Designing with Unconscious Human Behaviors for Eco-friendly Interaction

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Overview
Eco-design has become a central research issue for interaction design, as emerging interactive products can create serious environmental impacts while products are being used. We investigate a design method and develop case studies for eco-friendly interaction. A main concept of the design method is to apply unconscious human behaviors in interaction design. Products designed with this method are expected to be used unconsciously by users with reduced environmental impacts. In this paper, we present a framework of design space matrix and initial case studies for the design method. For the framework, we identified the types of interaction behaviors causing environmental impacts and the attributes of unconscious human behaviors. Based on the framework, three design cases - a power cord, a trashcan and a speedometer of an automobile - were developed. The proposed framework and design cases can be used as a base of an advanced eco-friendly interaction design method.

Keywords
Eco-friendly interaction design, unconscious human behaviors, thoughtless act, design for sustainability, interaction design

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Objectives

Recently, eco-design has become a central research issue in human computer interaction [1]. In particular, it is very important to consider the ways to reduce environmental impacts while the products are being used. Many electronic products such as washing machines, cars, and electronics devices can create more serious environmental impacts while being used than manufactured or disposed [2].

Researches on sustainable interaction largely remain in emphasizing the importance of this approach in the HCI domain or producing a few design examples [3]. Existing approaches of eco-friendly interaction design are mainly focusing on educating users or making them recognize the need of sustainability. The effects of these approaches are limited because interactions are highly influenced by users' habitual behaviors that are not necessary to be eco-friendly.

The objective of this research is to develop a design method for eco-friendly interaction. The main concept of the design method is to apply unconscious human behaviors in interaction design. Unconscious everyday human behaviors, sometimes referred as thoughtless acts [4], have been used as a source of inspiration for intuitive design [5]. We intend to apply unconscious human behaviors to increase eco-friendliness of interaction. Products designed with this method are expected to be used unconsciously for reducing environmental impacts. In this paper, we present a framework of design space matrix and the design cases.

Process

To achieve the objectives, we first identified types of interaction behaviors in terms of sustainability while products are being used. The second step was to identify the attributes of unconscious human behaviors. A framework of design space matrix was then developed. Based on the framework, three design cases were created to explore exemplary solutions and to generate insights for an advanced eco-friendly interaction design method.

Key Findings

Types of eco-friendly interaction behaviors causing environmental impacts

DEFRA explains 13 categories of pro-environmental behaviors in everyday life [6]. It presents guidelines for reducing environmental impacts in various situations. Based on the DEFRA's categories and our interpretation, we classified three types of interaction behaviors that may cause environmental impacts.

Behaviors involving a toggle selection: This type causes environmental impacts by performing or not performing an action. Existence of the behaviors decides the eco-friendliness. Example behaviors include switching off electronic products, pulling out a plug from wall outlet, or reusing materials. With these behaviors, users often do not know which action is appropriate, or they have a weak motivation although they know the required action.

Behaviors involving a selection among multiple options: This type causes environmental impacts by selecting one among multiple options. Optimal options vary depending on situations. Example behaviors include separating garbage collection for recycling, turning on lights in need, doing correct flush in the toilet, or selecting proper options in washing machine and air

	Toggle selection	Selection among multiple options	Analogue adjustment
Reaction			Curvy-speedo-meter
Adaptation			
Conformity		Follow-me garbage collector	
Signal	Pull-me-out power cord		

Table 1: The design space matrix with one axis of behavior types and the other axis of attributes of unconscious human behaviors

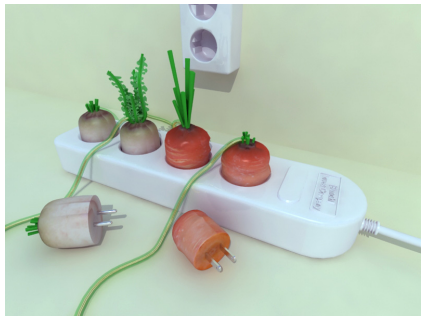

Figure 1: Pull-me-out power cord

conditioner. This type of behaviors takes place quickly, so users tend to be habitual.

Behaviors involving an analogue adjustment: This type can minimize environmental impacts by analogue adjustment for an optimum condition. This type frequently occurs in interaction with products which consume energy and resources. Example situations include finding optimal amount of detergent for washing clothes, deciding right quantity of water for bath, or using toilet paper. Careless behaviors bring about redundant energy use.

Attributes of Unconscious everyday human behaviors

People often behave unconsciously by external stimuli and environment without their own intention or knowledge. Unconscious behaviors can be explained as automatic process as being effortless, unconscious, and involuntary [7]. Suri presents the examples of thoughtless acts that inspire intuitive design [4]. Further to the classification of thoughtless act and psychology literatures, we identified four attributes of unconscious human behaviors described below.

Reaction: People interact automatically with objects and spaces that they encounter, even without any purpose. Affordance of an object often triggers this attribute [8]. People tend to walk on the road lines, or to place a cup on the safe area of a table. This is triggered by the fact that people enjoy making their own orders and desire the orders to be met.

Adaptation: Adaptation is related to people's intention. People tend to find opportunities from other objects for a desired condition. People take physical advantages from their surroundings, to achieve their objectives. For example, people usually put their coat on the back of a chair, or use their newspaper as a pot stand.

Conformity: In social psychology, conformity is the process by which an individual's attributes, beliefs and behaviors are influenced by other people. People unconsciously conforms not only what other people is doing, but also the results of others' behaviors.

Signal: This attribute is related to the need of achievement and power. People have a desire to inform the rules, to make others to follow the rules and to control others. An example behavior can be to leave the door open for signaling that a visitor may come in.

The framework for designing eco-friendly interaction

Identified types of interaction behaviors and attributes of unconscious human behaviors are used to develop a framework for this design method (Table 1). The purpose of framework is to identify design space matrix which designers can systematically develop design solutions for each spaces in the matrix.

Design Cases

For each type of the interaction behaviors, three design cases were developed respectively to show how design solutions can be generated while applying specific attributes of unconscious human behaviors in the design spaces.

Pull-me-out power cord: The design of Pull-me-out power cord allows users to pull out when it is not used or over used (Figure 1). This involves interaction of a *toggle selection*. The *signal* attribute is applied to the design. The cord has a shape of a carrot or radish, whose sprout grows up when connected devices are

Figure 2: Follow-me garbage collector

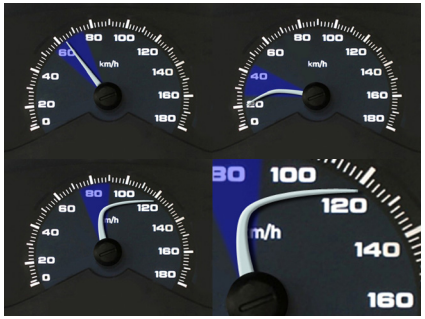

Figure 3: Curvy-speedometer

being used. A longer length of the sprout asks users to pull out the cord.

Follow-me garbage collector: Follow-me garbage collector is designed to promote correct garbage collection for recycling (Figure 2). The type of interaction behaviors involves a *selection among multiple options*. The *conformity* attribute is applied in the design. The solution is a graphic design for a garbage can. It shows a picture of many people who are throwing away waste into the trash can. It is expected that people follow the act of separating recycling waste into the correct bin. The graphical solution is effective and low cost for installation and maintenance.

Curvy-speedometer: Curvy-speedometer is a design of a car dash board (Figure 3). It supports fuel-efficient driving for car owners. The type of interaction behaviors involves *analogue adjustment*, and the *react* attribute is applied in the design. The main feature of the design is a deformable indicator needle. The needle indicates current speed while at the same time the curvature indicates how far the current speed is from the most fuel-efficient speed. Due to the bending shape, a driver may unconsciously adjust the driving speed. For installation, an electronic display can be used for interactive deformation graphics of the speed indicator. The safety issue of car driving should be considered before implementing the design concept.

Results and Impact

The framework and design cases provide a theoretical base for eco-friendly interaction design method that can be practical in both industry and academia. The results of this work can be used as a design method to change users' behaviors for sustainability. The proposed framework can also be used as a systematic and an analytic tool for evaluation. A general guideline for each type of interaction behaviors can be further developed considering all attributes of unconscious human behaviors.

For future works, the framework should be verified and many design cases should be developed. A design method and general design guidelines should be further developed. A structural evaluation of environmental impacts adopting this method should be accomplished to examine the feasibility.

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