OPEN HOUSE
Reclaiming The Interior of Household Electronics

Pia-Marie Stute
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Innehållsförteckning

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Introduction

The repetitive cycle of consumerism that consists of buying, using, breaking and disposing of products is a prominent and rigid structure that consumers immanently find themselves in. An interference in this structure by repairing broken products is commonly not a part of it. Instead, objects that are designed to break and specifically not to be repaired have evolved to an economic strategy. «They don’t make them as they used to» is a common statement towards products of all kinds that are available in today’s stores and present in every household. It refers to the apparent decrease in quality that opposes the life-cycle of products that actually used to last «life-long» and instead causes consumers to frequently purchase new products as their old ones break. This phenomenon does not derive from an innocently poor set of skills of the industry, its quality of today’s production methods or less-durable construction materials – instead it is a conscious economic decision that runs under the name of «planned obsolescence». It is an immanent consequence of sustainable businesses to constantly giving people goods they desire and shows in various forms, from subtle to unsubtle. «From so-called contrived durability, where brittle parts give out, to having repairs cost more than replacement products, to aesthetic upgrades that frame older product versions as less stylish – goods makers have no shortage of ruses to keep opening customers’ wallets.» (Hadhazy, 2016). What power do consumers have to go against this institutionalized status-quo?

While today’s economy is largely build upon the constant re-creation of consumer needs, the awareness of a lack in sustainability not in economical, but in ecological terms simultaneously grows. In 2017, the Swedish government has passed a reduction of taxation on repairs of shoes, clothing, textiles and bicycles (Bratt, 2017). With this work, I wish to add household electronics to this list of repairs by facilitating the users to repair the products themselves – an approach, that is commonly not encouraged by today’s industries. As a way out of the wheel of consumerism for electric devices, Industrial Design can serve as a mediator to facilitate the users themselves to carry out those repairs. Focus of this work are the physical qualities of the industrial product that can facilitate this process. Here, especially in terms of electric circuitry, understanding is the essential prerequisite towards the act of repairing. Open House aims to outline possibilities that open up the technological interior of electronic devices to the consumer and to explore the new opportunities of ownership that these steps entaile.
On The Relationship Between User and Technology

Back in the year 1988, Mark Weiser, influential researcher in computer and communication science at the renowned XEROX institute, coined the term of „ubiquitous computing“. As a counter-scenario to virtual realities, he envisioned a future in which technology will merge with the world of its users, instead of asking the users to merge into the world of technology. „The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.“ (Weiser, 1991). Today, his vision of omnipresent yet invisible technologies has proven to be an accurate forecast. Even former analog artifacts are equipped with technological agents: the bedside table that charges cell-phones, packaging material that is equipped with rfid technology and the IOT that turns the personal environment into the self-acting smart home. Connected consumer products within the „Internet of Things“ have introduced a new era in the communication between people and technological artifacts: zero-interface. This new generation of user interfaces describes the trend towards which the only input that technology reads are their user’s regular daily routines. While technology therefore gains importance by growing continually closer into the private life of users, the consumers simultaneously grow further away from the technological artifacts with rising automation. It invites easy consumption that requires little involvement and even less understanding of the functioning of artifacts (Verbeek, 2009).

In his analysis of the relationship between humans and technology, the American philosopher Albert Borgman distinguishes the electronic device’s properties into means and ends (Fallman, 2010). In this division, the ends are the commodities which are effortlessly delivered to the user by the objects and define the relationship of easy consumption. The machinery that enables this functioning in the first place has however become an interchangeable and invisible part that remains hidden not only from the users’ eyes but also their concern (Borgman, 1984). Termed by the system theory, electronic devices have become “black-boxes” whose inner workings are as irrelevant to the consumers as they are inaccessible.

While this does not have any immediate effects during a product’s use, it becomes apparent in the moment in which the pro-
duct breaks. In the Actor-Network-Theory, Bruno Latour describes this phenomenon as “reversible black-boxing” (Verbeek, 2005). The term refers to the moment in which the vast network of actants that constitute the products existence is revealed to the user who is faced with the problem of the error. The product’s multi-faceted supply chain and the singular, highly specialized production steps come to the surface. As an effect of this characteristic industrial production, means and ends have become separated and industrial products rarely allow to be accessed on their insides. Sometimes, other parts of the hidden networks of electronic products can include some form of repair and warranty services as well as standardized recycling mechanisms. But in most cases, the act of breaking a product merely reveals the borders of the owner’s actual ownership over the object – that manifests itself in the inability to fix the error.

**Reclaiming the Interior**

This work explores the possibility for the user to claim ownership not only for the intact product, but also over its technological interior through the means of industrial design. At the basis of empowering consumers to fix broken devices lies their understanding of the products functioning. The consumer is invited to make acquaintances with the machinery which becomes an essential and accessible part of the product again. How can today’s black-boxes be transformed into white-boxes instead?

Led by the question how «open» household appliances can be, the democratic idea of open source is translated into the physical and functional world of consumer electronics. This bears the opportunity to empower the user before companies and strengthen the term of ownership, as well as making the mindset towards a more sustainable, alternative ecology accessible. In this, Open House moves away from a top-down approach from corporation to consumer, to a future scenario in which users are actively involved in producing, repairing and modifying their own products. This project aims at the self-empowerment of the user to interfere with technology instead of being fully dependent on a product’s company. I wish to give form to ecologic desires and use industrial design to mediate between current and alternative visions of economy. By re-imagining the view of consumer electronics, I hope to give a realistic alternative that empowers users without any pre-knowledge to access, understand and interfere with the devices surrounding them. As opposed to viewing these problems through the lense of legislature or means of services, I instead focus on the physical qualities of electronic devices to aid in this process assigned through the discipline of industrial design.
Design Research

Repair Opportunities

The initial motivation to this project lay with the repairability of household electronics which is where the research process began. In order to understand the opportunities and burdens of repairing things, I visited different organisations that deal with the act of repairing on a daily basis. Most influential in this process were collectives that count themselves to the DIY (do-it-yourself) or rather the DIT (do-it-together) movement. In this, both virtual and physical spaces offer help to consumers that seek out to take repairing into their own hands. Free online services such as “ifixit” provide photographically documented step by step guides on specific products, uploaded by users for users. In the physical realm, other communities gather for events such as repair cafe’s, where volunteers pass their expertise on to the visitors that brought their broken things to be repaired. Some organisations have opened established repair shops in which for example students are invited to repair their bicycles themselves.

Through conversations with organizers and their visitors, I was able to understand the thresholds to repairing on your own and therefore could identify the necessary prerequisites that the organisations provide. In all cases, the knowledge needed was represented by experts who proved to have a profound understanding of what they were doing and who volunteered to pass their skills on through teaching, creating documentations or patiently explaining to others. As a second parameter, the physical repair spaces provided the (often specialized) tools which were needed for the repairs and created an environment in which these were accessible for use. Thirdly, the organisations contributed to the repairs with the necessary spare parts which were sold cheaply or even given away for free.

Repair Thresholds

The assumption of the necessary three main parameters that were 1. knowledge, 2. specialized tools and 3. spare parts was proven by a self-study to repair a series of broken devices. As part of my research on the repairing of electronic products in specific, I visited the Svensk Röda Korset’s own repair workshop in Södermalm, Stockholm, who has kindly provided me with a number of old household electronics for my study.

The following observations were made through investigating several different household devices, such as coffee...
the ASTA BikeKitchen in Cologne

RepairCafe at the DingFabrik in Cologne
machines, toasters, electric stoves, air fans, hairdryers, water boilers, flat irons, hair curlers, electric speakers, blenders and mixers. In fact, my attempts to repair these broken devices often failed at the first step of opening the casing: specialized screws required corresponding tools that I, regardless the privileged access to tools that a design school provides, didn’t have. Other parts were glued together and had to be broken apart to reveal the products interior. On its inside, the technological interior clearly wasn’t meant to communicate to non-experts. Colour-coded cables seemed to change their code as they moved along the circuit, and oftentimes soldering connections had to be broken and parts to be removed in order to access the underlying actants. A sense of chaos ruled over the technological interior, instead of ideally clearly communicated connections between the parts. The obstacles I crossed when attempting to open their casings, the communication of the design (or lack thereof) in the products’ interiors and of their single parts, as well as my obvious lack of the tools I would have needed to carry out the repairs, clearly communicated the feeling that I – in the role of a consumer – was not meant to repair these products.

**The Circuit Inside**

With the possibility of having opened and deconstructed several electronic house-
But in which way was this theoretical research relevant for my design process? Following the question of how these electronic principles and connections are traditionally represented and therefore communicated, I continued to research the classic schematic language of the representation of electronic circuits in the discipline of physics. Based on my previous findings I was able to create an example of these classical representations for a common household device, the hair-dryer. It served as the basis of a series of graphic transformations through which I explored principles that could make an understanding of circuits (outside of the range of physics and therefore for the average consumer) easier.

One of these graphic experiments was to replace the official physical icons with intuitively understandable pictograms that closely represented the physical reality which the user sees when opening an electronic device. The second step I took was to pair those pictograms with colours. They for their part resulted from an associative workshop which I carried out with ten participants on the relations between colour and electronic events or forces. Rather than assigning a shade of a colour to the electronic component, such as for instance the diode, colours were instead assigned to abstracted statements like “I slow down” which I was able to derive from my theoretical research of the electronic principles. Based on these graphical experiments I further created a card-game to test my assumptions on the communication and understanding of electronic circuits with others. While the use of colours and icons, as well as the personified statements was said by a majority of the participants to aid in terms of the understanding of a circuit, it was another quality that influenced the perception the most: the orientation and shape of the circuit.

The alignment of the single actors which aimed at representing the physical counter-piece of a hair-dryer as closely as possible proved to deliberately assist the understanding process. Only this shape-changed circuit created the reliability between the abstract schematic representation of electricity on paper and the actual household product that it described. This finding finally led me to finally create a three-dimensional representation of a hair-dryers circuit made of bent wire and symbol cards. In this direct and close translation I had found a principle that I wanted to apply to a final product which ultimately led to the design process of the first product in this project, a hair-dryer.
graphical experiments with the schematic representation of circuits

workshop on the relation between colour and electronic events

design of a card-game on understanding the electric circuit
Design Process

I See A Black Box And I Want To Paint It White

The main threshold to repairing broken devices is the difficulty of understanding electronic products. This simple discovery from my personal research became the main content during the design process that followed. As repairing is a form of action, accessing and understanding are the two necessary prerequisites to it.

In order to solve the problems that the black-box poses, I defined the metaphor of the white-box that led me through the design process. As opposed to a black-box, a white-box describes a device whose inner components or logic are available for inspection. As a whole, its outside as well as its insides, a white-box is accessible to the user as is therefore meant to be opened. Furthermore, the white-box contains all the information necessary to understand its functioning. It is designed to communicate and aid the viewer in the understanding process. These two elements serve as the prerequisites for the third point: lastly, a white box is designed to allow the consumer to act, for instance, in the form of repairs.

These three words are the invitations that a white box embodies: It would be meant to be accessible and understandable, facilitate this in the easiest way possible, in order to, finally, allow the user to act. In the following chapters, the three main principles are explored and applied to an exemplary product, the hair-dryer, that serves as a representative for numerous electronic products in the household.

Accessing a white-box

The first invitation that a white-box embodies serves as a necessary prerequisite to the further steps of understanding and acting: it needs to be accessible. In terms of household electronics, this access refers to the possibility to open a device's casing in order to inspect also its interiors. Not only the functional exterior of an intact product, but also its technological interior should be included within the user's ownership of a product. Without the threads of losing the claim to the device's warranty, without specialized tools or prior knowledge, it's inner workings should be accessed easily.

In order to translate this abstract ideal of a white-box to the design of an industrial product, I approached the problems I faced during my research with a focus on
two things: the first step of opening the casing is followed by the second step of accessing the technological actors. At the example of a white-boxed hair dryer, I experimented with different ways to open its same distinctive exterior shape in different ways. Beginning with the classic constitution of two rather large pieces that I observed in most industrial products during my research, I continued to move closer towards more practical ways of accessing the products interior. How can products’ casings be opened that have been designed precisely for that purpose? The different form explorations resulted in a final proposal of numerous smaller product pieces that each allow a local and thereby precise access to the parts they shell. Each component could be exposed to the same level of inspection, as opposed to the findings of my research where occasionally parts had to be removed by cutting its connections before accessing the pieces underlying. The concept of parting the products into several pieces made a second radical change in the device’s constitution necessary. After all, the casing could not be divided without also dividing the cables that connect the different pieces. How can the circuit be protected while inviting the user to open and reclose the product manually?

Addressing the confusion that the cable connections within the previously tested devices caused during my research and the obstacle of having to occasionally cut and thereby permanently destroy soldier connections in order to access each part, I experimented with the idea of electronic bricks. In simple shapes, I created a small electronic circuit that erased the idea of cables with the more sturdy and clear concept of solid wire connections. Integrated into the products protective shell and characteristic shape, these connections can conduct electricity through mechanical contact of force rather than the chemical process of soldering. Furthermore, this mechanical idea could be applied to all of the single actors as well. During my research, I was occasionally able to observe electric circuits that were closed through screws that exercised force to connect parts, or copper clips that hold smaller actors in place and connection. If these principles would be uniformly applied to a whole product, the unnecessary and forceful breaking of connections and the specialized skill of soldering in order to repair would become obsolete. Similar technologic solutions have been applied to concepts of modular electronics such as google’s Project Ara, Samsung’s or the educative tools of xx. This gave me the confidence that the approach of electric bricks could be technologically realized and allowed me to integrate this principle into my design proposal.
Understanding a white-box

While the previous chapter described my process of developing concepts for the access to a product’s technological interior, the question to the second step was: How could this interior communicate to the user? After the access, the second necessary prerequisite to all acting was the understanding of the inner working of the product. Here, a white-box has the obligation to aid the user in this intellectual process.

For this step, I turned back to my research on communicating electronic circuits and combined it with the previously described concept of electronic bricks and their hard-wired circuit. As in the board game that I created for my research, the white-boxed hair-dryer should be constituted as a puzzle: it’s sturdy electric connections being visible to the user, its interchangeable electronic actors clearly defined and distinguishable.

The latter was supported by the colour research I had done with my workshop participants. Thereby could I draw up an intuitive colour-code for the abstract tasks that the electronic actors fulfilled. As the interior of a white-boxed hair-dryer was meant to be seen, it was meant to be designed. Colour here helped to communicate the identification by written instructions or through a possible service. The interiors’ design embodies the permission for the user to act also within its interior. Now, the single components don’t disappear in the darkness, but are clearly visible and colorfully marked.

The colourful actors were edged with the clearly defined circuit. During my research, the three-dimensional representation made such a big difference in relating to the actual products functioning that I would like to apply this principle to the product itself. It emphasizes the characteristic of a white-box and its invitation to be understandable. And it underlines the connections between each actor, the role it plays and the position where it has to act. The circuit is visible, clearly defined, on the inside – and also on the outside.

As the product is perceived as a puzzle through the previous described concepts, the re-assembly of the single pieces are just as much part of the understanding process. While I first concentrated on the devices interior in the representation of the circuit, attempts to reassemble proved that a visual aid on the exterior was necessary. Here, instead of adding the additional element of visual signs for only that purpose – indicating where two pieces need to be connected – I applied the three-dimensional representation of the circuit also on the products outer shell.

Acting in a white-box

Only through accessing and understanding the product’s interior can the third, but most distinctive invitation of
a white-box become possible: acting. As the project began with the motivation to repair broken electronics, repairing was the most obvious action that should be made possible through the white-box. As the product can be opened easily and the interior communicates to the user with distinct representations of the circuit and clearly identified parts, as well as through the use of mechanical instead of connections through soldering, the exchanging of broken actors is facilitated.

But can the proposed concepts lead to an even greater freedom of action for the user? At this point, I was fascinated by the question of what the idea of openness could mean for household electronics. Apart from the newly gained ability of the users to repair, I was lead by the question what further actions could evolve from a white-boxed device. Rather than exchanging previously broken parts, could new parts be added to the circuit as additional elements? The idea of updating, an already established concept in the world of the Internet of Things and Open Source, could also be applied to our physical devices. In the example of the hair-dryer, a supplementary block of new technology, such as the use of free-floating ions to smoothen the dried hair, could be added to the already existing circuit. Other devices could be equipped with sensors or platines to connect the device into the network of the internet of things with additional smart blocks.

This degree of freedom for the users could furthermore lead to the power to transform devices and their functions into completely new objects. Bricks could be added to change its shape to individualize its use, but might as well be altered to fulfill a completely different purpose. If apart from the hair-dryer that has been used as the exemplary product during the design process, the whole household equipment would be designed according to this white-boxed system, the consumers could be free to transform and decide the use accordingly.
Design Proposal

Open House – Reclaiming the technological interior of household electronics

The design process led to the proposal of an open concept for household electronics. Focusing on this general idea, this coherent system of products in the household has, for the frame of this project, been represented by three white-boxed devices: the hair-dryer, the hand mixer, and the table fan. Chosen for their intuitive relation through the electric motor as their shared actor they also fulfill the important criteria of familiarity. As all three objects are common parts of average households and they thereby create an immediate relation to the addressees of Open House: the regular users, describing people without specialized knowledge and experience regarding electric circuits, with an ecological desire to prolong the life-cycles of their products or the wish to strengthen their term of ownership before the industry.

Each of the three devices was designed after the in the previous chapter defined principles. Developed at the example of the white-boxed hair-dryer, previously defined features of the white-box have been equally applied to the table fan and the hand mixer. Rather than the exterior form that is commonly focused in most industrial design processes, the products’ technological interiors play the more important part in Open House and is emphasized through the design. It has resulted in three devices whose subtle outer shape corresponds with the semantics present in today’s market and households.

Yet, the devices are deliberately distinctive from today’s standards in the way that and how they can be opened by the users, allowing an inspection of all parts equally and without specialized tools. As an invitation to the user, the devices interiors communicate through colour, as do their single actors inside. Through the application of mechanical rather than chemical connections to close the circuit, the objects allow an easy inspection and replacement of each of the parts that constitute the machinery. Part of the collection are furthermore additional elements such as smart blocks. They can be combined with the existing circuits and allow for an extension of function and thereby manual technological updates. Underlining the concept of users’ action, their form breaks with the subtle exterior of the devices. Designed as a collection of single parts, the three products convey seemingly complicated electronic devices
as puzzles, accessible to the user and with new opportunities of action. Open House is not a description of a service and marketing concept, but an exploration of the physical qualities an electronic product has to fulfill in order to allow the user to act – and an outlook to what those actions might lead to.

Exhibition at Konstfack

Open House was exhibited during the Vårutställning at Konstfack University of Arts, Crafts and Design in Stockholm during in May 2018. To illustrate the open concept, I decided to display the project as the collection of all single pieces laid out for the visitors. Rather than exhibiting three fully-assembled white-boxed household appliances, the image of their dispersed parts communicated the evident openness of household electronics and gave way for the view and the underlined access to its interiors. For the purpose of the exhibition, a number of magnets were embedded into the rim of each of the parts. They hold the prototypes in place when assembled and allowed the visitors of the exhibition to experiment with the devices’ composition.

As an additional medium to convey the concept, I created a stop-motion animation of the finished prototypes in which the single pieces dis- and re-assemble themselves to explain the different features, possible actions and the main assembly possibilities of the three devices. “Most electronic devices in the household are black-boxes whose inner workings are inaccessible to the users. What if household electronics were instead designed to be white boxes?”, were the two introductory sentences that marked the beginning of the animation. While the 3 min long video playfully communicated through its moving images, the three titles "Access", “Understand” and “Act” parted the movie into three chapters each highlighting the certain features.

While I considered the term “black-box” of system theory to be common knowledge, I was proven wrong by the visitors of the exhibition that I approached to explain and discuss my project. Yet, they unanimously agreed with meaning behind the term and were aware of the problems that black-boxes cause for the users.
Summary and Reflection

With Open House, I have explored the power of industrial design to unravel the inner workings of everyday machines – in order to invite the user to make acquaintances with the machinery. Through researching the obstacles of repairing electronic products, I have investigated the physical qualities of products to invite, communicate and assist users to act in the technologic interior. Open House has been exhibited at the Varutställning at Konstfacks University of Arts, Crafts and Design from the 17th to the 27th of May 2018.

Before the background of our increasingly technology-driven society, I have investigated the relationship humans have not with the ends, but the constituting means of these technologies. The reflections of Albert Borgman have been a main influence in this work. They describe the relationship to electronic products in the sense of ‘black-boxes’ which separate realities through devices that deliver commodities where the actual labour carried out is hidden. While delivering comfort, they alienate the users from the actual physical events, causing a sense of dependence and helplessness in regard of the inner workings. Motivated by this resulting inaccessibility of the actual electronics inside our household electronics, Open House illustrates a vision to empower the users to reclaim the interior of their own products.

In order to answer to the problems that the relationship to black-boxes poses, I have defined the metaphor of a ‘white-box’. This ideal represents the characteristic to be accessible, understandable and allow for the ability to act – and thereby re-empower the users of electronic products. Rather than describing the detailed future scenario in which white-boxed devices would be embedded, I chose to focus on the physical qualities that the white-box embodies and, therefore, on the parameters that can be directly influenced by the discipline of industrial design.

These qualities have been illustrated through three exemplary devices which represent the vast number of everyday machines in the household. The white-boxed hair-dryer, hand-mixer and table-fan describe an open system of household electronics. While each of the products were deliberately designed to be opened-up by the consumer, their interiors are meant to be accessed, seen and communicated. Furthermore do the devices allow for the user to take action: By repairing and exchanging parts in the circuits and even adding new elements to update and extend functions. The freedom of action is furthermore illustrated by the ability to transform the functions, creating the dryer, mixer, fan or individual devices that can’t semiotically fit any category. Open House
shows a scenario in which electronic products are perceived as building bricks of a bigger, open system.

The exploration of the intellectual action of understanding and consumer empowerment in close relation to the physical form of a product has illustrated the power of industrial design to change the industrial system in which it operates from the inside – potentially allowing for new understandings and relationship to form. While this work on the physical qualities of a product was my focus during this project, the concept allows for further development to represent a coherent scenario. For this step, the artefacts would need to be embedded in a product-service-system which would guide the user through the process of trouble-shooting and provide with spare parts as well as physical extensions in a system of circular-economy. The choice of the single devices of Open house has created an intuitive relation among them and thereby helped to communicate the concept. A tempting challenge for the future development of Open House would furthermore be to add devices to the system that work with distinctively different main actors, such as water pumps, heating plates – or purely electronical actors based on digital events such as platines. How far could the idea of white-boxes reach into the everyday machines of our increasingly complex, technology-driven society?
Referenser


