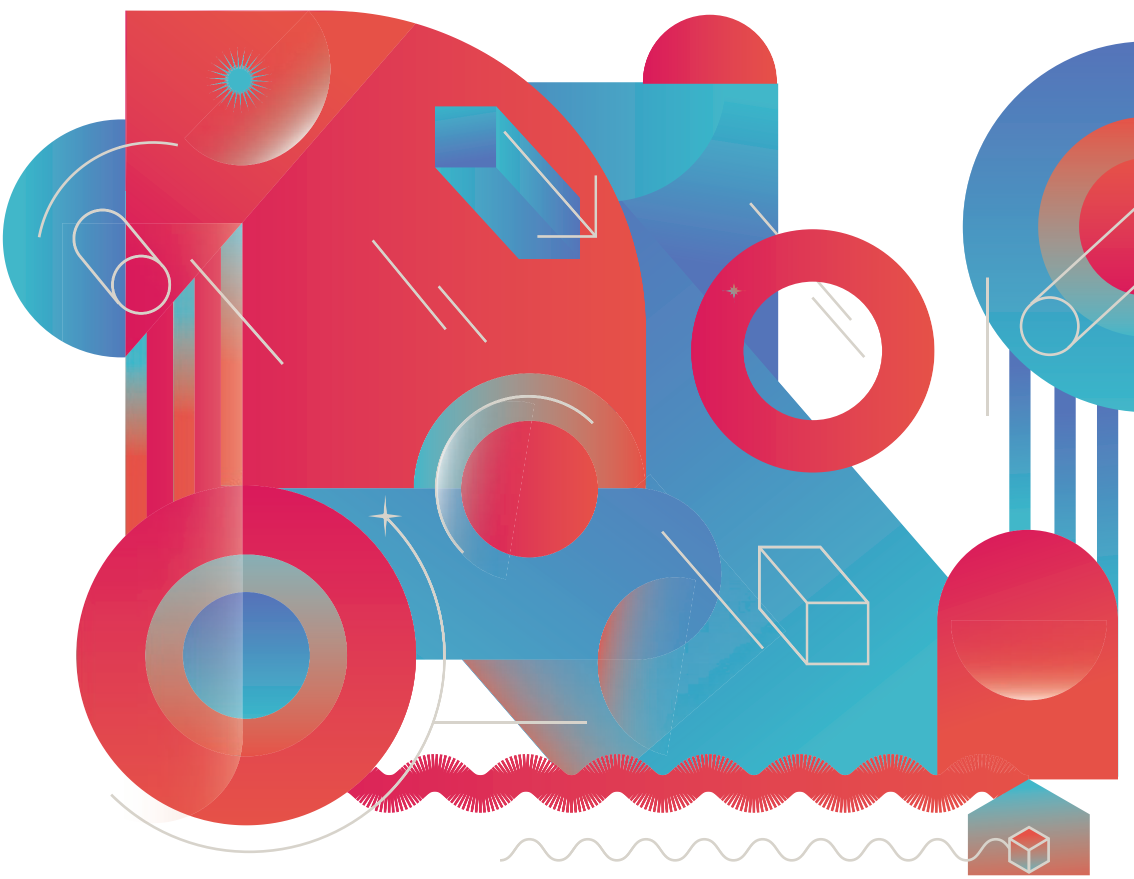
EMBEDDING INTELLIGENCE

Designerly reflections on AI-infused products

edited by Davide Spallazzo, Martina Sciannamè



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Contents

4. The role of design in the era of conversational interfaces

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With the spread of voice assistants such as Alexa, Google Assistant, and Siri we are witnessing the multiplication of products we can interact by talking using natural language. This chapter refers to these products as "Conversational Smart products", or ConvSP for brevity.

The term *conversational* is used to describe them since they embed and embody Conversational User Interfaces (CUIs). The suffix "Smart" is earned because they possess particular technical features, as they are cyber-physical (merging digital-software and physical-hardware components), networked, and have computational intelligence capabilities.

The first half of the chapter explores the specific traits of Conversational Smart Products, while the second revolves around how conversational interfaces influence products and product design practice. It offers a descriptive analysis framework and strategic design guidelines for novice and expert product designers interested in approaching the design of ConvSP[1].

4.1 What are Conversational User Interfaces? And what does "conversational" mean?

Conversational User Interfaces (or CUIs) are digital interfaces where the primary mode of interaction is a conversation – a repeating pattern of replies and responses (Ashri, 2020). The term CUI implies an inter-

1. This chapter synthesizes and re-elaborates some elements of "hidden for blind review" Ph.D. Dissertation.

face that can use natural language following the structure of a human-like conversation. To be considered "Conversational", an interface must offer the possibility to interact for several dialogue turns, going beyond the first round of interaction and beyond the simple question/answer pairs (Pearl, 2016).

CUIs simulate natural dialogue by applying human conversation patterns (Moore and Arar, 2018) and using spontaneous, informal language (McTear *et al.*, 2016), endowed with greater human likeness.

There are different types of Conversational Interfaces, classified depending on how humans can interact with their system. CUIs include **Chatbots**, **VUIs**, **VPAs**, and **ECAs**.

Chatbots are computer programs that process a user's natural-language input in text form and generate a textual response. Therefore, they converse with users through text messages.

A Chatbot presents itself as a virtual character (a Conversational Agent), with a name and a defined personality, expressed by its writing style.

Chatbots were the first examples of conversational interfaces, and their history goes back to 1966 with ELIZA, the first chatbot developed at MIT by Joseph Weizenbaum.

Chatbots are commonly integrated within websites and applications, including messaging platforms and social media. They communicate through text, including gifs, emoticons, media, and interactive elements. Chatbots are used to assist, complement, or replace human-provided services, especially by companies with large volumes of user interactions. Bots can take the role of routers between humans in a service context, sorting customers with the most appropriate human service provider.

An example is Vodafone's TOBI, which provides 24/7 support and immediate question answering for the telecommunication brand. Bots can also be used for productivity, coaching, alert notification, and facilitating business workflow (Shevat, 2017). Chatbots sometimes replace mobile apps for information retrieval, conversational commerce, companionship, brand engagement, gaming, and entertainment purposes (Klopfenstein *et al.*, 2017; Gentsch, 2019).

The term ***Voice User interface*** **(or VUI)** refers to interfaces that operate **voice as input and output modality** (Pearl, 2016). The term VUI is often used in contrast to GUI (Graphical User Interface) because it specifies a different interaction paradigm **since there are no visual affordances**; its design should follow separate guidelines. Not all VUIs are strictly "Conversational": using speech does not necessarily mean that the interface can simulate a conversation i.e. a smart trash can be opened and closed through voice commands but has no personality nor the ability to dialogue with users on multiple turns.

VUIs are CUIs that can afford a conversation with the user. Indeed, a VUI is conversational when it becomes a Conversational Agent (CA) such as **Virtual Personal Assistants (VPAs)**. Conversational Agents are dialogue systems that conduct natural language processing and respond automatically using human language.

VPAs (Like Alexa, Google Assistant, and Siri…) are powerful **cloud-based** dialogue systems that can be **integrated into various devices.** They usually allow both voice and chat-based interactions. VPAs support a broad set of functionalities and become platforms for creating conversational applications and services. Third-party developers can create applications that are compatible with VPAs. i.e., Amazon Alexa calls these apps *Alexa skills*, while Google calls them *Actions*. These apps can be found, downloaded, and added to the assistant's capabilities at any time.

VPAs can be defined as super bots that facilitate and manage multiple services (Shevat, 2017). **Compared to chatbots, VPAs can carry out a broader set of tasks.**

Although there is the ambition to build VPA companions, most VPAs remain transactional tools, not yet able to create long-term relationships with users (Luger and Sellen, 2016), and aimed at facilitating precise tasks rather than being digital friends.

However, any Conversational Agent is characterized by features designed to communicate its personality and character (e.g., tone of voice, specific wording and use of language, use of emojis, visual elements, etc.). Among those aspects, particular attention should be given to the choice of the tone of voice assigned to the virtual assistant, because it could contribute to strengthening stereotypes. Voice assistants nowadays mainly adopt female voices reinforcing gender prejudices, since these objects use female voices and have a subdued tone and role. The female voice could be associated with a submissive figure, negatively stereotyping the woman's figure, unconsciously linking the woman's skills to the housekeeper (Hall, 2018, p. 83). At the same time, artificial voices should be more varied, including male and neutral tones of voices. The designer should use this opportunity to represent individuals who have not yet been considered in the world of artificial voices, such as non-binary individuals (UNESCO, 2019). However, voices without clear gender markers or discordances between voice and personality are perceived as less clear (Nass and Brave, 2005). Therefore, the designer needs to pay special attention to the tone of voice and investigate how voice assistants can be designed not to perpetuate gender biases, valuing the brand identity.

Embodied Conversational Agents (ECA) are the last category of CUIs. They are agents in the form of animated characters on screens. ECAs combine verbal and non-verbal communication signals synchronously. They can use body posture, gaze, and hand gestures, all synchronized with the verbal dimension, enhancing and complementing it.

ECA research aims to transport the richness of human face-to-face communication to the interaction with computers to get a more intuitive and engaging interface, able to recognize and reproduce emotions and expressivity (Cassell *et al.*, 1999). Embodied characters range from human-like characters, i.e., news anchor-man, to more stylized virtual companions such as animated animals. ECAs may exist virtually as software or become part of physical objects (Mctear *et al.*, 2016).

So far, we have defined ConvSP as conversational because they embed and embody Conversational User Interfaces (CUI). Moving forward, we also described them as "Smart".

4.2 But, what does it mean for a product to be smart?

Nowadays, it is common to use the word Smart to indicate physical objects that process information and showcase a certain degree of intelligence.

Smart's suffix is used with technological significance: it represents the intelligence obtained through embedded IT technology. We refer to Smart Products as a category including internet-connected consumer electronics that possess three main technical characteristics: cyber-physical, networked, and computational intelligence.

Smart products blend hardware and software. They are physical objects with a digital representation. Material things need a digital counterpart to represent them on the network and be part of the IoT (Internet of Things).

The term cyber-physical (Abramovici, 2014) has been used to describe this dualism.

Globally unique IDs identify smart products and make them accessible for remote control and communication during their product lifecycle (Gutierrez *et al.*, 2013; Kärkkäinen *et al.*, 2003). Interaction is a significant aspect of smartness and can occur through multiple interfaces on physical and digital touchpoints. Maass and Janzen (2007) stress that smart products' interfaces are dynamic: they can offer real-time communication and use data (about the product itself or its surroundings) to be localized in time and physical spaces. Various modalities can be used as input and output (Sabou *et al.*, 2009). For example, a product could synchronize a physical UI and an external web application.

The second common characteristic of Smart Products is the connectivity: Smart Products are networked. Thanks to unique identification numbers and an Internet Protocol (IP), they can connect to the Internet and other products using different wired and wireless communication technologies (Abramovici, 2014; Greengard, 2015).

Internet connection makes them part of a larger network of things, people, and services. They can communicate, bundle, and interoperate with other devices (Maass and Janzen, 2007; Gershenfeld *et al.*, 2004). They can connect with the encompassing environment (i.e. a smart car that connects to a bigger infrastructure at the city level) and with peer products that dynamically become available (i.e. a smart home product that detects a new smartphone to connect to) (Mühlhäuser, 2007). Machines can automatically interact with other machines in bidirectional exchanges of information (Boswarthick *et al.*, 2012).

Connectivity gives devices access to services and capabilities external to the physical product, such as cloud services. It can also be used for interaction purposes (i.e., remote control of a connected device) and to communicate to users, even proactively (i.e., a smart product sending a notification, Kärkkäinen *et al.*, 2003).

In addition, the capability to connect enables smart products to be revised thanks to "over the air" updates. In time, a smart product can expand with new functionalities and evolve. This ability brings implications for product designers building new conceptions of products.

Moreover, smart products can collect data about themselves and their environment (Gutierrez *et al.* 2013; Lyardet and Aitenbichler, 2007). Once shared, collected, and aggregated, data become a valuable asset at the economic level and for the development of future products and services (Greengard, 2015).

Lastly, Smart products have computational intelligence as they embed electronic "brains" (processors and microprocessors) able to process data and perform programmed behaviors.

Their "intelligence," as in the ability to handle information or carry out decision-making, that can be located not necessarily at the device level (Meyer *et al.*, 2009). Intelligence could occur inside the physical product or even outside, such as in the cloud, or be unloaded to a different device like a smartphone (McFarlane *et al.*, 2003; Kärkkäinen *et al.*, 2003). Smart products collect, process, and produce information (Rijsdijk and Hultink, 2009). They display autonomous and proactive behaviors and can operate independently, performing tasks without the need for direct user interaction (Sabou *et al.*, 2009). They can often learn from experience and infer patterns and high-level events from data (e.g. understanding the preferences of a specific user). This enables smart products to display forms of awareness and evolve their performance in time.

4.3 How do Conversational interfaces impact the product design of smart objects?

In this vast category of devices, the impact of conversational interfaces on physical products is little explored by academic research, especially in the design field; most existing research focuses on the user experience and interaction with smart speakers and social robots. It is less explored how CUIs physically get embodied in products outside these two categories. From the analysis of 40 Conversational Smart Products (Vitali, 2020), it emerged that there are three qualities common to any ConvSP: they are related to a conversational agent (by embedding, embodying, or being able to connect to a CA), have their own physical shape, and tangible parts. Each of these qualities manifests differently depending on the kind of ConvSP.

4.4 Different ways in which a Conversational agent can be infused into a physical product

- It is **physically embedded** when the CA is built-in in the product, but it has an overall low impact on its shape, as the product design doesn't try to deeply be "the body" of the CA. For example, a built-in Alexa washing machine: the product should integrate a speaker and have available internet connectivity to relate to Alexa and answer user's requests. Still, the washing machine design remains pretty traditional.
- When the CA is **physically embodied**, the product makes it more evident that there is a conversational intelligence built-in inside and communicatively becomes the "body" of the agent. The products can interact with the user through more complex and expressive feedback. For example, an expressive smart speaker, whose design clarifies the presence of a conversational agent and uses interactive feedback to be more explicit.
- The embodiment can even be **remote** when the input/output of the conversation happens on another device. It is the case of those products that are compatible with assistants but don't have them built-in. *E.g.* a TV remote is used to record the user input, yet the agent interacts on the TV.

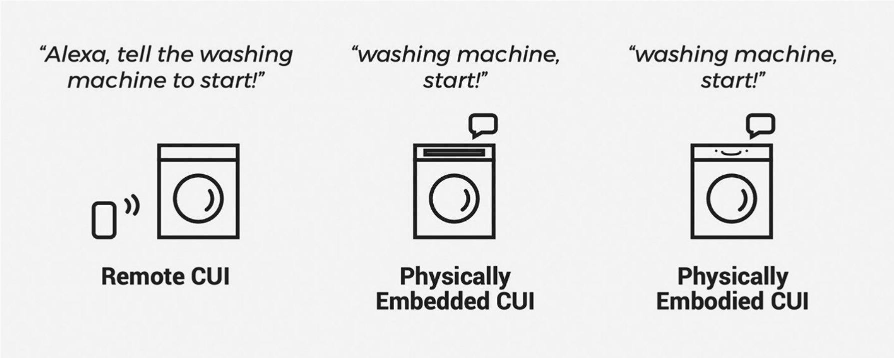

Fig. 4.1 – Different ways CAs can be infused into a product.

On the market, ConvSP primarily embed and embody the virtual assistants developed by large telephony and e-commerce companies such as Amazon's Alexa, Google's Assistant, Apple's Siri, Samsung's

Bixby, and Alibaba's Aligenie. The strategy of these large companies revolves around integrating the assistants' functionality into any product. Their VPAs are integrable, powerful, and generalist, because the same assistant should be able to be integrated into a variety of products and perform different tasks. It also means that there are very few Conversational Agents with "different voices" and personalities.

Indeed there are less specialized voices, typically present in domestic robots, toys, specific assistants (e.g., a VPA to teach a particular language), and products with a defined purpose (e.g., a washing machine with a chatbot assistant to set the washing cycle). Specialized voices own proper names and personalities, with precise capabilities and are not ideal for generalist assistants.

4.5 How does the presence of a CUI affect the shape of a product?

First, the impact of the CUI's presence manifests in the physical shape with the need to display the conversational agent's presence through status indicators and talking/listening feedback. The product shape must communicate that it contains an active intelligence able to listen and respond; it is a right for whoever enters a "monitored" space, as the presence of agents who can listen to us extensively worries users who care about their privacy.

Common Feedback components such as light effects, animations on screens, or simple icons can concur to make it evident. The Feedback components can also become branding elements that make the presence of a particular assistant recognizable on different devices (e.g., Alexa-based products use blue light rings).

The agent's presence should always be visible, even through feedback that appears only when a request awakes the assistant.

It was observed that the presence of the CUI doesn't have a substantial impact on the physical design of the product, as more abstract, anonymous shapes and compact dimensions are preferred, as they easily fit into the home environment. More anthropomorphized or biomorphic shapes are less common, as they are less flexible for commercial applications.

Similarly, this happens for objects where the CUI is not the primary mode of interaction. In these cases, products generally maintain a shape more linked to their primary function (i.e., a monitoring camera with an integrated assistant may not make evident the presence of the assistant).

Among the Conversational Products analyzed in the study (Vitali, 2020), only a limited number employed shapes with biomorphic or anthropomorphic features. It was the case in which products tried to create a deeper connection with users (i.e., robot companions, toys, voice assistants to teach languages, Smart speakers intended for kids…). In this case, the choice of these shapes is used to give a deeper embodiment to the Conversational Agent.

Deeper embodiment impacts users' perception, who tend to attribute more intelligence, animacy, and empathy to the agent, increasing the user's expectations of its ability to dialogue. Indeed, the level of embodiment and anthropomorphism in the design needs to be evaluated according to the device's capabilities, because it may cause a mismatch in user expectations.

4.6 Tangible aspects of interaction and feedback

ConvSP usually integrates tangible controls, and screen-based interaction, and produces listening and talking feedback when interacting.

Tangible controls are a shortcut to interact with the agent, to provide shortcuts to control the agent into its most frequent operative functions. E.g., wake up the agent, control volume, move music forward and backward, and "mute" button to interrupt the agent's listening capabilities. Indeed, users tend to use conversational functions only when it is the most convenient, fast, hands-free way to perform a task (Luger and Sellen, 2016). Therefore, offering tangible alternatives to voice for the frequent and standard functionalities increases the interaction's efficiency, resulting in a fundamental part of the user experience.

The integration of touch screens can increase efficiency. It is visible from the market that displays are the future add-on to ConvSP that will simultaneously possess voice and touch screens.

Proof of this trend can be seen by following the evolution of the smart speaker category, which has gone from being objects without a screen to full-fledged 'tablets' with speaker capabilities (e.g., Google Nest Hub, Amazon Echo Spot, Amazon Echo Show, Lenovo Smart clock).

The combination of VUI and screen allows mitigating some of the negative aspects of voice interaction, such as:

- The difficulty of discovering the CA's abilities.
- The cognitive load for recalling information instead of recognizing them as in GUIs (Murad *et al.*, 2018).
- The slowness of the conversation compared to other modes.
- The difficulty in performing predominantly visual tasks such as managing lists or multiple choices.
- It also provides flexibility in updating the interface and the product.

Smart screens can upgrade the visuals and screen-based content that complement speech. Screens also allow additional functions such as becoming a clock or making video calls (e.g., Amazon Echo Spot).

Whether the ConvSP has a screen or not, Listening and Talking feedbacks are their primary expressive cues. Listening (and thinking feedback) frames the product's interactive behavior when the user is speaking and when the system processes a response. While talking, feedback concerns the device's behaviors while generating a response to the user's request.

This feedback is generally obtained in the products through animated lights and on-screen animations. As already anticipated, they become branding elements that communicate the agent's presence and let users feel how advanced the solution is.

Deepening the non-verbal communication skills of CUIs & ConvSP is one of the intervention areas for designers. In particular, a greater synchronization of speech and visual feedback makes speech more expressive (i.e., using paralanguage, prosody, and a greater variety of responses).

Few ConvSP employ Embodied Conversational Agents (ECA) on screens in the form of animated characters or partially animated features (e.g., faces, expressive eyes). ECA is also common in robotics to create Expressive face robots (Breazeal, 2003). In products, the same screens used to simulate the character often double as interactive surfaces to interact with the product. In this way, the screen takes the role of both the product's face and an input modality for the user.

4.7 Defining five categories of Conversational Smart Products

Embodiment, Tangibility, and Shape are the three common characteristics of any Conversational Smart Product, but they can manifest differently into the devices. All the possible variables have been grouped in the descriptive framework proposed by Vitali and Arquilla (2019), composed by five units of investigation.

1. **Type of CUI**: it specifies which kind of conversation interface is used by the product (i.e., **VUI, VPA, Chatbot, or ECA**).
2. **Type of Conversation:** a conversation with a digital agent can be defined as ***task-led*** (transactional – single user request, the CA focuses on accomplishing a concrete task) or ***Topic-led*** *(user* discusses in a multi-turn interaction, the CA discusses, exchanges ideas on a set of subjects, and maintains positive relationships with users).
3. **Conversational Level**: describes the complexity of the CA's abilities. **Low** (based on a script with limited command) ***Limited*** (support user's initiative on a specific topic) **Moderate** (CUI supports *user initiative and mixed-initiative on a few topics)* ***High*** *(can manage multi-turn interactions and follow-up questions and support topic-led conversations).*
4. **Type of CUI Embodiment**: how the CA is physically **integrated** and **embodied** into a **tangible** object.
5. **Details of tangible interaction and feedback**: the way ConvSP communicate their conversational capabilities in the form of inputs, outputs, and feedback. Does the agent have **Tangible controls?** Does it give any **feedback** when **listening** and **talking?** Does it support **Screen-based interaction?**

The descriptive framework successfully portrays and categorizes the currently existing ConvSP, distinguishing their functionalities and common traits. It is also a fundamental guide for designers of ConvSP.

The descriptive framework identifies **five types of ConvSP:**

1. **Conversational Companions**: this ConvSP category has deeper embodiment and higher conversational capabilities and expressive feedback: they can support topic-led dialogues and multi-turn inter-

actions. This category includes social robots and toys, usually used as companions, teachers, and personal assistants.

i.e., ***Lily speaker by Maybe*** is a smart speaker designed to teach the Chinese language and practice simulated conversations in different settings. Lily uses speech recognition to understand what users say and speech synthesis to respond with a human voice; it can also display expressive facial expressions to better communicate with users. The product has an accompanying app where users can chat with Lily and exercise their grammar.

2. **Products with Physically Embodied Agents**: their primary function is to give a body to a conversational agent with transactional purposes (like Amazon Echo or Google Home). The product is the shell of the agent, displaying its presence by using communicative feedback (e.g., specific light patterns) concurrent with conversational output. The limit of this category is that it usually lacks a clearly defined "killer functionality", possessing an unclear purpose instead. They are currently used for playing music, hands-free search, IoT control, and entertainment. Therefore, when designing this typology of ConvSP, it is necessary to define the agent domain of expertise to frame the product's purpose and benefits correctly.

   i.e., ***Amazon Echo Dot***[2] (3rd generation) (visible at Amazon.it) is a compact smart speaker that integrates Amazon Alexa. It can play music, answer questions, control compatible devices, make calls, and use Alexa skills. It has four built-in microphones to listen from all directions and gives visual feedback through a luminous ring. The light ring produces different effects depending on the state of your request (e.g., it blinks if it doesn't understand the query). Alexa can be muted with a corresponding button, and there are physical controls for the volume.
3. **Products with Physically Embedded Agents,** their CUI is not the only mode of interaction, nor is the primary. They tend to maintain a more linked shape to the object's primary function and yield more simplified talking and speaking feedback. The limit is that their

2. Although chapter 1 already takes Amazon Echo as an example to analyse the landscape of all Smart Domestic Assistants, in this chapter, we instead provide the same products to position a specific type of smart assistant within the landscape of all smart conversational objects. Indeed, Amazon Echo is one of the most famous and familiar "Products with Physically Embodied Agents", ideal to represent this category of ConvSP.

ability to listen and converse is not always evident. The first question for the product designer is to understand if the conversation skills are coherent with the product's primary purpose. If so, how to declare the agent's presence and conversational ability (light effects are commonly used).

i.e., ***Nest Cam IQ*** (visible at store.gogle.com) is a smart security camera with a built-in Google Assistant. The cam uses infrared LEDs to see in the darkness and automatically recognize familiar faces. It supports a monthly monitoring service 24/24h. When the assistant recognises the wake word, a light ring hidden on the cam perimeter fades with a standard animation. The light remains on when the product is talking and switches off afterward.

4. **Conversational Screens** are smart screens with conversational capabilities that present outputs in both spoken and written/displayed modalities. Displays can support conversational interactions and provide additional information on the screen. It benefits from both VUI and GUI interactions adding considerable flexibility, it reduces the amount of training required for the user. Screens can enrich conversational interaction by providing additional content synchronised with speech. This doubles the design effort but has the advantage that it can be adapted flexibly**.** i.e., Amazon Echo Spot and Google Nest Hub (visible at store.google.com).
5. **Conversationally** Enabled products have partial conversation capabilities. Inputs and outputs may happen via an external interface (e.g., a smartphone) or require the support of other products to work (e.g., a conversational remote control for a smart TV). Depending on the application, these products can have limited, more simplified conversational abilities. These products only work when paired with another device, but they are compatible with several products on a positive note. The downside of this product category is the discoverability of their conversational ability. If the product doesn't communicate this capability adequately, e.g., through dedicated icons on the product, the functionality may remain unnoticed. Examples for this category are Alexa Fire TV remote and Apple Air Pods (visible at apple.it).

This categorization of Intelligent Conversational Products is a starting point for exploring an area still little covered, especially for product design researchers and professionals.

4.8 How to design Conversational Smart Products

With the birth of smart speakers and the pervasive diffusion of virtual assistants within products, we witness the first waves of conversational products (ConvSP) at home. This is a relevant change, challenge, and occasion for product designers that continuously need to be updated. Indeed, for designers that wish to explore this category of objects, this is a precious design guideline for any kind of conversational smart product.

Considering the different insights on how conversational interfaces impact products in terms of embodiment, shape, and tangibility, it is possible to identify eight critical aspects in the design of ConvSP grouped into two categories. Three more strategic dimensions should be considered in the early stage of the project, and five dimensions related to product design and the physical and formal aspects of ConvSP.

Strategic Dimensions

1. Assess the conversation's purpose and its desirability: Why should the product become conversational? This is the first big question for ConvSP designers. Not every product should have a built-in conversational agent, especially those whose main feature is not conversation (i.e., a toothbrush). Thinking critically about this aspect allows designers to identify the most promising configurations for integrating conversational interfaces into physical products. This means understanding which type of CUI would fit better and the ideal embodiment scenarios. For example, would it be better to create a proprietary conversational agent or use an available one like Alexa? Will the product communicate through voice or text? Should the product physically integrate the agent (built-in agent) or need another device to work (remote agent embodiment)? This phase opens up different directions for product development, impacting the product shape, interaction, and overall user experience.
2. Assess the Conversational level: the strategic decision consists of understanding how advanced the conversational capabilities will be (low, limited, moderate, or high). The scale considers initiative (the ability of both user and system to lead the conversation and ask questions), the breadth of the domain of expertise, and the ability to follow up responses and go beyond the first round of discussion. It

is an essential technical requirement that defines consistent forms and interactions for the ConvSP aligned with user expectations and doesn't oversell the agent's capabilities.

3. Assess embodiment necessity: which will be the correct configuration in terms of embodiment: remote, physically embedded, or embodied?
   The need for embodiment (achievable in terms of anthropomorphic/expressive shapes, and through the complexity of product behaviors, feedforward, feedback, and movements) depends on functions, technical limitations, and on which will be the assistant's role. Not every product needs to embody the presence of the conversational agent deeply. i.e., an object that wants to teach a language may need to communicate its presence strongly, while if it is an intelligent microwave, it may not be necessary. It needs to be evaluated depending on the product's core functionalities and the relationship with the user.

Physical Dimensions

4. Visibility of agent's presence: how to physically communicate the agent's presence. The visibility of the agent's presence contributes to raising user trust: a little evidence of the agent's presence makes ConvSP be perceived as intrusive because they listen "in secret". (i.e., lights feedback for listening and speaking behaviors of the agent).
5. Antrophomorpic or machinelike shapes? The existing user experience scales to evaluate robots differentiate between anthropomorphic/biomorphic or machinelike/abstract forms (Bartneck *et al.*, 2009; Bartneck and Forlizzi, 2004), and they can also be applied to ConvSP. The designer should consider that the more the level of anthropo/biomorphism is present in the product, the higher the users' expectations for intelligence and conversational capabilities will be.
6. The complexity of listening and talking feedback: this is a relevant dimension for product design because they are the expressive behaviors perceived by the users as manifestations of the agent's intelligence. The user perceives ConvSP with more complex talking feedback as more capable and intelligent than those with simpler

limited feedback. Examples of simple listening and talking feedbacks are static signals such as a LED light switching on and off; more complex behaviors could be performing various messages or synchronizing with the content and form of speech.
7. The need for physical controls: As users strive for efficiency, they will use voice only when it is the best way to interact. Physical controls can still prove valuable for users for more frequent interaction (such as on/off and volume).
8. Branding value of CUI: The static and dynamic elements of the device, such as listening and speaking feedback, are not only seen as signals of agent embodiment; they are also branding elements. They make recognizable and identifiable the presence of a specific VPA agent. That's why the designer's job is not just to find expressive solutions for each conversational product. Still, it is also to define or apply a design language that allows its expansion to other products. As the same VPA could be embedded and embodied in multiple devices, it is necessary to design rules for coordinating the agent's presence, making it distinctive and compelling. For example, many products with Alexa built-in use a blue light ring, a light bar, or the assistant's logo as visible trademark elements, and Amazon provides style guidelines with rules to follow for the agent's physical integration.

4.9 Conclusion

The constant increase in products' processing capabilities and connectivity facilitates the diffusion of smart products with conversational interfaces. Starting from the reference of this chapter and looking at the birth of an important field called Conversational User Experience Design (Moore and Arar, 2019), it is always more evident that product designers need to improve and incorporate more skills. Designers interested in specializing in this path must become curious conversational experts and draw knowledge from different disciplines that study human conversation.

Doubtless, technology has changed and will keep changing the way we live, transforming our daily objects into devices. Therefore, designers should continually be updated on new technologies to adequately embed them in everyday objects and change their ordinary meaning.

Thinking from a conversational point of view does not only mean that an object uses Voice Control, but that the products themselves acquire conversational logic that transforms the object and its usefulness and functionality. The designer must think about how the user will be recognized, through what technology.

How will the device react to events and adjust coherently to the environment and context? Will it be able to learn by the user and adapt its behavior over time? Will it anticipate users' plans and intentions?

These features make smart products such an opportunity for designers to build the next generation of daily objects and user interactions.

They raise new challenges, such as designing interactions distributed across multiple devices, in which the focus of the user experience is the service and not the product itself (Vitali and Arquilla, 2019).

Intelligent products can perform multiple functions that often are not evident, traceable, or geometrically comprehensible in the artifact's shape. This leads to anonymous bodies that do not communicate or invite users to interact. Many smart products can't even be manipulated, since interaction occurs through external interfaces and smartphones (Vitali *et al.*, 2019).

Therefore, the ability of the designer is to make the design comprehensible to the receiver/user by presenting qualities that will cause and fulfill certain expectations (Kazmierczak, 2003).

The guidelines given in this chapter are a precious starting point that foster innovation and creative thinking around possible variables for Conversational Smart Product.

The last but fundamental prerequisite for designers is sustainability, which must be considered a constraint in the design of ConvSP, and in general, for any type of smart object. Any user interaction requires a vast planetary network, powered by the extraction of (currently) non-renewable materials, labor, and data. This type of object creates an ever-growing network of data-consuming objects that stay on forever, using incredible amounts of energy. The way users interact with products leads to substantial environmental impacts (Tang and Bhamra, 2009). In this regard, the designer must take into consideration two further aspects: the amount of energy consumption invested in the life of the designed product, given the quantitative aspect of its energy demand; usefulness for people, to understand when a product significantly improves people's lives and if it is worth it to consume energy.

Given that design usually focus only on the end users, Circular Design approach instead considers the whole system in which the design will exists and its consequences. The designer needs to foresee the design impact. Thus it is fundamental to assess both user's needs and the systemic implications of the product in society and on earth, continuously analyzing these two equally critical perspectives (Circular Design Guide by Ellen Macarthur Foundation). The designer should ponder this trade-off when designing ConvSP.

This is still an open question that reminds us that the professional practice of design is changing in two ways. The first is hybridization; the product designer must now be able to handle knowledge from different disciplines and stay up to date on a technological level. The second is the integration of product design by digital designers who could find themselves interfacing with physical products, in a transversal exchange of knowledge.

These dimensions of hybridization and integration also refer to a cultural background that should not be forgotten. Indeed, the designer of the future should handle three elements: acknowledge traditional design practice, owing marketing skills with a design thinking perspective, and have computational skills to comprehend

smart objects. In his book "How to speak machine", Maeda (2019) proffers every designer to have this type of skill.

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Artificial intelligence is more-or-less covertly entering our lives and houses, embedded into products and services that are acquiring novel roles and agency on users.

Products such as virtual assistants represent the first wave of materialization of artificial intelligence in the domestic realm and beyond. They are new interlocutors in an emerging redefined relationship between humans and computers. They are agents, with miscommunicated or unclear properties, performing actions to reach human-set goals.

They embed capabilities that industrial products never had. They can learn users' preferences and accordingly adapt their responses, but they are also powerful means to shape people's behavior and build new practices and habits. Nevertheless, the way these products are used is not fully exploiting their potential, and frequently they entail poor user experiences, relegating their role to gadgets or toys.

Furthermore, AI-infused products need vast amounts of personal data to work accurately, and the gathering and processing of this data are often obscure to end-users. As well, how, whether, and when it is preferable to implement AI in products and services is still an open debate. This condition raises critical ethical issues about their usage and may dramatically impact users' trust and, ultimately, the quality of user experience.

The design discipline and the Human-Computer Interaction (HCI) field are just beginning to explore the wicked relationship between Design and AI, looking for a definition of its borders, still blurred and ever-changing. The book approaches this issue from a human-centered standpoint, proposing designerly reflections on AI-infused products. It addresses one main guiding question: what are the design implications of embedding intelligence into everyday objects?

FrancoAngeli
La passione per le conoscenze