Inherent simplicity in hybrid products

- How to design for simplicity in a technological world

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ABSTRACT

Inherent simplicity is viewed as a goal in design of both physical and digital products. Still, we interact with an increasing amount of technology in our everyday life. This article explores the application of principles within the field of simplicity and usability when it comes to *hybrid products.* As hybrid products contain physical, digital and connected properties, principles for usability within all these fields are taken in to account. Ten guidelines have been suggested based on a literature review conducted on this topic. These guidelines provide aspects that should be taken into account to achieve perceived simplicity when designing hybrid products.

KEYWORDS: simplicity, usability, hybrid products, Internet of Things, physicality

1. INTRODUCTION

In the field of design, simplicity and how to design to achieve this simplicity in digital and physical products is a debated subject.

> *"Simple can be harder than complex: You have to work hard to get your thinking clean to make it simple. But it's worth it in the end because once you get there, you can move mountains." – Steve Jobs*

One of the main contributions to the debate on simplicity in design is "*The Laws of Simplicity*" by John Maeda, Professor at MIT [1]. This article will pair the principles defined within the field of simplicity, with the core principles of usability and design of everyday objects defined by design author and cognitive ergonomics professional Donald A. Norman [2].

Furthermore, these principles will be linked to the technological development we are currently undergoing and the increased amount of technology we interact with on a day-to-day basis.

> *"Technology has made our lives more full, yet at the same time we've become uncomfortably "full". – John Maeda*

1.1 Contribution of this paper

This paper aims to contribute to a set of guidelines to assist the design of simple and intuitive hybrid products. It is based on a literature review on the field of simplicity in design, and resources on how to design for usability in products with different levels of technology.

The literature review has been conducted in conjunction with a design project exploring how to achieve simple user interaction in the design of an indoors hydroponic grow system for private users.

1.2 Structure

The paper consists of 7 sections. Section 2 deals with definition of and principles within simplicity. Section 3-5 explores existing principles for how to design for usability in physical objects with different levels of technological properties. Section 6 and 7 discusses the impact physicality and emotions have on how the user perceives the degree of simplicity in an object.

2. SIMPLICITY

2.1 Definition of simplicity

Despite many publications advocating the subject, not everyone agrees that simplicity in design is something to aspire at all. The average user will, given a choice always choose the item that does more [3][4]. The choices users make in a buying situation are not driven by the same qualities that make a product easy to use. After purchase, however, the same desired complexity frustrates [4]. Not because we want simple, but because we want things that we understand how to use. Norman advocates that we should not be discussing simplicity at all, but rather the frustration, or lack of frustration, associated with the product [5][6].

The entire discussion about simplicity versus complexity is a case of over-simplifying the issue at hand. This is because the terms are not opposites and can therefore not be discussed as a binary choice [5][7].

Furthermore, to make something "simple" you cannot simply eliminate the complexity of the product, it is rather a matter of relocation. If the complexity of a product is consciously relocated to the system side, rather than the user side, the product will be referred to as simple[8]. The issue with this discussion lies not in whether or not simplicity is desirable in design, but rather in the definition of simplicity. Simplicity is not a question of making the least complex or most simple product, but rather what qualities a product should possess to be *perceived* as simple in use, or *inherent simplicity [8][5].*

To achieve this, one must embrace the complexity of the situation [4][7][9]. Only by acknowledging the full complexity can we start applying principles for simplifying the user side of the product. If we stop the design process prematurely, the result will be unnecessarily complex products [5].

> *"When you start looking at a problem and it seems really simple, you don't really understand the complexity of the problem. Then you get into the problem, and you see that it's really complicated, and you come up with all these convoluted solutions. That's sort of the middle, and that's where most people stop… But the really great person will keep on going and find the key, the underlying principle of the problem — and come up with an elegant, really beautiful solution that works." – Steve Jobs*

2.2 Principles of simplicity

Although he does not offer a good definition on the term, Maeda's laws deals with the way we perceive simplicity in objects. The most important ones presented below.

2.2.1 Reduce

The most basic principle of simplicity is to *reduce* [1]. If too much is removed however, the object will be harder to understand. The object will be perceived as more complex, even though the object itself is more "simple".

2.2.2 Organise

The second principle is to *organise [1].* The human mind is constructed to make sense of the inputs it is presented with [1][2]. We automatically combine bits and pieces to make up patterns and structure. Given an amount of information, this information will be perceived a lot less overwhelming and complicated if structured and presented in an organised and intuitive way.

2.2.3 Time

Savings in time feel like simplicity [1]. However, Maeda also stresses that the potential for actually saving time in design is often limited, but with well-designed features may reduce the *perceived time* of an action or process. An example of this is including an indication of how much time you should expect the process to take, like a progress bar in digital interfaces vs. a frozen screen. Hence, just knowing what to expect may reduce perceived time.

2.2.4 Knowledge

Design that utilises pre-existing knowledge will be perceived more simple, as there is no need for learning new skills to understand the product. As an example, smartphone apps are a lot more complex now than they were only a few years ago. This development is partly because the world has learned the language of the touch screen, for instance we automatically consider swiping as a possible action, something no one thought to do before the touch screen was introduced. Everything is simple if you know how to do it [1].

2.2.5 The one

Maeda concludes his search for simplicity in one law called "the one";

> "Simplicity is about subtracting the obvious and adding the meaningful."

2.3 Summary:

- Inherent simplicity is the real goal and is achieved by;
    - Relocating complexity to system side of a product
    - Reducing, organising, saving time and taking advantage of pre-existing knowledge

3. INTERACTION WITH OBJECTS

To be able to design for inherent simplicity we need to design for smooth interaction between user and product. This entails designing every interaction point so that there will be no confusion about how to use it. To achieve this, the designer must consider seven different stages of every action: *Forming the goal, forming the intention, specifying an action, executing the action, perceiving the state of the world, interpreting the state of the world and evaluating the outcome* [2]. This is what Norman defines as the Psychology Of Everyday Things (POET), the interaction between humans and things. Norman identified certain principles for intuitive design that should be applied to achieve good usability in all stages of an action; Visibility, conceptual models, mappings, affordances, constraints, and feedback.

3.1 Visibility

Just by looking, the user should be able to determine what state the object is in, and the possible actions that are present.

3.2 Conceptual model

Visibility is closely linked to conceptual models. If all functions and abilities of the system in question are sufficiently visible, the overall conceptual model will be easy to interpret. Conceptual models are how users imagine the way an object work before having any experience with said object. The user will often construct a conceptual model based on fragmented and lacking information, and will naturally fill in the blanks and construct an assumed model, correct or not. It is all about taking advantage of the human mind's ability to see patterns and ensure that the overall model the user receives is consistent with the actual product.

3.3 Mapping

Mapping is the relationship between controls and their movements on the one hand, and the results these controls have on the other [2].

A subcategory within mapping is natural mapping, which deals with the situations where one can take advantage of physical analogies and cultural standards in mapping the controls and actions related to a product. For example, if the desired result is to move an object up, the control should be designed to move up as well.

As long as the control affords that it can, in fact, be moved up, there will be no confusion in this interaction. Other senses may also be taken advantage of in this context. Amount and loudness are other examples of properties that may be utilised in natural mapping [2].

3.4 Affordances

The term affordance was introduced by the perceptual psychologist Gibson as early as in 1977 [10]. Still, it did not get known in the world of design until it was introduced anew by Norman in the book "Design of everyday things". Affordances refer to the perceived and actual properties of an object [2]. More precise, it describes the basic and fundamental properties that a thing has, that determine the possibilities of use. For example, a chair is for support and thus affords sitting. It can also be carried, and sometimes stacked. These are all properties the chair physically affords.

3.5 Constraints

In addition to what a certain knob or property affords, there are constraints in place in the interaction the user has with an object. Constraints may be of a different character; either physical, semantic, cultural or logical. Physical constraints limit the possible operations in interaction with an object. Semantic constraints depend on the meaning in a situation to limit the actions the user will consider as possible. Cultural constraints rely on the given cultural paradigms to restrict the set of possible actions related to a product. Logical constraints are usually also in place in an interaction with an object. Here, there are no physical or cultural principles involved in the limitation of possible action, but rather a logical relationship between the presented possible actions. Natural mapping works by providing logical constraints [2].

3.6 Feedback

Feedback refers to the response the user gets after completing and action related to an object. What does this object send back to ensure the user that the action is received? According to Norman, full and continuous feedback is essential in a human-object interaction [2].

3.7 Summary:

- *An action has seven stages of interaction which all should be thoughtfully designed*
- *Principles for design are; visibility, conceptual models, mappings, affordances, constraints and feedback*

4. INTERACTION WITH ELECTRONIC OBJECTS

After Norman had presented his cognitive usability perspective to the world of designers, the term of affordances was according to Norman widely misused [11]. The term was adapted by graphical and UX-designers and said to be the long sought after criteria for how to design for usability. Graphic designers would describe a button on a screen that affords to be clicked etc. By the definition of the term affordance, it is in fact not possible that a button on a screen affords to be clicked. The mouse that you use to click on said button affords to be clicked, but the digital switch itself is affected by perceived affordance and logical and cultural constraints [11].

4.1 Feedforward

This shortcoming of affordance also applies to electronic objects. A switch on a lamp only affords to be pushed, but the button itself is not capable of affording what will happen as a result of pushing the button. The affordance in this case only clarifies part of the interaction, thus does not ensure good and intuitive usability. Djajadiningrat et al. address this gap between affordances and action in electronic products [12]. They advocate that the essence of true usability is not found in communicating the right action, but rather communicating the purpose of the action, or *feedforwarding*. The result of the action is communicated to the user before the action itself is executed. Hence, the user will with good feedforwarding never be in doubt of what action is necessary to achieve what he intends.

Norman defines the gap between the intentions and the permitted actions as the "Gulf of Execution". Feedforwarding is an effective tool for bridging this gulf. However, designers of today are not sufficiently aware of this concept to exploit its full potential [13].

4.2 Inherent feedback

The concept of feedback is also not sufficient when it comes to electronic products. In addition to giving feedback after an action is performed, the feedback needs to be sufficiently linked to the action itself. In nonelectronic products, this will happen naturally, as it will be a matter of mechanical feedback, but when it comes to electronics, this links is not as obvious. This link is defined as inherent feedback [12]. To achieve inherent feedback in design, the object has to be designed from the ground up with appearance, actions, and feedback in mind every step of the process. Inherent feedback cannot be added in retrospect.

4.3 Summary

- Affordances have shortcomings when it comes to electronic products
- Feedforwarding is necessary to bridge the gulf of execution
- Feedback must be sufficiently linked to the action itself

5. INTERACTION WITH HYBRID PRODUCTS

Djajadiningrat et al. describe a more complex situation when dealing with electricity in objects, but the everyday products of today do not only extend to purely physical and electronic objects. We also need to design for products that hold more advanced technology than merely electronic; we have to consider products that are connected.

5.1 Ubiquitous Computing

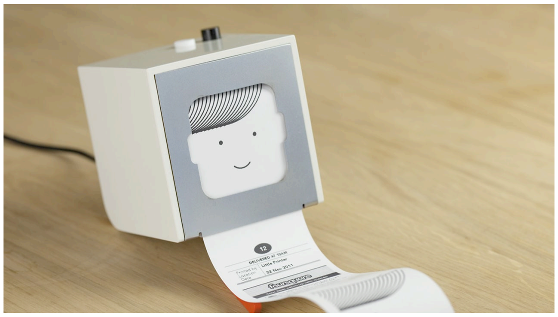
Computing has in the last 30 years done a full circle [14]. According to Weiser, this circle may be divided into three different phases; Mainframe, Personal computer and ubiquitous computing [15]. These phases describe the shift from the first era of computing, where computers were only dealt with by experts, to the age of the personal computer and finally to the age we are entering now; ubiquitous computing. In 1997 Weiser defined this last era as the phase where the computers would be embedded in the things that surround us [15]. In other words, he predicted the arrival of the *Internet of things.*

5.2 Hybrid products

Due to the decreasing prices of sensors and components, we have in the latter years witnessed a spike of new embodied technology. Thus emerge a new product category; the *Internet of Things* (IoT), and more specifically *hybrid products*. The number of devices connected to the Internet is predicted to reach 50 billion by 2020 [16]. These are not only computers and smartphones, but also include connected everyday objects, or *hybrid products*;

> *"products that are connected to online services that are based on digital data (often from sensors) and that rely on digital networks to function." [17]*

Connected or hybrid products represent a new dimension in the interaction of products. The products are no longer only able to react to the immediate environment or direct user actions; it may also respond to information from the Internet. This connection may complicate the direct principles of designing user interactions like affordances, feedforwarding, feedback and inherent feedback. Still, it may also represent a simplification of the growing amount of data we see in the world today [18].



The Little Printer is an example of how hybrid products may offer a simplified presentation of data by adding narrative, personality and physicality to the equation [19]. The printer works by printing updates on pieces of paper from your social media networks, your local newspaper, the local weather forecast, and so on. The same information could have been accessed within seconds on your phone, but the Little Printer offers an alternative that appeals to our emotions and presents the information in a way that is perceived more personal and meaningful.

5.3 Paradox of technology

Technology is often associated with making life easier and more enjoyable [2]. New technology is added to provide new or increased benefits, but will simultaneously increase difficulty and frustration. Norman introduces a U-shaped curve describing the correlation between the complexity of a new technology and the development over time [figure 1]. The essence being that the introduced technology that simplifies life with its new features also complicates life by making the product harder to learn and use. As the technology matures, the users become more educated and the device in question more powerful and reliable. After this stabilisation, newcomers will enter the playing field, introducing new capability at the expense of the ruling simplicity.

The first predictions about the subject in the early years of IoT were often regarding ubiquitous computing and large systems where every object talks to each other [20]. Perhaps the most typical example of this was smart housing.

There have been several attempts at making houses that are able to anticipate your every need, and automatically respond to those needs. This may be coordinating your morning coffee with your alarm clock, raising the temperature when the house senses that you are on your way home, or just opening the garage door when you approach. This technology may still be how the bottom point of the U-curve of IoT looks like, but we are just not there yet. Several concepts for smart houses that have failed due to technology that does not work perfectly at all times [21]. When not working seamlessly, concepts like this exclusively represents a complication of what are already simple tasks. If the automatic lights you put in does not turn on, and you have to turn to flashlight or candles, it is no longer a simplification, but rather a vast complication of something you have viewed as simple your whole life.

The development of new technology is not only dependent on time and complexity, but also how this technology is applied. Höök argues that in the phase we are finding ourselves in at the moment, the embodied technology and IoT will firstly be used for fun, for games and for life [20]. When designing products meant for fun, it will be more dedicated to answering only one problem or focus area, and therefore also end up as a better and simpler utilisation of the technology in its start phase.

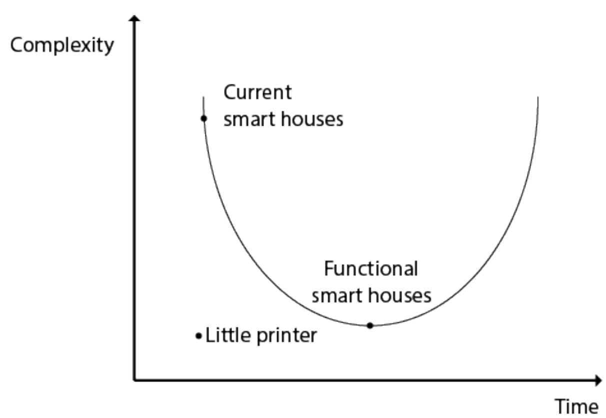


Figure 1: The development of new technology over time.

5.4 The screen and things

As many hybrid products are designed to record data as well as interpreting it, we have seen many products launched with related smartphone applications. The smartphone contains an interface with rich display and interaction that most people have available at all times [14]. By utilising this screen, you may also take advantage of all the pre-existing norms and knowledge that people already have acquired related to use of smart phones [2].

Therefore, it may be tempting to include an application to present the information that your device record, to make it accessible from afar, to be able to send a notifications, and so on. However, by the other main principles of design for simplicity, this makes the total interaction between user and product (or system) more complicated. Also, the actions expected of the user increases drastically. The application will, therefore, represent a complexity added not only on the system side but also on the user side, which is the opposite of inherent simplicity [7].

5.5 Summary:

- Hybrid products represent a new level of complexity in interaction. However, if kept in mind throughout the design process may ultimately lead to increased simplicity.
- The most successful concepts we have seen are dedicated, physical devices rather than large systems
- Smartphone applications connected to physical things should add clear value to system.

6. THE ROLE OF PHYSICALITY

Hybrid products hold the advantage of including both technological and physical aspects. Interaction with physical objects entails a more rich sensorial and actional potential [12][22][23]. They address all senses, compared to purely screen-based designs that only have the ability to address a few.

6.1 Dedicated controls

While the screen of an app is constantly changing, and all the information of the application is constrained to the small space of a smartphone screen, physical products does not have the same limitations. A physical product may contain controls that do not change form or result.

> *"Whenever the number of possible actions exceeds the number of controls, there is apt to be difficulty." [2]*

We have recently seen a shift from general devices to more specialized products [24]. More specific devices increase the potential to design dedicated controls. With a control dedicated to just one action and associated response, we have the opportunity to design a control to convey precisely what will happen when the user utilises the control, thus being able to fully exploit the essence of feedforwarding, feedback and inherent feedback.

6.2 Calm technology and Periphery

Weiser first introduced the terms calm technology and Periphery in 1997 [15]. He defines calm technology as technology that engages and moves between both the centre and the periphery of our attention. More recently, Bakker et al. also stress the risk of being overburdened by information by the complex human-computer interactions that exist today [25]. In digital interaction, we have all kinds of different notifications and information that all try to attract our attention, often at the same time. In the physical world however, we have the same amount of information, or even more, but this information does not demand our immediate attention in the same way. We can observe that it has started raining outside without paying much attention to his information. We are able to move a lot of information out of our attention span when it comes to physical information; to the periphery, and take advantage of it only when necessary.

Although somewhat extreme, the concept of Monotasking introduced by Paolo Cardini is an exemplification on how a lot of the technology we use every day is designed to scream for our attention. As a reaction to this constant occupation of the centre of our attention span, he presents a simple product that can calm down the screen of your smartphone to only show what is relevant at that specific moment. “It is time we stop multitasking and start monotasking.”[26]

6.3 Emotions in physical interaction

The mere tactual attributes of a physical object are also important to take into account when designing hybrid products. The affective aspects of tactual experience represent a close encounter and have immediate emotional responses [23]. Touch is the basis of our understanding of the materiality of the world. Still, we find it hard to communicate these tactual experiences, even as designers [22]. Sonneveld presented a guide to tactual experiences that contains divides the topic into five different domains; tactual properties, movements, affective behaviour, sensations and gut feelings [27].

This guide presents a new take on a field that has not been described much theoretically. However, it is flawed in the sense that it does not consider the other senses that also affect the interaction with a product [22]. The tactility of an object needs to be addressed by a designer but set in context with other sensory inputs we get from that same product. Utilising this consciously as a designer may result in a more simple and intuitive product. Take a water boiler as an example. You know what phase in the process of boiling the water is solely by listening to the natural sounds made by the water.

An example of how physicality and dedication can be utilised to simplify information is the Magic Calendar. The Magic Calendar is a concept that utilises E-ink technology to make a link between the traditional paper calendar and the electronic calendar that every smartphone hold.

The e-paper makes it look like any other physical calendar, but it also syncs with your smartphone, or your family member's phone [28]. By adding physicality to something that otherwise seems complex and stressful, the information in the calendar is perceived closer and more graspable. It also calms the information by moving in and out of the centre of our attention span seamlessly.

6.4 Summary:

- Interaction with physical objects entails a richer sensorial and actional potential.
- Dedicated controls can be designed specifically for the one task they answer to.
- Interaction elements can be removed from the centre of attention and to the periphery.
- Tactility ensures higher emotional connection and investment level from user.

7. THE ROLE OF EMOTIONS

As seen, the physical aspects of an object ensure greater emotional connection than a screen-based product. Maeda emphasises that in certain cases one has to move towards complexity to trigger emotions [1]. By adding aspects that give a perception of personality in objects, an action does not seem like it requires as much effort to perform. In the 90s Tamagotchis were quite successful despite demanding that the user performed several actions a day, and by giving no more in return than the sense that it felt happy. This is called anthropomorphism; we feel that objects have personalities, and assign them human abilities and body language [29].

7.1 Products with personality

With new technology and hybrid products, this reaches a new level. Products are no longer only able to react to your actions, but also to what is happening in the world around them. An example of this is Brad the Toaster.

Brad the Toaster is a product based on the concept "Addicted Products", a conceptual collaboration between product designer Simone Rebaudengo and The Hague Design Research centre. Addicted Products is a sharing service of products based on the product's satisfaction [30]. The toasters are connected to the web and each other, creating a peer product network. Brad the Toaster *wants* to be used and measures its hosts based on the frequency of use and how it is being treated compared to the other toasters on the cloud. If it is not happy with the way it is being treated, it will let you know, and if it stays unused too long, it will find a new host that will take better care of him.

> *"I guess I didn't deserve Brad, really." [31]*

Although algorithms and mere lines of code control Brad, the product is talked about as an object with personality. Instead of thinking about the reaction to how it is treated compared to other toasters as just a direct reaction to the data, we say that the toaster is getting jealous. Instead of looking at the movements it makes when it is not happy, as a digitally programmed state as a result of recording data, we say that it is *feeling neglected*. As soon as physical objects show behaviour similar to human interaction, we consider them as having the actual ability to feel and think.

Another good example of how we assign human abilities to objects is Apple's *Breathing Status LED Indicator.* This subtle LED indicator simulates the average respiratory rate for adult by fading on and off exactly 12 times per minute. This makes the user subconsciously relate the indicator to sleeping, leaving no doubt what state the machine is in [34].

7.2 Emotions and simplicity

Emotions we have towards physical things affects our interaction with them and how we perceive the level of complicatedness. Complexity needs to be added to trigger emotions, but the perceived simplicity may remain the same, or even increase [1]. With emotions triggered we have a deeper connection to the product, and therefore also a greater motivation to perform actions related to it. We do not mind feeding the Tamagotchi several times a day, as long as it means that our virtual pet is happy. This concept also applies when it comes to aesthetics [32][33]. We disregard and forgive more complexity and lack of usability if it is in conjunction with a product that holds aesthetic qualities [29]. The lack of personality and narrative in the interaction might be another reason why the smart houses have not yet caught on. We do not forgive any malfunction in these systems, as we have not formed an emotional connection to them.

7.3 Summary:

- Physicality ensures greater emotional connection to objects
- We assign personality to objects if presented with a narrative
- We forgive complexity in aesthetically pleasing or objects and objects we feel emotionally connected to

8. HOW TO DESIGN HYBRID PRODUCTS

Inherent simplicity is a matter of designing legible and intuitive products that do not cause frustration in interaction. Electrical and technological advances compose a complication of existing principles for intuitive design. They may therefore not be transferred directly and should rather be utilised in conjunction with additional principles that bridge the gap created by technological aspects. On the other hand, technology also represents a potential for increased inherent simplicity if exploited correctly. In addition, inherent simplicity is deeply related to physical and emotional aspects of the product in question, and may as such not be achieved only by removing complexity.

This chapter proposes principles for designing inherent simplicity in hybrid products.

8.1 Subtracting the obvious and adding the meaningful

This is the one law of simplicity according to Maeda. But how should we as designers deal with this when it comes to hybrid products?

8.1.1 Balance the features

More features are often viewed as an added value. Not only by designers and developers, but also by the user about to make a choice concerning what product to buy. While a feature may add value in itself, it does not necessarily add value set in contrast to the complication of the object it represents. In addition, technological advances lead to cases where technology is added just because we can. The opportunity to make a connected product without significant extra cost does not mean every object should be connected. Every aspect of added technology should be evaluated according to how it affects the user actions and inherent simplicity of the resulting object.

> *Only include features that offer a clear value that surpasses the complication it represents.*

8.1.2 Know where to add complexity

Complexity added on the system side of a product will reduce the actions demanded of the user and hence offer increased inherent simplicity. If this functionality is sufficiently integrated into the system and conveyed to the user, it will offer a simplification of the system as a whole. Hybrid products represent a greater potential in this context, as part of the system side is removed from the object itself, and thus holds greater capability.

> *Minimise user actions by adding complexity on the system side of the design.*

8.1.3 Know when to borrow the screen

The smartphone represent a rich screen filled with features we already have learned. Thus, this is a simple way of conveying complex information. However, it entails adding an entirely new product to the interaction, and constitutes a severe complication if the object does not contain complicated information.

Only include smartphone applications if there is information collected by, or associated with, the product that cannot be presented more easily the product.

8.2 Physicality

Hybrid products have the advantage of possessing both technological and physical aspects. This makes for a rich scope of opportunities in achieving inherent simplicity in the end design.

8.2.1 Calm down

By consciously designing calm technology that manages to shift seamlessly from the centre and the periphery of, we can take advantage of all off our senses in an interaction, and the amount of information presented at a given time may be reduced drastically.

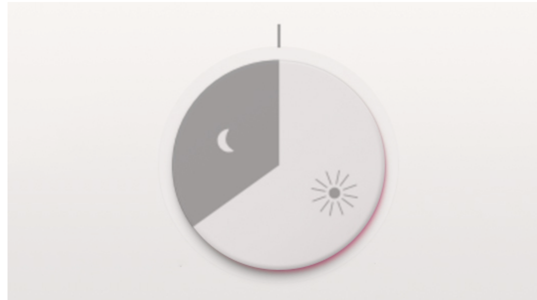
Use the Periphery, and do not scream for attention at all times.

8.2.2 "Analoguify"

Aspects of physicality ensure a deeper emotional connection with the product. Therefore, one should aspire to design controls that draw on physical analogies and mimicsphysicality even when dealing with electronic controls. This will increase the legibility and familiarise the object.

Make interaction points seem physical.

An example of "*analoguification"* is the light setting included in the project done in conjunction with this article. The goal was to design a timer that switches a grow light in the grow system on and off to simulate a natural cycle of day and night.



8.2.3 Consider the feelings

Designs that trigger emotions will be perceived more simple. Physicality is not sufficient to trigger the full potential that lies in being emotionally connected to an object. Narrative and personality ensure that complexity and demands of regular actions will be forgiven. When dealing with hybrid products that are able to react to information from afar at the same level as direct interaction, the potential for creating a strong narrative or personality increases.

Include narrative and "human" qualities.

8.3 Information is gold

Everything seems easy if you already know how to do it. Hybrid products represent a relatively new product category, and it is crucial that the known principles of interaction are transferred into this new field.

8.3.1 Organise information

Information structured and presented in a way that makes it easy to see a pattern in the presented data will be perceived as less overwhelming and thus more simple. If presented in a logic and intuitive way, pre-existing knowledge of the information in question will be redundant.

Information organised in an intuitive way will be perceived more simple.

8.3.2 Do not reinvent the wheel
By relying on pre-existing knowledge one can achieve immediate understanding. Even in cases where it does not exist accurate parallels to draw on, one may utilise elements of known knowledge, to ease the transition to new concepts. By introducing objects that do not stray too far from the current paradigm, and introducing new products in a step-by-step - manner, the new object will be perceived as more familiar.

> *Draw on pre-existing knowledge, especially when introducing new technology.*

8.3.3 Link purpose, action and feedback
Hybrid products require a more apparent link between the purpose of an action, the action itself and the resulting feedback. All seven stages of an action should be considered and thoughtfully linked, as the link between them might not be as direct in hybrid products as purely mechanical ones.

> *The purpose of an action or reaction must be linked to the cause in a manner that is immediately apparent for the user.*

8.4 The design process
To achieve inherent simplicity in designing a hybrid product, the simplicity must be thoughtfully considered throughout the design process.

8.4.1 Embrace complexity
To achieve a design that is truly perceived as simple, as a designer you have to embrace the complexity of the situation you are designing for. If the situation seems straightforward, you do not know enough about the situation you are designing for and should seek more inputs.

> *Seek a sufficient number of inputs on the issue you are designing for. Only then are you able to simplify and structure in an intuitive way.*

9. GUIDELINES FOR INHERENT SIMPLICITY IN HYBRID PRODUCTS

9.1 Balance the features
Only include features that offer a clear value that surpasses the complication it represents.

9.2 Know where to add complexity
Minimise user actions by adding complexity on the system side of the design.

9.3 Know when to borrow the screen
Only include smartphone applications if there is information collected by, or associated with, the product that cannot be presented more easily the product.

9.4 Calm down
Use the Periphery, and do not scream for attention at all times.

9.5 ”Analoguify”
Make interaction points seem physical.

9.6 Consider the feelings
Include narrative and “human” qualities.

9.7 Organise information
Information organised in an intuitive way will be perceived simple.

9.8 Do not reinvent the wheel
Draw on pre-existing knowledge, especially when introducing new technology.

9.9 Link purpose, action and feedback
The purpose of an action or reaction must be linked to the cause in a manner that is immediately apparent for the user.

9.10 Embrace complexity
Seek a sufficient number of inputs on the issue you are designing for. Only then are you able to simplify and structure in an intuitive way.

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