DYNAMIC PRODUCTS: AN INSTRUMENT FOR SAVING RESOURCES. IMPROVE USER'S AWARENESS THROUGH DESIGNING PRODUCT EXPERIENCES.

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Abstract

Nowadays, householders hear about the need to reduce their resources consumption, but they are still not really conscious about the amount of their daily usage.Studies proved that giving to householders clearly feedback can help them to be more aware about their consumptions and they can positively motivate users to not waste resources.In this context the role of the industrial designer seems to be marginal, but thanks to new materials and technologies, designers can create artifacts more attractive and fascinating for engaging users, such as designing Dynamic Products. The aim of this research is to investigate Dynamic Products as a medium for transmitting information about resources' consumptions. In the first step of this study, a literature research has been performed in order to identify the characteristics of the information that have to be conveyed; in the second step those findings have been compared to previous researches on Dynamic Products for exploring advantages and limitations in this field. In this study an important role of industrial designers has been emerged, who can help users to be more aware about their consumption creating new engaging product experiences.

Keywords: Industrial design, saving resources, Dynamic Products

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1. INTRODUCTION

Waste resources means "to use, consume, or expend thoughtlessly, carelessly, or to no avail" (dictionary.reverso.net).
In this study for resources we mean Food, Energy and Water.
The excessive use of resources (such as: Food, Energy and Water) is strongly depending on the user's behaviors. In several circumstances, the wrong behavior adopted in the home is one of the causes of increased resources use (Barilla center food for nutrition, 2012; Darby, 2006).
Also in the definition of Food Waste, Energy and Water conservation, the importance of user's behavior is underline: *"Food losses refer to the decrease in edible food mass throughout the part of the supply chain that specifically leads to edible food for human consumption. Food losses take place at production, postharvest and processing stages in the food supply chain Food losses occurring at the end of the food chain (retail and final consumption) are rather called "food waste", which relates to retailers' and consumers' behavior."* (Parfitt et al., 2010)
"Energy conservation is reduced energy consumption through lower quality of energy services, […] Often it means doing without to save money or energy. It is strongly influenced by regulation, consumer behavior and lifestyle changes." (Herring, 2006)
Water conservation is *"Water management practices that improve the use of water resources to benefit people or the environment."* (Alberta Water Council's Water Conservation, 2007)
For better defining the importance around the increasing of resources usage, different statistic studies were performed. The European Commission estimates that more than 1.3 billion tonnes of food, or 1/3 of global production, are wasted every year. This datum account for the 89 million tonnes of food (that means 179 Kg for person) in good condition which is squandered each year in the European Union (EU commission, 2012)
Domestic electricity consumption is the second cause of waste, representing the 27% of the all usage; whereas energy used for public transportations is 30% of the total (Bertoldi and Atanasiu, 2012).
As a paradox, lighting was the first service offered by electric utilities and it continues to be a major source of electricity consumption (Herring, 2006).
Each European uses, on average, 100-200 liters of tap water a day (European commission, 2010). In Italy, Istat (2012) investigations point out that each person uses 182.8 liters every day.
Those data underline the importance of saving resources especially in a domestic context.
Designers can help householders to save resources giving them the right information about their consumptions. Feedback can be used as learning tools that can help users to be more aware about their behaviors. The process of giving information on consumption motivates consumers to save energy through reduced waste. It was demonstrated that clearly feedback lead to decrease energy consumptions from 5% to 15% (Darby, 2006).
Product designers can contribute to saving resources designing communicative artifacts. Recent studies (Colombo and Rampino 2013; Colombo, Bergamaschi and Rampino, 2013; Colombo, 2014) have theorized a new category of communicative products able to convey information through their materiality. Those artifacts are able to transfer messages to users changing one or more of their features, for instance Skin-Bone (Fig. 1) is a necklace that changes its shape to show the stress level of the wearer.

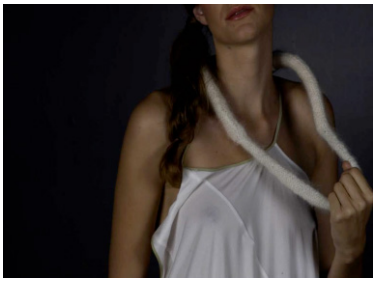

Figure 1. Skin-Bone by Secil Ugur

These transformations can be addressed to different sensory stimuli (visual, tactile, olfactory and auditory stimuli). The exploration of senses allows designers to design multisensory experiences that can be a fruitful strategy for engaging user through products. Moreover, designing engaging experience can give prominence to messages conveyed through products that become memorable and enjoyable (McLellan, 2000).

2. OBJECTIVE

In this research, the theme of domestic wastefulness is viewed by a product designer point of view. The aim of this investigation is to better understand the role and strategies that the designer can use to make users aware about their consumptions of: food, energy and water. That awareness can be useful for helping users to change their behaviors in order to be more sustainable. Information about the consumption can be convey by product designers through industrial products.
The product designer is strongly familiar in working with materials and tangible features for creating new products and new scenario.
Thanks to new materials and the development of new technologies, the physical features can become the support for the communication, for instance products can change their features (such as shape, color, texture, etc..) for conveying information to users (as shown in Fig. 1).
Products that show these changeable features are defined in previous researches as dynamic products. (Colombo and Rampino 2013; Colombo, Bergamaschi and Rampino, 2013; Colombo, 2014).
The aim of this research is to verify if dynamic products can be a fruitful strategy for encouraging householders to be more sustainable in their daily life. If yes, advantages and limitations of dynamic products as an information medium for conveying data about users' consumptions will be explored for providing suggestions to designers who want to approach the design of dynamic products for saving energy, water and food in a domestic context.

3. METHODOLOGY

This study is based on results coming out previous researches on dynamic products. The process we followed consisted in merging knowledge coming from our previous studies on dynamic products and the findings found thanks to the literature research about the theme of saving-resources.
The research process is summarized in three different steps:

1. Previous studies on dynamic products that have carried out by our research group in the last years
2. Literature research
3. The investigating the possibilities offered by dynamic products comparing the step 1 and 2

As first, previous research those we have carry out on dynamic products presented. In those studies (Colombo and Rampino 2013; Colombo, Bergamaschi and Rampino, 2013; Colombo, 2014), we investigated the communicative intent of these products thanks to the collection of case studies.
Literature research was performed for better understanding the possible role of these products. The aim of this literature research is to create an overview about the theme also looking at disciplines different from product design**.**
The findings obtained thanks to literature research are compared with results of previous studies on dynamic products.

3.1 Dynamic Products: previous researches

Previous research has permitted to define Dynamic Products as artifacts with sensory features that can change proactively and in a reverse manner over the time, activating one or more user's sensory modality (Colombo, 2014).
For instance One Kettle (Fig. 2) is a kettle that informs users about the temperature of the water inside showing a texture on its surface. This kettle at ambient temperature is white but when the temperature is increasing a colored texture appears. That change communicates that the water inside is boiling and the tea can be infused.

Figure 2. One Kettle by Vessel Design.

Dynamic products involve not only visual stimuli for transmitting information (such as virtual interfaces) but involve also smell, hearing and touch stimuli.
Designers, designing dynamic products, can create multi-sensory experience that can be a fruitful strategy to engage users during the interaction with products (Desmet and Hekkert, 2007).
Designer can also design for a sensory stimulus instead of another according to the content of the message (Colombo, Bergamaschi and Rampino, 2013); some sensory stimulation, such as vibration, can alarm the user; who is activated instinctively to do actions or to give a cognitive answer.
The collection of case studies (Colombo, Bergamaschi and Rampino, 2013; Colombo and Rampino) point out that dynamic products are not spread in the market, which means that users are not familiar with them. Thanks to that, in several cases this artifacts are perceived as a novelty and often they elicit positive and pleasure experiences. Surveys made with users point out those experiences of dynamic products are described as: charming, pleasantly surprising, and they can create sense of admiration and desire (Colombo and Rampino 2013).
Positive experiences, those are generated by dynamic features, can support the motivation of users. Positive emotions can encourage the users to interact with the products itself and can catch their attention to the message transmitted by the artifacts.
The particularity of dynamic products is to communicate through their materiality and their physical presence. That can be an advantage because product itself can remind to users the message through their presence also if the changes are not activated.
In addition, designers can work on the aesthetics and on dynamic sensory stimuli (such as visual stimuli, tactile stimuli, hearing stimuli, or olfactory stimuli) for create cognitive associations; which are linked to the message conveyed through products. Those cognitive associations are defined as Metaphors. Metaphors can remind to users some words, ideas, and values. For instance, if the designer want to convey messages related to nature, dynamic products could be metaphorically connected to sounds and aroma that remind it.
Previous study (Colombo and Rampino 2013) has shown also limitations for dynamic products. Messages transmit through dynamic products have to be simple, because complex data are difficult to transmit by basic sensory transformations, in an effective way. Often the simplicity could represent an advantage, but in some case it can be a limit, since the accuracy of information is reduced. For this reason complex messages are better expressed through other system support by alphanumerical language as the digital interfaces.
This study tries to add knowledge about the fields in which is possible to apply dynamic products, such as for helping people to decrease their domestic wastage.

3.2 Literature review

During the literature review not only the product designer point of view was considered, since the objective of this investigation also concerns other disciplines such as: persuasive technologies, interaction design and experience design.
For better understand the state of the art of these disciplines in the investigated field a literature research was carried out, using as a keywords the aim of this research: “saving resources”.
Literature research points out several studies about the usage of feedback for leading people to reduce their daily consumptions, in particularly talking about energy.
The first study on energy conservation was performed in the 1970 (Darby, 2006). During this first experiment, researchers observed that informing householder about the amount of electricity consumed in a day related to the perfect amount of daily energy consumption, leads users to change their behaviors.
In this first experiment data about the usage were written by the researchers on a post-it that was put on the kitchen’s window of participants. Nowadays, thanks to the development and the diffusion of computers and new technologies, digital interfaces become the most diffused way for giving feedback to the users. Several studies in the field of persuasive technologies were performed (Fogg, 1999; Marcus and Jean, 2009; Fitzpatrick, and Smith, 2009; Kim et al, 2009; Petkov et al, 2012) and some of them try to give to designers some guidelines for designing interfaces able to persuade and motivate users to be more sustainable.
In the field of product design, interesting results were achieved by critical design. For instance the Heat-Sensitive Lamp designed for the project Static! (Backlund et al, 2006). This lamp changes its shape during the usage, since the material of the lampshade melt with the heat of light bulb (Fig. 3).
This lamp cannot be considered as a dynamic product, since its changes are not reversible.

Figure 3. Heat Sensitive Lamp by Interactive Institute & Front

In order to point out some suggestions useful in design practice, only studies that provide test with users were considered.
Comparing data collected, it is possible to evidence the main features that designers have to consider when they design a medium for conveying resource’s saving information. Those characteristics are collected in three main concepts: Metrics that is the unit of measure of the data transmitted (for instance quality or numerical data); Frequency, when and how many times is necessary to give the information to users; Representation, describing the different way in which is possible to figure the information. The last feature is the most important for involving users and for persuading householders to save resources.
About the metrics, studies (Fitzpatrick et al, 2009; Jacucci et al, 2009) were carried out for comparing different unit of measure, such as the amount of CO_2 emitted, the cost over energy and the amount of energy used.
In those studies was observed that financial savings as a motivator is not effective in a long time (Jacucci et al, 2009; Darby, 2006) because it is strictly connected to low incomes and to the financial crisis.
Fritzpatrick and Smith (2009) point out that numerical data such as the amount of CO_2 emitted, could lead users to misinterpretations. For overcoming that problem is better to transfer qualitative data.

About Frequency, was observed that continuous information are preferred instead of when something is changing in the usage of resources. That means that users need to be informed from the product whenever they want and they feel the need instead of when something wrong is happening.
Moreover, studies show that it is better to have historical details about consumption so the users can compare their behaviors in a fixed period, for instance they can compare their usage of resources day by day. Thus, they can learn about their consumption trends.
Several studies were focus on the representation of sustainable data.
Analyzing the motivations behind the resource-saving behaviors some researchers (Petkov et al., 2012; Jacucci et al, 2009) observed that is better to give a positive message to users rather than presenting the negative impact of their behaviors.
Moreover, Petkov et al. (2012) highlight that feedback proved should show vision close to users (such as information regarding local plants and local animals, user's neighborhood ,etc..).
In other words, it is better to remind to householders how they can contribute to conserve resources showing scenarios closed to their everyday life rather than showing how they are damaging the environment with their daily careless behaviors.
As we said, ordinary people not always are familiar with the scientific measure (such as the amount of CO_2 emitted and the amount of energy used) thus, designer could transform numerical data in qualitative data designing metaphors. Metaphors could be easily understood and the messages conveyed are more immediate.
Test with users shown that the messages conveyed with metaphors are able to be more engaging and they led users to be sustainable in a long period (Kim et al., 2009).

3.3 Dynamic Products as a medium for fostering resource-saving behaviours

Thanks to the literature research different ideas for designing feedback were emerged. Making a comparison between the previous studies on Dynamic Products and the findings in the literature research, it is possible to verify if dynamic products can be used as a medium for giving information to users about their consumptions.
As a first result, the findings of steps 1 and 2 were compared. Thus, the three main concepts underlined in the literature review (Metrics, Frequency and Representation) were related to dynamic products.
Metrics: as some studies point out, numerical data are often difficult to understand for ordinary people, so designers can take advantage of the changes features of dynamic products for conveying qualitative information. Those are more intuitive, easy to read and to understand.
In previous research (Colombo, Bergamaschi and Rampino, 2013) the easiness of dynamic products to convey quantitative information was observed. For instance Coral cooking by William Spiga & Juliana Martins transmit information about the temperature of the pot changing color from blue to red to indicate the increase of its temperature instead of using numerical data (Fig. 4).

Figure 4. Coral cooking by William Spiga & Juliana Martins

Frequency: it is preferred to use continuous and comparative feedback. On one hand, continuous feedback allow users to read the information about their usage whenever they want and need; on the other hand, dynamic products can change proactively and in a reverse manner over the time. Dynamic features can be designed in order to change for showing real-time information.
For example E-Plant (Fig. 5) lights up and changes color to constantly indicate the amount of energy consumption in the house.

Figure 5. E-Plant by The Signers

More accurate reflections have to be made regarding the comparative feedback. Previous studies had shown that the information that can be conveyed through dynamic products have to be simple; comparison feedback could add complexity to products; thus, they could be required more investigations.

Representation: studies put in evidence the importance of positive messages (such as: good! today you have contribute to save the local plant!), metaphors and visions close to users. dynamic products communicate to users by stimulating different sensory channels; such sensory communication can give rise to metaphors, thanks to the consistency between the aesthetics and the sensory stimuli employed. For instance if the designer wants to create a link with nature he can designing some transformable feature, such as diffusing smell, changing colors or texture, etc.; those changes can remind to users the natural world (as a flower that blossoms, a tree that loses its leaves; etc.). If dynamic products are designed in the correct way, they can engage users through metaphors; those are useful for attracting householder and leading users to be sustainable in a long term.

For instance, Flower Lamp (Fig. 6) changes its shape (as a flower opens its petals) on the basis of the energy consumption in the house.

Figure 6. Flower lamp by Interactive Institute Swedish ICT

Moreover, previous studies point out that dynamic products can convey messages through different sensory stimuli (such as changing color, texture, aroma, sound); that means that designers can give prominence to messages using the appropriate stimulus related to the message (for instance if the message have to be read urgently the designer can use the vibration, that is able to activate immediately the users, on the other hand if the message is not urgent the designer can convey it through visual stimuli such as changing color).

Designer can also use changeable features for interfering or promote actions; for instance artifacts can become easy to use (such as lightweight to move or easy to open) if the resources consumptions are sustainable; on the contrary, they can become hard to use (such as heavy to move or difficult to open).

For instance the concept Eco Drops designed by Tommaso Colia (Fig. 7) changing the texture on its surface that annoys user when he/her stays for a long time in the shower.

Figure 7. Eco_Drops designed by Tommaso Colia

As a conclusion, the comparison between previous studies on dynamic products and the finding of literature review has highlighted that dynamic products show potentiality in the investigated field. On one hand, these artifacts are able to trigger engaging experiences; those involve users during the interaction with artifacts and give prominence to the message conveyed. On the other hand, the three concepts point out some insights for designing dynamic products as a medium for transmitting information about the consumptions of energy, food and water.

4. FUTURE WORK

In this research we focused on theoretical aspects take no notice of design practice. This investigation has permitted to add some insight for designing dynamic products focused on a domestic context and for leading users to decrease their consumptions.
Additional considerations have to be made regarding the application in a design process of the insights found thanks to this study.
Future research can evaluated those suggestions by testing them through design activities and questionnaire with users. The next step is to organize a workshop involving product designers, asking them to design dynamic products for giving feedback to users about their resources' consumptions, focusing on one of the three resources that are considered in this study (either food or energy or water). Designers are asked to consider the three main concepts that were presented in this study: metric, frequency and representation. At the end of the workshop, product designers will be interviewed for collecting their impressions and their comments about the whole design process. At the conclusion of the design activity a collection of concepts and prototypes will be expected. Thanks to these concepts and prototype will be possible to make some tests involving the end users of these products for understanding also the impressions and the evaluations of the people, who will use dynamic products for decreasing their consumptions.

5. CONCLUSION

This research points out that dynamic product has some potentialities for encouraging householders to be more sustainable in their daily life.
This category of products can take advantages from the involvement of senses. Senses can create engaging experiences that can be designed for motivating, reminding, and giving prominence to the message conveyed through the product.
Based on previous studies on the communicative potential of Dynamic Products and on a multidisciplinary literature research about saving resources, this investigation provides some insights (in terms of: metrics, frequency and representation) for product designers who want to lead users to decrease energy, food and water consumptions.
As a conclusion, this research is the first step towards the exploration of the possible application of dynamic products as a medium for giving feedback about the consumption of food energy and water consumed in a domestic context.
Future works will be performed about the applications of these suggestions in a design process for testing both the product designer's point of view and the user's point of view.

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