Concrete or Abstract User Interface?

Abbas Moallem(✉)

Charles W. Davidson College of Engineering, San Jose State University,
One Washington Square, San Jose, CA 95192-0085, USA
abbas.moallem@sjsu.edu

Abstract. This study investigates what kind of mental image a design triggers when a user views the user interface and whether that image would be matched with the image of the real object in the user's mind.

In this study, a standard scenario to design a remote control for lighting and temperature controls was given to 200 students completing an HCI course at graduate and undergraduate levels. The given scenario asked each student to provide a low fidelity prototype of a suggested design within a timeframe of 10 min. These prototypes were then classified and grouped into either concrete or abstract designs.

The results of these investigations show that a majority of participants perceive abstract representations for their design rather than concrete: a depiction of a real light switch to represent turning lights on and off.

Keywords: UI design · Paradigms · UI designer · Mental image

1 Introduction

User interaction with computers is now a constant in our lives, an active part of our daily routines. We are not only using computers to perform tasks but also for common instances working through remote Internet access to control devices such as home security devices, camera surveillance, and temperature light controls. All users, from young to old, count on user interfaces to work for them in helping them successfully complete their essential tasks. One of the issues that have been observed is how the interface should be designed so that it properly reflects how users want to view the devices they are remotely managing.

The question comes up as to what kind of mental image should the design trigger when a user views the user interface? The knowledge as to how this mental image matches the real concept of the user interface is key to creating a capable design.

A variety of researchers investigated mental images, imagery and perception and their effect on how we interact with our world. To mention a few examples, Norman suggests that people form internal representations or mental models of themselves and the objects with which they interact which create predictive and explanatory powers for understanding the interaction (Norman, 1983a) [1]. Gentner and Stevens (1983) [2] support the concept that mental models are based on the way people understand a specific knowledge domain. Johnson-Laird [3] believes that mental models play a

M. Kurosu (Ed.): Human-Computer Interaction, Part I, HCII 2015, LNCS 9169, pp. 390–395, 2015.
DOI: 10.1007/978-3-319-20901-2_36

central and unifying role in representing objects, states of affairs, sequences of events, the way the world is, and the social and psychological actions of daily life (p.397).

Many researchers are focused on how mental images differ among designers and users. Overall, two mental models are distinguished: a user's mental model, referring to what an end user believes about a system (Nielsen 2010) [4], and a designer's mental model, which refers to the conceptualization of what was invented by a designer. (Staggers and Norcio, 1993) [5]. Nielson believes that "What users believe they know about a UI strongly impacts how they use it. Mismatched mental models are common, especially with designs that try something new" (Nielson 2010). Several studies tend to investigate, understand and use mental representation to design interfaces that are based on users mental and propose formwork (X. Qian, Y. Yang & Yong Gong, 2011) [6].

Athaavankar's (1997) [7] study illustrates that a designer creates virtual models in his/her "mind's eye," then manipulates and alters them, and makes them behave according to his wishes during the development of his ideas.

This study tries to understand how the object type and designer representation affect the user interface of the devices that those interfaces control. To understand this we made the hypothesis that if the user interface were presenting the virtual image of the object that the UI controls, it would be easier for the user to manipulate or control through the UI versus an abstract representation by the user interface. For example, to turn a light on and off, it would be easier to click on a representation of lighting than checking a checkbox. Or to regulate temperature, it could be manipulating a virtual representation of a thermometer rather than entering or moving up and down a field.

2 Method

Over a period of one year (2014 and 2015), a design exercise was given to 200 graduate and undergraduate students who were taking an HCI class. The participants were a mixture of human factors and software engineering students. The students were at mid-level of the course and already had fundamental knowledge of HCI and user interface design. The exercise was given during class time, and students were given 10 min to provide a 1 page paper prototyping (low fidelity) of a design case with no other instruction besides what was written on the exercise description (Table 1).

After collecting the prototypes, they were classified into the following categories, Virtual and Abstract. The virtual were divided in two sub-categories: Concrete and Semi-Concrete (See Figs. 1, and 2).

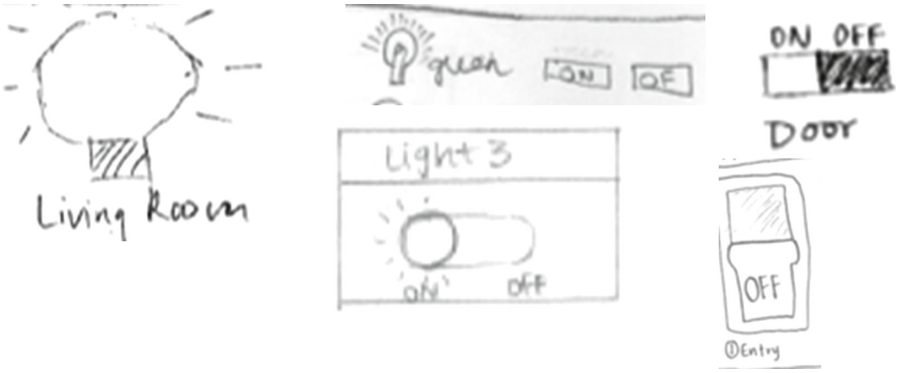
3 Results

Charts 1 and 2 show the percentage of design types classified as Concrete, Semi Concrete and Abstract for the Light control and Temperature control.

The results show that 71 % of the participants who created a UI for light control had a more abstract meaning using a nonfigurative image of the object, 4 % Semi concrete (somehow visualizing the light) and only 25 % had a very concrete view of lighting to illustrate the on and off functions.

Table 1. Design exercise description

Design Exercise: A new service application offers people an online account where they are able to login and use a browser to view and remotely control one's home lighting and temperature. 6 Wi-Fi sensors are already installed on five lighting controls and one has been placed on the home temperature control device.
The requirements are:
• After logging in to the account through a browser (not needed for this exercise) the user should be able to see.
• Date and time
• 5 light switches and their status (i.e. on or off at the present time) with the ability to changed their status
• Home temperature at the present time with the ability to change the temperature
• Users: All home owners have different levels of computer knowledge
• Expectations: An extremely easy to use and robust system



A- Concrete B-Semi-Concrete C: Abstract

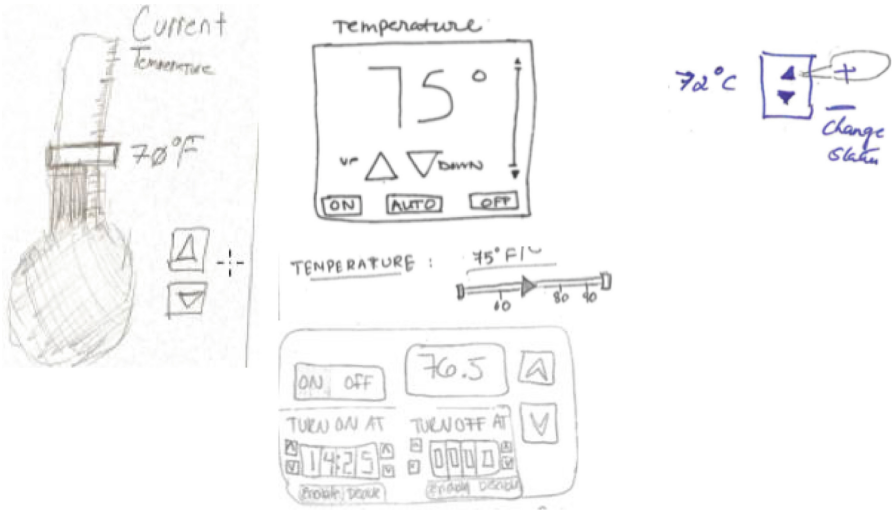
Fig. 1. Classification of the design Categories for light control

For the temperature control group, the breakdown was 52 % abstract, 32 % semi-concrete and 16 % concrete.

4 Discussion

The results of this study suggest that the representations of the controls do not confirm our hypothesis that people tend to use a concrete representation of the object and its control. This is supported by the fact that 71 % in one case and 52 % in the second case were designing a user interface that was quite abstract.

This study just shows a trend but does not provide a fundamental answer or guideline as to what image would be better to create the right action and reliable representation in the mind of users. Factors such as the participants' background in



A- Concrete B-Semi-Concrete C: Abstract

Fig. 2. Classification of the design categories for temperature control

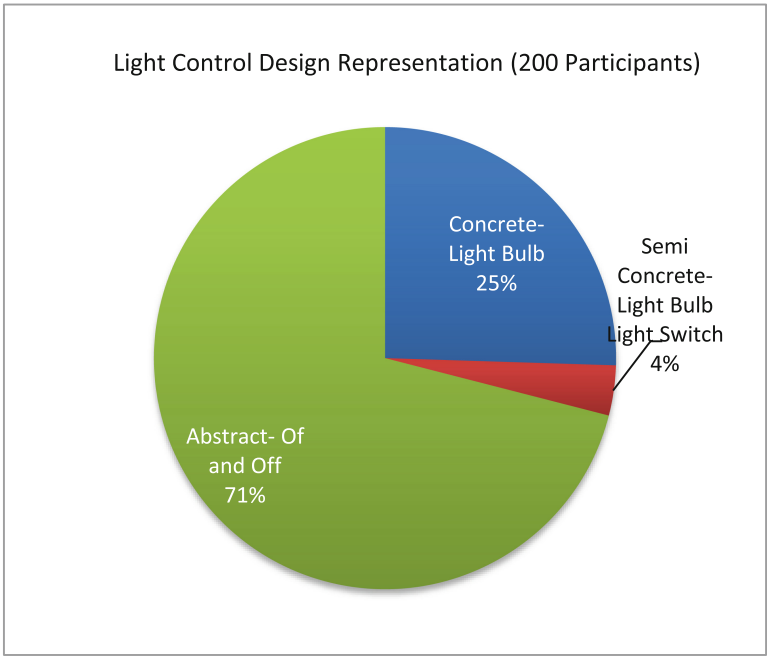


Chart. 1. Percentage of participants who used concrete design for light Control

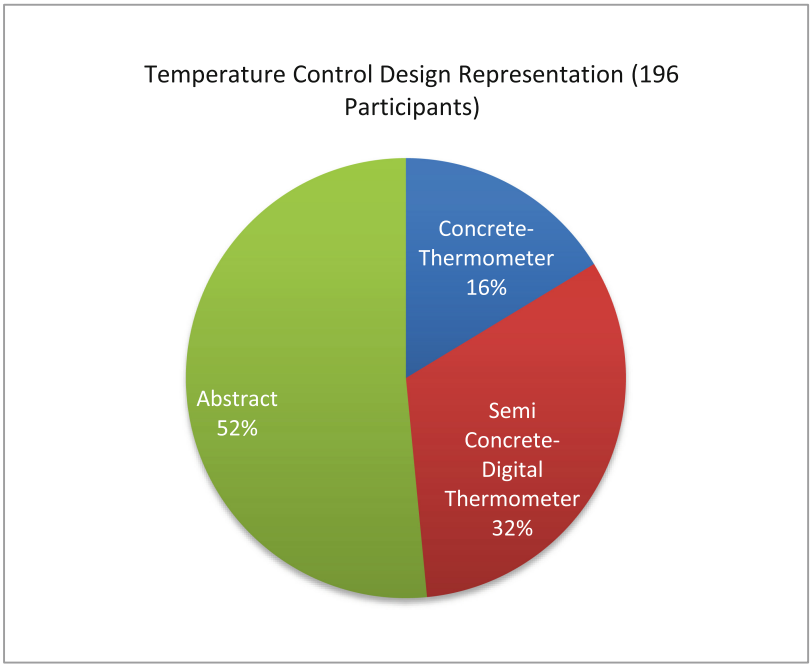


Chart. 2. Percentage of participants who used concrete design for temperature control

terms of level of education, and the area of studies might affect their respective design choices. For example one might think that a student with a software background and familiarity with UI elements might make them choose a more abstract choice, although when No significant differences were observed when we separated the software engineering group with the other discipline. Once might think that accessibility of the concrete object might be more accessible to older adults or to a different user profile.

Further study should investigate user preferences by showing examples of Abstract and Concrete designs and seeing what participants would prefer between the two choices.

Acknowledgement. Thanks all my students at San Jose State University who took part in this exercise.

References

1. Norman, D.: Some observation on mental model. In: Gentner, D., Stevens, A.L. (eds.) Mental Models. Lawrence Erlbaun Associate Inc., Hillsdale (1983). Psychology Press, 14 Jan 2014 - Psychology - p. 352
2. Gentner, D., Stevens, A.L.: Psychology Press, p. 352, 14 Jan 2014 (1983)
3. Johnson-Laird, P.N.: Mental Models. Harvard University Press, Cambridge (1983)

4. Nielson, J.: Mental Models, 18 October 2010.http://www.nngroup.com/articles/mental-models. Accessed 2 Feb 2015
5. Staggers, A., Norcio, A.F.: Mental models: concepts for human-computer interaction research. Int. J. Man-Mach. Stud. **38**(4), 587–605 (1993). http://userpages.umbc.edu/~norcio/papers/1993/Staggers-MM-IJMMS.pdf
6. Qian, X., Yang, Y., Gong, Y.: The art of metaphor: a method for interface design based on mental models, VRCAI 2011. In: Proceedings of the 10th International Conference on Virtual Reality Continuum and Its Applications in Industry (2011)
7. Athhavankar, U.A.: Mental imagery as design tool. Int. J. Cybern. Syst. **28**(1), 25–42 (1997)