iLook: a Zoomable User Interface to support the interaction with home appliances

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ABSTRACT
iLook is a User Interface designed to support everyday interaction between people and home appliances. Following the project brief we focused on four potential assets: a) remote control; b) energy management & saving; c) community & networking; d) support & maintenance. Through a participatory design process that involved both end-users and stakeholders, we devised an information architecture to support people in many everyday scenarios of activity. We defined five levels of possible interaction with home appliances in the physical space and mapped the four fields of interests on each level. As a result of the process we present iLook, a Zooming Interface (ZUI) that embodies some focus+context features and allows the integration of the different assets on the different home appliances in one unifying context.

Categories and Subject Descriptors
H.5.2 [**Information Interfaces and presentation**]: User Interfaces- *Evaluation/methodology, Interaction styles (commands, menus), Graphical user interfaces (GUI).*

General Terms
Design, Experimentation, Human Factors, Theory.

Keywords
Participatory Design, Information Visualization, focus+context, zoomable user interfaces, Sense Making.

1. INTRODUCTION
The paper addresses the design of new services for users of home appliances (dishwasher, washing machine, refrigerator and oven) exploring the use of digital networked technology. The four leverages that Indesit Company, one of the leading firms of home domestic devices, was considering were: a) remote control; b) assistance and maintenance; c) ecological-economic impact; d) social networking. The design brief was pretty clear about the expected results: the proposed services (infrastructures, functions, interfaces, interactions) should create for the final user an unambiguous added value regarding the reason, the motivation and the experience of buying and using home appliances. We will describe two of the main steps of the participatory design process that lead to the current working-in-progress solution.

2. THE PARTICIPATORY DESIGN PROCESS
A design process concerning home appliances must consider as a lead the users point of view in a real-world setting because interacting with domestic appliances is a well established human activity for which every end-user has clear aims and for which he or she can define specific conditions of satisfaction [11]. For this reason we chose a participatory design approach (PD). Our goal was to collect suggestions based on everyday experience and to envision new possible services for home appliances with the direct involvement of final users. We focus in this paper on two essential steps of the design process: a) the future workshops phase that we integrated with the use of cultural probes [5]; b) the role prototyping & concept design phase.

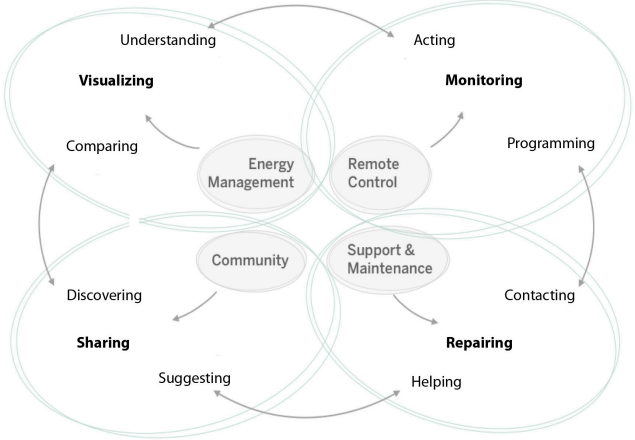

Figure 1

We started with preliminary contextual interviews to end-users that we can sum up in the following statements: a) the four assets clearly have a different importance in users perception (i.e. saving money and energy is considered more important than every other issue); b) the services should be available on different devices: appliances display, smart-phones, tablets, personal computers, ad hoc devices; c) the mood should not be that of domotics but that of a more "under control" environment that would allow graceful degradation from system control towards manual control/mixed control. Furthermore the interviews showed that the perception of the home appliances technology was strictly correlated to their User Interface. This happens because the interactive services in the house are not developed as new ad-hoc technologies but are adaptations of standard patterns converging from mobile and networking fields. This situation determines a wide ambiguity of

User Interfaces in the different home appliances since they appear as a collection of different pattern of interaction rather than an integrated unit. For an investigation of this ambiguity see [10].

2.1 Future Workshops and Cultural Probes

We organized two Future Workshops (FW) involving both users and stakeholders from Indesit Company with the aim of exploring user's perception of home appliances. A FW is a creative session where a group of people with different background and role in a design process work together on envisioning new ideas and solutions for socio-technical matters [14]. We adapted the FW structure splitting it in two separate sessions within ten days. Our goal was to let participants spend the time between the sessions rethinking of the resulting concepts in their everyday activity with home appliances. In the first meeting designers, managers, technicians of Indesit Company and end-users were divided in small random groups and worked to create concepts and a suitable context of use starting from the scenarios produced after the contextual interviews. None of the end-users involved knew anything about the focus of the design brief (i.e. the four assets). At the end of the first FW people defined 28 different concepts, envisioning new possible services for home appliances. For instance people imagined energy tokens to place in every home appliance so to have an association between a physical item and an immaterial one such energy consumption; another concept was a community of users for sharing in real time information on how to set the dishwasher, advices on using the oven and save energy and tips on how to repair broken washing machine.

The concepts were laid down in a two-dimensional surface and clustered in five categories, four of which corresponded quite well to the assets of the brief, the fifth category concerned the envisioning of new appliances (i.e. a new portable hood). After the clustering the concept were reduced to 16 and for each one Users and designers created a Concept card structured with a title, a few key features, a brief description and some evocative images. (See in Figure 2 an example of the concept Eldo Jones created during the FW).

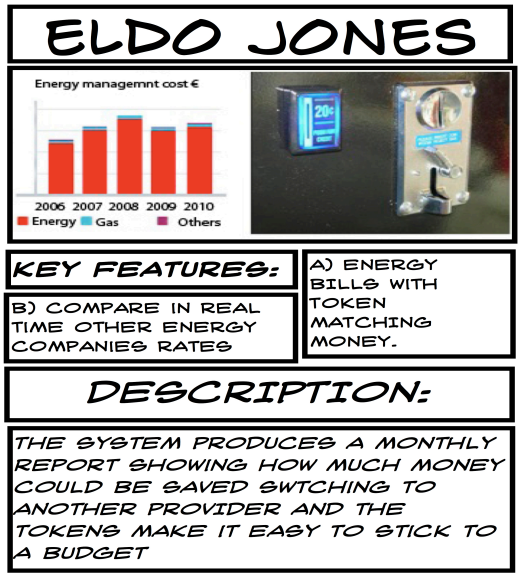

Figure 2

After the first session each participant adopted a concept and was also given a diary and instructed to use a mobile phone or camera to take shots for documenting events and interactions while casting the concept to their usual environment. The rationale for combining FW with a focused version of the cultural probe method [8] is to be found in the situated nature of human cognition. It does not matter how sophisticated are the scenarios that can be produced to explore a concept. It's only when the concept meets the real setting that it can be properly explored [13]. In the second FW the script of diaries were shared so that each concept could be enriched by the experience of all the participants. Then the concepts were evaluated by the end-users in a plenary session highlighting strong points and weak points and clustered, so they were reduce from 16 to 6. Each of the resulting concepts embodied also the most appealing features of the discarded ideas. As an output of the concept generation phase we observed an early convergence among the four assets even though the resulting ideas were lacking precise organizing principles.

2.2 Role prototyping

The second step of the design process we focus on here is the role prototyping session. Role prototyping is part of a three dimensional model made of role, look and feel and implementation [6]. We focused on the role issues to explore how the concepts provided new opportunities for users everyday activities. When introducing new functionalities the most important questions concerns exactly what that role should be and what features are needed to support it. Role requires the context of the artefact's use to be established. In our process this meant envisioning the more convincing everyday scenarios to express and latent features of each concept. To this aim we conducted a workshop with 22 Interaction Design students and shared with them the brief and concepts expressed in the earlier phase. The students were organized in six groups and each group worked on two concepts, so that each concept was elaborated concurrently by two teams.

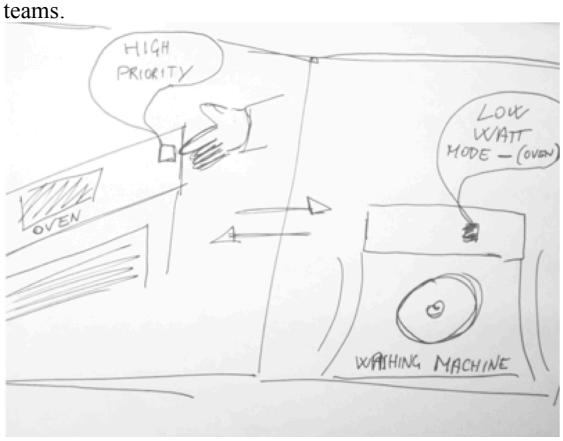

Figure 3

2.3 Aggregating the concepts in iLook

The rich sequence of everyday scenarios and design solutions were elaborated in plenary session and in the attempt to give them an organizing schema the iLook solution emerged. iLook is a lens that allows to interact with home appliances at five different levels along the spatial dimension: e.g. from the inner components of an appliance, the INSIDE level, to the community of users of all the home appliances, the WORLD level. iLook, allows both to merge features of the different assets in one level and distribute them on different levels.

2.3.1 iLook different levels

The five levels are:

a) INSIDE: to show what the inner components of every single Home appliance are and interact with them;

b) ELDO: to extend and make available anywhere the interface of home appliances;

c) HOME: the default level. To let people have an overview of all the devices connected in one specific house among the ones potentially under control and check other houses too;

d) INDESIT: to let people receive information and help from the factory that produces electrical appliances;

e) WORLD: to allow people share their practices of everyday use of the home appliances.

Each level embodies some features of the four assets as elaborated in the role scenarios, and the contents are mapped so that the passage from one level to another is as seamless as suggested in the activity scenarios developed during the role prototyping phase.

2.3.2 Which UI for iLook different levels?

The key feature of the above hierarchy consists in the analogy with the physical space where the information is located. The services within iLook become the landmark of a conceptual space that is analogue the real physical space [2]. In the real world the information is spread in different places and never fully available at one time so users need to change source to find what they need. What is good about the physical space though is that this limited availability of information often provides a natural constraint that let users achieve their goals smoothly. This is a key feature for the design of a UI and it's necessary to establish in a prototype a matching representation with what happens in the real world. Interacting with home appliances usually occurs through common gestures not to be ignored in the design of the UI. Our aim then is to rely on those physical patterns of interaction and provide the users with a single tool to retrieve information and carry out tasks while in the real world they would be interacting in different environments. To make an example we imagine a user who can easily see the instant overall energy consumption and some general info like the weather in HOME level where all the information about the appliances in the house is. Then he moves to ELDO to program the washing machine, or even to the INSIDE if he wants to check if the inner components are working or need maintenance. The same user can switch to INDESIT to browse among different washing cycles or to WORLD to find other people experiences with laundry issues. Once defined the main conceptual structure of our concept we had to face the challenge of a proper information visualization [3], [4]. Our goals were: a) Building an effective User Interface that could work on different devices such as refrigerator displays, smart-phones, tablets; b) Giving the user access to a system where almost no training was needed; c) Allowing seamless passage from one activity to another through meaningful interaction; d) Reducing the complex and iterative process of information retrieval and task redefinition for each new activity; e) Allow the user to recognize patterns and anomalies in the information about energy consumption and appliances settings.

3. iLook USER INTERFACE

We describe in this section two early prototypes of the User Interface for iLook. Both of them were conceived as Zooming User Interfaces [1]. A ZUI has the aim of letting the user focus his attention only on the small part of the available information he needs for a single task. We designed a lens named iLook which only display contextual information for every level and also provides the user with some cues to anticipate other possible explorations of the system.

3.1 Early stages iLook mock-ups

The first animation mock-up was developed using the zooming presentation editor Prezi (prezi.com) to implement the zooming effects; in this phase we had not fully defined the interaction and interface detail, just the main information architecture and the navigation through the levels. The opening transition of ILook features a lens designed starting from Indesit Company logo, where the "i" becomes the handle of the lens and the circle becomes the edge.

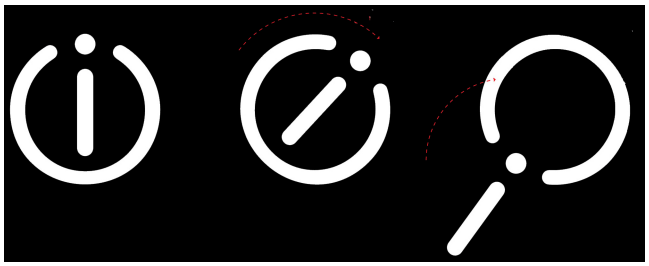

Figure 4

The transition effects between the information layers are enabled by the lens effect. The user zooms across levels and the same interaction is enabled on different devices such as refrigerator displays, smart-phones, tablets. In this mock-up there is an atom view with rings that widen or tighten depending on the focus. The main focus is on the activities held by the users. In figure 5 we show an example of the level ELDO. The User can choose which appliance he can manage and slide through all the appliances connected. The lateral icons for community, maintenance, energy, remote control, appliance works as graphical cues to the possible actions that can be done at this level.

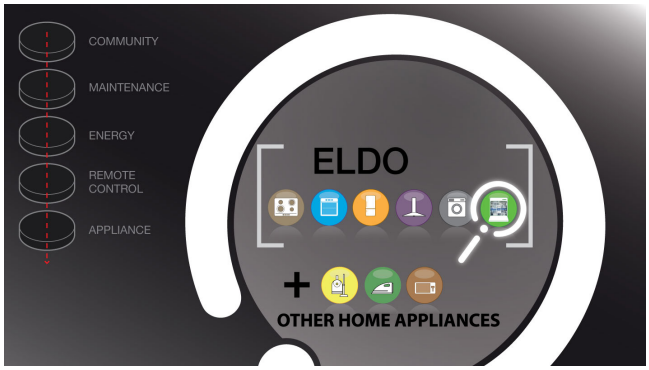

Figure 5

For instance in figure 6 we see what happens when selecting a washing machine and tapping on the appliance icon. The user directly interacts with the controls of the appliance and can remotely programme what time the washing starts and which options he wants to select. On the lower part of the figure is displayed a preview of the information available at INSIDE level regarding the inner components of the selected appliance.

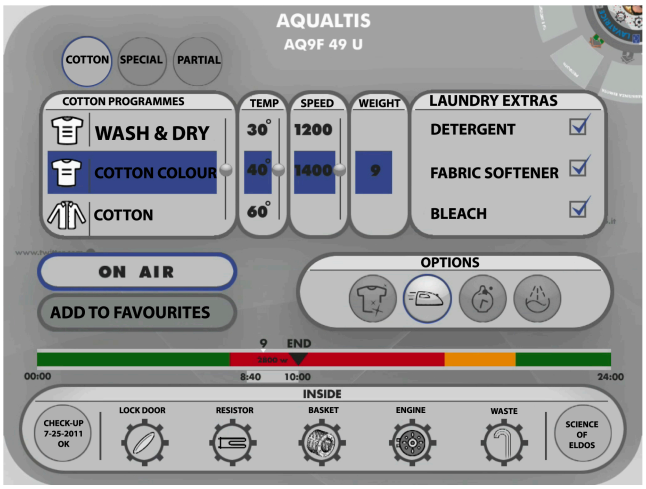

Figure 6

The second mock-up we present in figure 7 and 8 shows the interaction at home level and the passage from HOME to ELDO. Compared to the mock-up presented above this was realized using Adobe Flash and presents a different visual display of information. In figure 7 we see information on the selected house. There are two indicators in the user area of main focus: one for monthly overall energy consumption and another for instantaneous consumption. On the top part information from renewable sources of energy is provided such as how much kw/h are produced by photovoltaic panels and wind wheels. The four icons in the lower part represents the home appliances monitored in the house. Tapping on an appliance enables the control of the selected one.

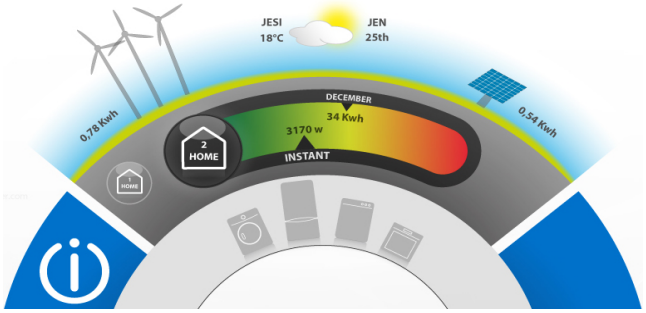

Figure 7

For instance in figure 8 the users zooms to ELDO level and manages the washing machine. The central layer now is no more related to energy in the house but to the monthly overall and instantaneous energy consumption of the selected appliance. The external layers now display information on how much energy is consumed by different kind of washing and enable the selection of the washing program in remote.

Figure 8

3.2 iLook interface: evaluation

We conducted an evaluation of both prototypes through activity scenario with end users and stakeholders. Our goal was the testing of the visual organization and the navigation between levels. In this paper we only report the guidelines we collected for the further graphic implementation of iLook: a) Replicate in the UI the interaction at the different levels as it is in the physical world; b) the focus must be kept on people goals without distracting them with too much information; c) similar contents need to be represented to afford different types of interaction. For example searching for assistance in a web community has much more sophisticated interaction than retrieving the same information reading manuals.

3.3 iLook interface: refinement

On Figure 9 we show one of the solutions we adopted. It embodies many of the zooming features of the early prototypes along with some new focus+context solution coming from the suggestion of the users. In the centre we have the user surrounded by his appliances. The main focus for the user is on energy consumption, but he also has the possibility to explore the appliances features and access information about remote assistance and news. At HOME level, in fact, the screen displays multiple layers. At a first glance the observer sees information on overall and instant energy consumption, with some advice on how to save money (i.e. delay washing machine cycles to cheaper time of the day). At an upper layer the timing of the day is shown with the programmed activities for home appliances in highlight – *washing at 10 am, pizza at 8 pm*-. In the background the weather forecast is displayed so that, alternative sources of Energy are used whenever it's possible -*solar and Eolic, in this case*-. The social networks are like planets orbiting around the house. This way the user can browse content both in relation to the information in focus and in context. The interaction deliberately distances from the usual patterns of web browsing and introduces a model that fits the use of mobile systems. Considering the wide range of tasks involved in the management of home appliances and how they could potentially benefit from the four assets proposed in the design brief, the external representations that could be of help should embody three main viewing modalities: a) an overall control of every home appliance connected to the system (figure 9); b) A view that let users carry out a single task without being distracted by an information overload providing at the same time meaningful transitions through each level (figure 6); c) An augmented modality that displays invisible information into the real world setting -i.e. the state of each appliance's inner parts or energy consumption visualized as graphs through the use of augmented reality tags- (figures 10 and 11)

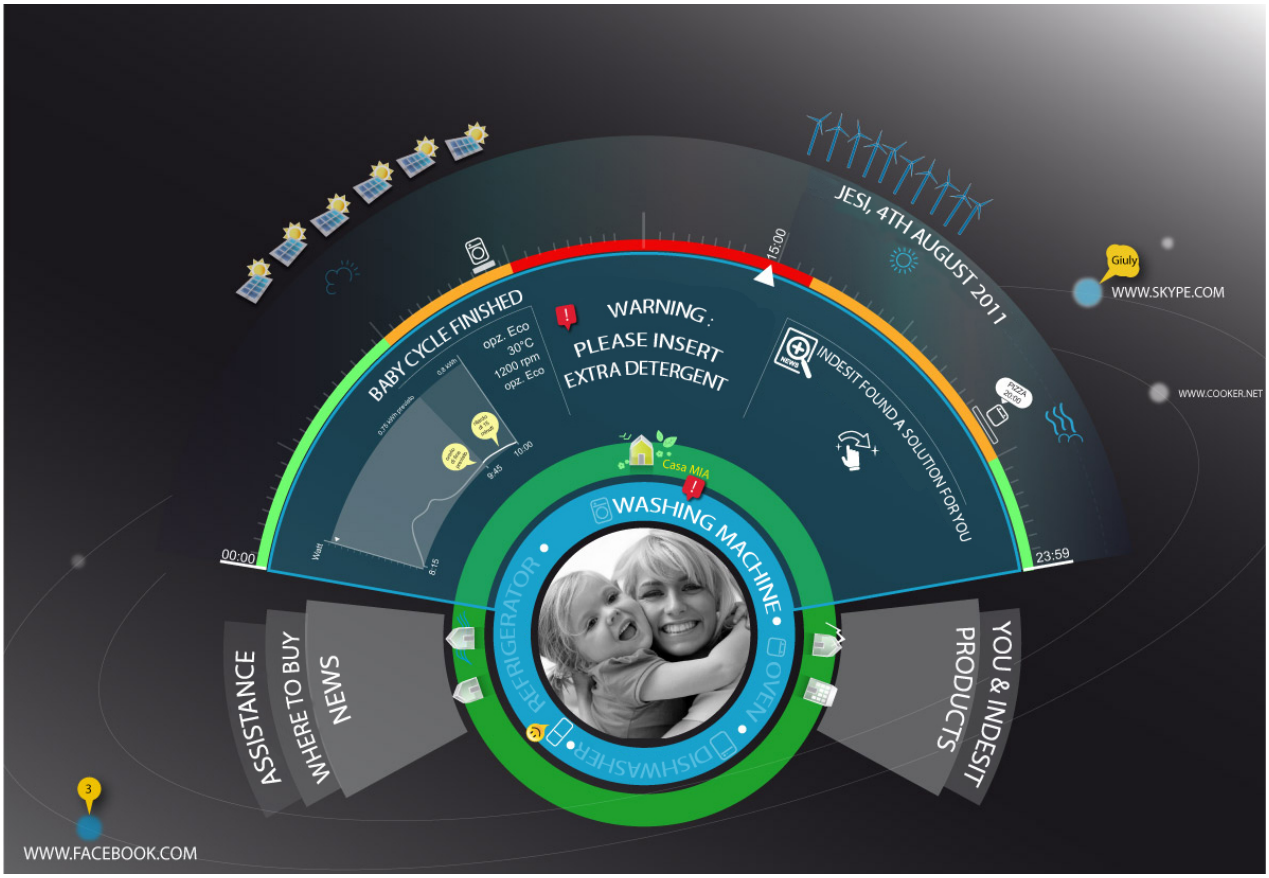

Figure 9

4. ILOOK INSPECTION

We realized that some of the information at levels INSIDE such as the inner components of each appliance and some of the energy saving functionalities could be better represented than how they are in the prototype designed in figure 9. This suggested us not just to add other information to our prototype but to build an extra display mode that the user can access with his smartphone or tablet. In addition to the type of navigation described earlier, iLook has a display mode called inspection that works through augmented reality. This mode enables an enhanced navigation of the physical space and let the user explore the functionalities of each appliance even when it is switched off.

Each level of iLook is supported by specific visualizations and animations in augmented reality (AR) designed to follow rather than guide the user activity. In terms of usability this means expanding the visual cues that users can rely on when they need extra information such as weather forecast to perform a task such as setting the washing machine. This visualization enhances the INSIDE level and to a wider extent improves all the support & maintenance field. Augmented Reality is a viewing mode that lets users visualize the inner part of the system projecting an animation of the home appliance structure. This information is a valuable mean to make users aware of how the home appliances work normally and will give them the possibility to diagnose failures of usage before asking for support and notice what appliances need to be fixed or replaced by comparing the animations with the real home appliances pieces.

4.1 iLook Inspection Scenarios

We devised two tasks to illustrate how the inspection works and conducted tests using two different scenarios. The technologies used were 1) Tags for augmented reality from AR toolkit. Each tag had animated 3D information about the energy class, prices, programmes and other features associated (see figure 10) 2) QR code stickers placed on the appliances associated to a video explaining the mode of operation of each program. In the first task the user is at home and through a smartphone displays instantaneous and cumulative energy consumption through 3D graphics, displays and augmented reality in a wash cycle as the amount of clothing washed in a load shown on the appliance. In the other scenario, the user is located at an electronics store and receives information about tagged home appliances straight on his smartphone through GPS. Once a user is close to the appliance, he can see through the AR the display as it is when switched on and understand how to set various programmes.

The benefits that the inspection mode provide are analogous to those of external visual representation: they afford an external anchoring to information and therefore reach the aim of minimizing the semantic distance by making the system interface support the users conception of how to carry out a given task in the most economic way [7].

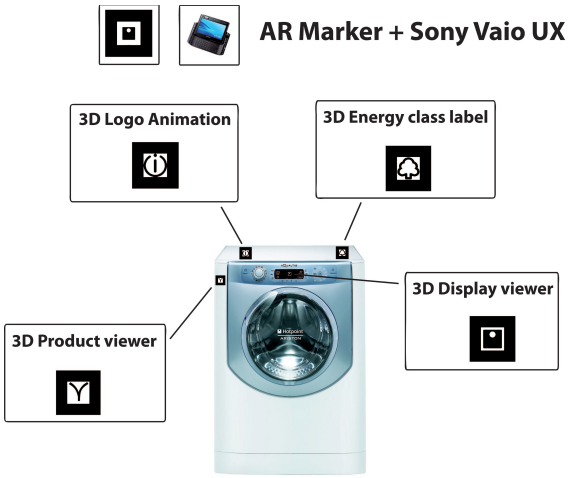

Figure 10

Figure 11

5. CONCLUSION

People are embedded in their environments and therefore coupled to the real world settings and cognitive processes are carried out in the place and time that they are more cost effective but, at the same time, they also "dis-embed" from those environments [9], [12]. Devising the UI for iLook levels means providing users the best external representation for performing multiple sequential tasks such as those connected to handling home appliances. However, such external representation can do more than just reducing the users overall cognitive cost of sense making. Interacting with external representation allows users many other opportunities such as understanding structures of greater complexity, envisioning new ideas and new ways of manipulating them, run simulation build conceptual schema to be casted on material objects. In the framework of information visualization neither standard overview+detail nor focus+context UI can be immediately used to display the different functionalities envisioned in iLook. A different kind of focus+context is necessary for each of the wide range of activities supported by ILook, since for many activities there is no need to display the context at all. A focus+context is useful when the content to display in focus is that of a homogenous map [15]. In our case, the content is multilevel and various so there would be no value, for example, to show in the context the overall energy consumption of the house when someone is seeking cooking tips. On the other hand a context is fundamental for other tasks like checking the activity of each home appliance to explain an expensive electricity bill. The context just so has to be both conceptual so to highlight the user goals and multi-layer because for certain task it must be the same at different levels of ILook. These considerations suggested us the choices of a zooming User Interface with some focus+context features so that the context at each level is necessary to better understand the object in focus and also work as a shortcut to pass to another activity with the navigation pattern we adopted in iLook.

6. ACKNOWLEDGMENTS

Our thanks to Marco Cammarata, Romina Catani, Roberto Tarabù and all the other members of the Indesit Company tha joined author in the design team of the project “BUI: Beyond User Interface”. We would also like to thank Matteo Del Balio and Andrea Camposarcone for their help with the UI mock-ups and all the other students of Interaction Design who participated to the Role prototyping workshop.

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