things participating in people's social life? How are privacy and personal boundaries understood and negotiated when things (or through things, service providers) get to know so much about us? What values are implicitly embedded in IoT design, and how do these constitute people's relation with things and with each other? What is lost by delegating agency to smart objects, and what is gained? Finally, what is the value proposition of the IoT to end user? Will people buy (and love) smarter juice squeezers, dog leashes, walking canes, surfboards or is this field still in search of its true soul?

These questions were a starting point for this book, developed through a series of workshops with design researchers and practitioners [6]. Whereas the Internet of Things is often described as a global networking infrastructure [3] (i.e. a special

kind of *Internet*) or a decentralised system of smart objects [7] (i.e. a special kind of *things*), we were determined, like a modern Diogenes, to find the people. We call this vision 'the Social Internet of Things', and throughout the ten chapters of this book we set out to explore some of the ramifications of this new computing paradigm.

The first three chapters articulate different visions for the social IoT, with particular attention to how the vision can be situated, respectively, within culture, place and practices.

In Chapter "Beautifying IoT: The Internet of Things as a Cultural Agenda", Jeffrey Bardzell, Shaowen Bardzell and Cyn Liu discuss the aesthetics of IoT products, and how these reflect and embody specific cultural sensibilities with implications that reach beyond technology issues and approaches. Moving from philosophy of art and beauty, the authors develop the concept of 'Beautifying IoT', i.e. object whose aesthetics is a key element of their experience, and that are conducive to a 'fuller, freer, and more meaningful way of being'. These aspects, which are almost absent from much of the discourse on IoT (both in Industry and Academia), are illustrated in two case studies from the authors' ethnographic work in Taiwan. Both cases involve renovation and repurposing in search of a higher sense of beauty: of people's whole lifestyle in the first case study (former city dwellers and professionals turned to farming and living off the land); and of an industrial material and family-owned business (a zinc alloy production plant turned into designer product manufacturing) in the second. The chapter is a call to action for design researchers in HCI to 'attend […] to aesthetic qualities of emerging technologies', and to do so at much larger scale than that of the traditional interface, app or artefact, as the reach of the IoT infrastructure is global.

Jack Carroll's 'Internet of Places' vision, detailed in Chapter "The Internet of Places", aims to capture 'new kinds of experiences and relationships between people and environments' that cannot be fully understood within the techno-centric framework that is typical of the Internet of Things discourse, and that, he notes, requires a further layer of analysis (the 'Social' IoT) above the issues of 'data and data handling'. In this view, place is a perfect case study in that its meaning is 'constructed through interaction and experience', as opposite to the data describing a location, that can be fully characterised and captured using existing techniques and sensors. Carroll explores this meaning at personal, family and community scale: new data and services infrastructures can enable 'richer interactions and experiences', but will surely entail socio-technical trade-offs. For example, configuring and managing security may undermine the vivid agency and partnership of one's places, compromising the social IoT. These reflections extend to all relations involving people and places, from family to neighbourhood, investing these relations of new meaning, that under the social IoT agenda scholars are only beginning to explore.

In Chapter "From the Internet of Things to an Internet of Practices", Thomas Ludwig, Peter Tolmie and Volkmar Pipek extend the reflection on IoT technologies to encompass the ways technologies are situated in *practice*. In the chapter, the authors set off to explore the process of collaborative appropriation, as it can be

supported by the smart interconnected devices that form the Internet of Things. IoT devices and their sensors have often been aimed at the environment (to harvest contextual information) or at their users (to collect behaviour patterns). Ludwig, Tolmie and Pipek, rather tune them to the situated action of professional practice, and imagine an IoT where *things* were capable to sense, share and mediate the nuances of their use in *practice.* Designing a tool, a photo camera in the example offered, as a *sociable technology*, means enabling that tool to sense and share detailed information on use, technical and socio-material context, and even the intention of the photographer (process context), in ways that can be communicated and appropriated by other photographers. The 'Internet of Practice' vision then raises the stakes from a current technological focus, towards the more intricate, nuanced and somewhat ephemeral realm of making sense of sharing, supporting and appropriating expert practice.

The next three chapters address aspects of the interaction design of the social IoT.

Nikolas Martelaro and Wendy Ju explore in Chapter "The Needfinding Machine" how designers may interact with users *through* prototypes to better bring to focus users' needs. A needfinding machine is a connected device that embeds a 'conversational infrastructure' through which designers can observe, communicate and interact with users, as well as remotely control the machine, monitor its status and document the interaction. As a design method, needfinding machines draw upon a vast diversity of related methods, from classic in-the-lab approaches like wizard of Oz to purely in-the-wild ethnographically inspired, passing through methods that enlist *things* as co-ethnographers, opening up unusual perspectives to designers. Applied to the context of the social IoT, needfinding machines additionally help us to focus on issues of privacy and reciprocity, and to do so from the sometimes uncomfortable designers' perspective, in their role of performing the machine. Schön's classic description of design as a reflective conversation with a situation is here then taken one step further by likening the user–designer conversation to improvisational theatre, in which 'unplanned opportunities' may arise at any time, to 'understand experience right as it happens'. These remarks may well describe any social interaction, which stresses once more the social nature of the IoT design space.

Donald Degraen in Chapter "Exploring Interaction Design for the Social Internet of Things" delves deeper into the interaction challenges that users will face in understanding and controlling smart objects. Networks of things that socialise can have countless benign outcomes but also pose challenges. Smart objects need to become trustworthy and able to autonomously socialise. Open questions that had been lingering for a while regarding the intelligibility and control of autonomous, context-aware systems are soon to become more pressing as IoT systems appear on the shelves of the retail market. Will users be aware of what is happening behind the scenes? Will they be able to understand and review the data that is being gathered, and the way it is processed? Will users be able to make sense of the role of each *thing* within the bigger infrastructure? And on what basis shall users trust the information that they receive through their things, or entrust those things with their own personal information? Degraen's characterisations of this design space address

these questions by unpacking the problem in terms of intelligibility and control on one side, and modelling the behaviour of social IoT objects giving them predictable personalities, on the other.

Maliheh Ghajargar, Mikael Wiberg and Erik Stolterman address how smarter objects and places will influence peoples' reflective thinking. On the one hand, the authors note, peoples' thinking is largely reliant on their interactions with objects and things. On the other hand, things are more and more 'computational, smart, networked and interconnected'. In this vision, our very thinking becomes part of a larger interconnected system, reflection is always socially and spatially situated, and the social IoT is better understood as a relational approach to the design of '*Places for Reflection*'. The relations to focus on are unpacked in the chapter, taking the 'place' as a cornerstone to which the reciprocal dependencies of objects, people and activities are anchored. So the presence of certain smart objects in a space will characterise that as a place for the kind of reflective thinking that is enabled by those objects, the performance of specific activities involving those objects will give meaning to the built environment; and people will inhabit these places creating there their own culture. But if the whole may escape our awareness, the specific relations that bind together places, objects, people and activities offer a suitable unit of analysis to make sense of the social IoT design space.

The following four chapters explore applications of the social IoT at different scales, from the home, to the workplace, the care centre and the community.

Using a toolkit of their own design, Arne Berger, Andreas Bischof, Sören Totzauer, Michael Storz, Kevin Lefeuvre and Albrecht Kurze explored use scenarios of IoT in the social context, the social implications of IoT data and how to engage people in participatory explorations of IoT applications; their reflections are the subject of Chapter "Sensing Home: Participatory Exploration of Smart Sensors in the Home". IoT devices and sensors can be deployed in many different situations to harvest environmental data in the home, enabling people to freely explore the possibilities of the technology and make sense of its limitations; or they can be used to support teaching in the wild, which offers insights into how the IoT can be appropriated into real practices, and on the complexity of contextualising the information gathered; or finally they can be tuned and positioned in ways that reveal unexpected traces of everyday life, raising interesting implications on the ethics of surveillance in private spaces by family members that are seldom explored in current research, and overall showing how open IoT toolkits can be used to explore and generate many different research and design directions.

Markus Rittenbruch and Jared Donovan bring the exploration into the workplace in Chapter "Direct End-User Interaction with and Through IoT Devices" in a quest to understand the growing tensions between increasing automation on one side and the availability of inexpensive and programmable tangible interfaces on the other. Their study shows that when personal devices are used to negotiate collective boundaries people will resort to varied and sometimes hard to reconcile strategies, also depending on subjective perceptions of comfort with the current situation, of alignment with the general preference, and on the feeling of agency, reciprocity and respect (or lack thereof). Rittenbruch and Donovan described how the design can

de-emphasise some aspects (and reasons for tension) in favour of others, but also how the physical level (of temperature, settings and sensors) and the social level (of negotiation of preferences, respect for boundaries and feelings of comfort) will always interact in situated and subjective ways.

Chapter "Engaging Children with Neurodevelopmental Disorder Through Multisensory Interactive Experiences in a Smart Space" by Franca Garzotto, Mirko Gelsomini, Mattia Gianotti and Fabiano Riccardi explores applications of the IoT to create a platform capable of supporting multimodal multisensory activities that promote motor coordination, attention and social interaction, for children with neurodevelopmental disorder. Here, the IoT has the potential to greatly improve the quality of life of children and their families, as well as supporting the daily work of therapists. The challenge, however, for a technological vision that is aiming at mass production and mainstream adoption, is to adapt to the individual needs and pace of each young user. For this to happen, end-user development paradigms should join forces with IoT initiatives, so that therapists, families and patients can design personalised, unique interventions that match the therapists' educational goals and the children's needs.

Can Liu, Mara Balestrini and Giovanna Nunes Vilaza finally present their reflections on the opportunities for social engagement with IoT, related to places and communities. When design is aimed to foster positive change, communities are a natural partner to seek, and HCI is effectively riding this wave of research. The roles for IoT technologies in this space are rich and varied, as the authors discuss in Chapter "From Social to Civic: Public Engagement with IoT in Places and Communities", from acting as a social catalyst to fostering awareness on social issues, from facilitating participation to collecting and spreading shared knowledge, up to an ultimate goal of empowering citizens by supporting the gathering of data, articulation of goals and advocacy of community efforts. There are, however, many challenges to address to make IoT in public places a sustainable and scalable tool for civic action, as the authors summarise in their 'lessons learned'. The trade-offs between opportunities and costs are complex and difficult to navigate. Key aspects capable of sustaining engagement, such as providing hyperlocal contents and fostering collective ownership, mean that no one-size-fits-most solution exists, and rather interventions that work tend to be highly specific, participatory and embody shared knowledge and memories.

Together, these contributions shed new light on the numerous implications of designing Internet of Things devices, tools, platforms and applications. The social IoT encompasses all aspects of the IoT scenarios that escape a straightforward technical analysis. One way to appreciate the sociality of networked technologies such as the IoT is to resort to social networks theories to model their architectures and approach their study [8]. This, however, can only offer a partial explanation, as it does not consider the situatedness, in culture, in place and in society, of those technologies, nor can it capture the ways in which technologies, practices and even moral and ethical values are mutually constituted and continuously renegotiated. From the intimacy of the home to the public space and workplace, issues of agency,

engagement, reciprocity, privacy, respect and dignity will always emerge as novel technologies are embodied in social interaction.

This book is an attempt to reposition the debate around IoT technologies within a more complex account of its social, political and creative, as well as technical roots, in the hope to spark a more nuanced conversation, and ultimately, contribute to the design and creation of the Internet of Things people *really* want.

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Part I
Social IoT Vision

Beautifying IoT: The Internet of Things as a Cultural Agenda

Jeffrey Bardzell, Shaowen Bardzell and Szu-Yu (Cyn) Liu

Abstract As an IT research agenda, the Internet of Things is often framed according to technical and economic issues, such as protocols, standards, job-creation potential, etc. We argue that IoT also constitutes a cultural and aesthetic vision, that is, a projected image of urban- or region-scale beauty, in which lives are pursued in more meaningful and fulfilling ways than before. In HCI and related disciplines, aesthetics—when not outright dismissed as too subjective and/or confusing to engage—is commonly investigated as individual judgments about individual interfaces. This is a problem, because we know that technologies can produce ugly and unlivable environments at scale—from nuclear disaster sites to urban desolation caused in large part by the automobile. Aesthetic IoT is not a matter of making device surfaces more pretty, but of thinking deeply about the ways it will shape how we live; after all, urban desolation didn't happen because roads weren't painted attractively, but because roads disrupted communities and their established ways of life. This chapter demonstrates that aesthetic theory provides concepts sufficient to engage matters of IoT aesthetics in precise and pragmatic ways. It does so by analyzing a policy intended to beautify a major city in Asia alongside aesthetic interpretations of two design initiatives contemporaneous with it: an agricultural IoT project that proposes a computationally enabled new intimacy between humans and their land, and a kitchen design company that innovates not only on manufacturing materials but also on the aesthetic conventions needed for consumers to recognize those material properties as beautiful.

1 Introduction

The Internet of Things (IoT) refers to a vest network of interconnected objects in our everyday environments [1]. It has received enormous interest and investments aiming to envision a new form of service ecology supported by streaming data through

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interconnected devices to provide meaningful actions in the context. Topics of IoT research and public policy discourses often focus on technical and economical aspects such as infrastructure, protocol, security, privacy, or its potential to create jobs and boost company profits [2]. HCI and CSCW researchers such as [3–5] have broadened this research agenda to encompass the socio-technical experiences that IoT devices bring about by studying the social arrangements of people and technology in everyday life. This literature shows how IoT innovation can go beyond tools to mediators of human social relationships.

Höök [6] takes this argument a step further, when she points to Sweden's traditions of participatory design and technology democratization to argue that the nation is distinctively fit to position itself as an IoT nation and a global innovation hub. On such a view, IoT is not only a product of technology but also a *cultural* product, that is, both a reflection of and a perpetuation of given culture. This view calls attention to issues that technocentric approaches to IoT—as vital as they are—tend not to. How well IoT fits with a given culture likely will deeply shape experiences, with implications for adoption, acceptance, and productivity.

In this paper, we began to pursue this question when we saw that participants in our ongoing multi-sited ethnography in Taiwan were likewise inquiring about it in earnest. Although many of them are engineers, themselves fascinated with the technical possibilities of IoT, they also equally asked what IoT could or should mean in Taiwan—not unlike Höök's ruminations on a Swedish IoT. These engineers wondered how IoT can contribute to and benefit from Taiwan's ongoing efforts to cultivate creativity, including the related question of how to establish innovation hubs [7]. This is in turn led to questions of Taiwanese ways of life, that is, a Taiwanese lifestyle, which reflects cultural tastes and values. Along these lines, we have seen a collective agenda—reflected in policy, social media discussions, public design events, and so forth—to "beautify Taiwan." This agenda includes but is not limited to IT development, extending to issues of environment sustainability, green energy, urban aesthetics, and the formation of a Taiwanese consciousness.

As we witnessed the overlapping discussions between beautifying Taiwan and the development of an IoT imaginary for Taiwan, we began to wonder: *what might it mean to beautify IoT?* To make this question more tractable, we scoped it to Taiwan: *what might it mean to beautify IoT in Taiwan?* We stress that this is a speculative question, not an empirical one. We are not asking, "what did beautifying IoT mean in Taiwan?", because beautifying IoT in Taiwan remains more an aspiration than a reality that can be investigated empirically. Accordingly, our methodology is suited to a speculative investigation, rather than an empirical one. We appropriate a methodology from serious science fiction: we use *cognitive speculation* [8] to constructively and experimentally imagine futures that are *plausible* (because they are based on the best available empirical knowledge) and *preferable* (because they more completely embody our values than the mundane present).

Specifically, we use our empirical knowledge from Taiwan as a launching point for our own speculative investigations of what beautifying IoT could mean if developed as a research and design agenda. Here we rely on a distinction we made in [8] between a technology agenda and a vision agenda. A technology agenda is primarily about the

research and development needed to pursue a technology agenda (e.g., improving computational sensing to improve computers' contextual awareness, in pursuit of the ubicomp agenda). A vision agenda is an image of how that technology agenda will play out when situated within society; it is a vision of everyday life when such technological capabilities are widespread, available, and mundane. Beautifying IoT is a vision agenda, in that it seeks to envision a future where IoT is mundane, yet also beautiful or beautifying.

Our contribution to design research is to contribute towards the construction of IoT agendas that take seriously, even centrally, the significance of aesthetic beauty in everyday life. A secondary contribution is to make our speculative methodology explicit, in hopes of supporting other design researchers interested in contributing speculative images that intervene upon and enrich IT agendas.

2 Methodology: Speculatively Contributing to IT Research Agendas

Our methodology can be summarized as follows. From our multi-sited ethnography of creativity and innovation in Taiwan, we identified an agenda of interest to stakeholders in Taiwan, that of beautifying Taiwan, in which beautifying IoT is a subordinate goal. We summarize the relevant discourses to demonstrate both that this aspiration is in the discourse and also that it is under-specified. From this point, we take a speculative turn. Obviously, we cannot answer for Taiwan what beautifying IoT could or should be for the Taiwanese. Instead, we treat this question as a prompt for our own imaginations, for us to envision an answer to take back to the HCI and design research community. We move forward by doing design criticism of two design initiatives in Taiwan that are contemporaneous with the policy agenda, and we turn to philosophical aesthetics to work from rich and generative theories of what "beautifying" might mean.

We have been conducting ethnographic studies on IT innovation and creative industries in Taiwan since 2011, focusing in particular on cultural and creative industry policy implementation [9], urban experimentation [7, 10], making and bottom-up innovation, and everyday aesthetics and traditional craft among others [11]. The present work draws from and is informed by our fieldwork on cultural creativity and making in Taiwan, involving hundreds of ours of participant engagements across different physical sites. We also conducted digital ethnography [12–17] of our informants' use of Facebook groups. While this paper does not primarily report on findings from these ethnographic engagements, it is through them that we became aware of relevant policy discourses, innovation initiatives, and design examples, which we discuss in more detail below. The ethnographic research gives us confidence that the topics and resources that we are drawing on are important to innovation stakeholders in Taiwan—policymakers, entrepreneurs, inventors, makers, educators, manufacturers, etc.

2.1 Policy and Beauty in Taiwan

Taiwan is well-known for its information technology and precision manufacturing. It is home to a host of high-tech companies including Asus, Acer, Foxconn, and HTC. It also has a long history in offering original equipment manufacturing (OEM) services to global IT innovators, such as Apple. IT and precision engineering are often foregrounded in policies because they drive the economic growth in Taiwan. In September 2016, the National Development Council of the Executive Yuan inaugurated "Asian Silicon Valley Development Plan", aiming to upgrade Taiwan's IT industry and innovation ecosystem to support entrepreneurship and the development of IoT [18]. The development plan is part of the government's five-plus-two pillar industries initiatives, along with intelligent machinery, green energy, biomedicine, national defense, high-value agriculture, and circular economy [19]. In spite of its name, the policy goal is not to clone Silicon Valley in Taiwan, but to use it as a hallmark for promoting this island as Asia's technological innovation hub. The plan will run from 2016 to 2023 with an initial budget of US$359 million for 2017. Official measurements of the plan focus on aspects of economic growth and industrial reform, such as "increase Taiwan's IoT global market share from 3.8% in 2015 to 5% in 2025", and "grow 100 successful companies" [18].

Part of this policy agenda and others like it in Taiwan is to build on Taiwan's cultural strengths, not just its technical ones. This includes constructing images of Taiwan's future out of its cultural past, arguing that its democratic values foster creativity better than alternatives, and that technology and culture are co-implicated [9, 10]. Thus, while the economic message is that Taiwan wants to transition from a service provider (i.e., manufacturing for others) to an innovation pioneer, this work will reflect and perpetuate the cultural identity of Taiwan. Although many have criticized the policy and its implementation, policy analysis is out of the scope of the present work. We are interested instead in the ways that the policy exemplifies the country's aspiration to leverage distinctive cultural knowledge and local infrastructure to foster the development of technology and innovation.

Indeed, cultural concepts have been foregrounded in recent Taiwan policy. We did not ourselves come up with the notion of "beautifying Taiwan"; in fact, the language of beauty is often highlighted in Taiwanese public policy. One example is the "Taipei Beautiful" (台北好好看) urban renewal policy issued in 2009, aiming to make the city "charming" in preparation to the 2010 Taipei International Flora Exposition. This policy offered guidelines and subsidies for renovating obsolescent buildings, creating green parks, and reviving idle spaces in order to "revitalize the [city's] shabby appearance" and transform Taipei into a "beautiful international city" [20, 21]. In this discourse, terms like "revive," "renovate," and "shabby" all suggest similar ideas—a city in a state of architectural decay needing to clean itself up and give it a new life. Green spaces will be used to punctuate blocks of these renovated buildings, the overall effect of which will be "charming."

Related development policies include "Shaping a Charming Taipei" and "Representing Taipei Elegance", in which vocabularies such as beautiful, attractive,

livable, visionary, creative, comfortable, humanized, and local characteristics were used in white papers to communicate a public imagination of urban style [22, 23]. As before, we recognize that the policy has been criticized [e.g., 21, 24, 25], but our purpose is to show that the policy wants to pursue a notion of "beautifying Taiwan." One might refer to such aesthetics as aspirational because it builds on a particular culture's traditions to propose a desirable future [10, 26–28].

2.2 Design Criticism

As important as verbal discourses, such as policy documents and press releases, are, IT research agendas are also manifest through non-verbal discourses, such as design initiatives, technological infrastructures, and so forth. For this project, we collected a number of design projects that exemplified some aspect of beautifying IoT. In this chapter, we present two of them: an IoT project often characterized as contributing towards aesthetic experiences, and a collection of kitchen products that exemplify how designers transform material properties into aesthetic properties. The second example does not involve computation at all; we chose it not as an example of emerging IoT, but instead because it exemplifies how products beautify environments. Our contention is that eventually exemplars such as these can be and will be blended, so that IoT products feature sophisticated material aesthetics, and everyday products such as kitchen accessories participate in computational environments.

We interpreted these using design criticism, a practice we have been engaging in for years, reflecting our own backgrounds in the humanities as well as current research in philosophical aesthetics, literary theory, film studies, and more. We have synthesized these practices using labels such as interaction criticism and design criticism, and we have attempted to define them as entailing "rigorous interpretive interrogations of the complex relationships between (a) the interface, including its material and perceptual qualities as well as its broader situatedness in visual languages and culture and (b) the user experience, including the meanings, behaviors, perceptions, affects, insights, and social sensibilities that arise in the context of interaction and its outcomes." Design criticism further seeks to explicate and evaluate "the relationships between present and near-future technological possibility and future ways of being, such that design solutions can be introduced" [29].

Our design criticism methodology included accounting for the qualities of the design as it is embodied in objects (e.g., collecting images of the designs, accounts of their materials and qualities, etc.); as they were intended by their creators (e.g., via media interviews, product descriptions, "About Us" content); and as they have been received by the public (e.g., media coverage, design awards, and so forth). This work provided us with many critical-interpretative statements about the designs, which became the "raw materials" of our analysis. But because our goal was to use these cases to construct an understanding of "beautifying" IoT, we also turned to philosophy of art. This body of work provides theoretical constructs, methodological moves, and a repertoire of examples to help researchers navigate complex concepts