A Study on Infographic Design of Door Dehumidifier

Junyoung Kim[1]and Eunchae Do[2]and Dokshin Lim[3†] [0000-0002-5146-1830]

[1] UNIST, Graduate School of Creative Design Engineering, Ulsan, Korea
[2] Hongik University, Department of Visual Communication Design, Seoul, Korea
[3†]Hongik University, Department of Mechanical and System Design Engineering, Seoul, Korea
doslim@hongik.ac.kr

Abstract. Millennials in Korea tend to live in a small studio alone. We focused on a common problem that this kind of one-person households have, which is that most of them suffer from laundry process due to the lack of drying feature in the built-in washing machines in their studios. "Door Dehumidifier" is a conceptual product that we propose to solve this problem. Installing our "Door Dehumidifier" in place of the existing door of their built-in washing machines will enable to manage the humidity automatically both inside and outside area of washing machines. The present paper describes how the infographic LED display of the new concept "Door Dehumidifier" communicate with the users. We designed the infographic with effectiveness and efficiency of the human-machine interaction in mind. Applying calm tech philosophy, we propose five infographics of "Door Dehumidifier" which we test and go through iterations to improve the final infographic design.

Keywords: One-person household, Dehumidifier, LED display, Infographic, Calm tech.

1 Introduction

1.1 Background

Often in an environment where the Millennial Generation's one-person households live, they have no choice but to use washing machines, a basic built-in home. Many of these users suffer from a double whammy of the lack of drying on the devices provided, and their lifestyle is difficult to take out immediately after the washing is finished. There is also a prior study [1] in which ideas are proposed and recognized on these issues. The "Door Dehumidifier" referred to in this study provides the ability to install in a built-in washing machine and manage the internal humidity after the washing is automatically finished. This could be one of the new concepts that will improve the inconvenience experienced by the aforementioned users during the drying process. However, if this concept is introduced, there is a new weakness that the transparent washer door is changed to opaque, blocking the user's visual information through the transparent door. Through this study, LED infographic designs were developed to complement this weakness in developing a new category of products called "Door Dehumidifier" but to be a good enough design choice.

1.2 Purpose

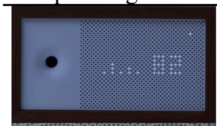
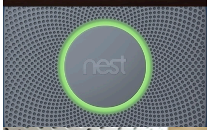
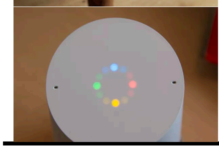
The market competition structure of products such as refrigerators, washing machines and air conditioners, commonly referred to as the "big three", has become no longer differentiated by functional benefits according to the law of diminishing marginal utility. Manufacturers are struggling to gain an upper hand in the competition through the positive emotional benefits of the joy, pleasure, and surprise they experience in using the product or the services associated with it [2].
This empirical benefit requires a different design approach than simply providing benefits by adding functionality, of which "Calm Tech" is the one that is drawing attention from Internet of Things (IOT) smart products where Door Dehumidifier are attributed. With the addition of smart functions, users surrounded by the increasing number of functions and the amount of information are feeling tired from the overflowing information and cognitive burden on complex decisions. "Calm Tech" is a combination of "calm" and "technology", meaning quiet, and Dr. Mark Weiser, a computer science professor who foretold the "Calm Tech" era, called it "a high-tech technology that gives information but does not require attention" [3]. How will the user interaction mechanism design and user interface design of sensor-intensive smart appliances permeate the daily lives of natural users in line with the "Calm Tech" philosophy?
This will be possible only if the utility of smart appliances is interpreted as the benefit felt by users in their daily lives by utilizing data and communicated easily and at the right time. Sensors should also play an active role in understanding the user's status to realize Calm Tech, as well as enhance the product's basic functionality. In this study, the design guidelines were drawn by presenting Door Dehumidifier infographic alternatives and conducting verification of target users through various case studies of infographic designs that affected products used in the home, the representation of air quality management information, and the method of communicating utility in real time, especially in Door Dehumidifier in millennial household washing machines.

2 Infographic Design

2.1 Research for Design Trends

Based on the research objective, design trends were investigated focusing on the user interface of the latest home appliance devices. We could see that the main design of the user interface fits the Calm Tech philosophy was the "glanceable" user interface design. Glanceable user interface refers to an interface that provides users with quick and easy access to information, and this has been considered particularly important for peripheral displays [4]. The examples in **Table 1** shows that a glanceable user interface with just a dot of LEDs is sufficiently designable, and that this information is not over-represented in everyday life, with light of the weak century and simple color composition, an aesthetic design can also be reached.

Table 1. Examples of interface design on the latest home appliance devices.

Sample image	Product	Explanation for Interface
	AWAIR	Numerical values such as temperature, humidity, etc. are expressed in the number of LED.
	Google Nest Protect	Carbon monoxide is expressed in light color
	BRUNT AIRJET	Colorful representation of indoor fine dust and outdoor air
	Google Home	Presenting the state of the device as 12 lights

2.2 Infographic Design

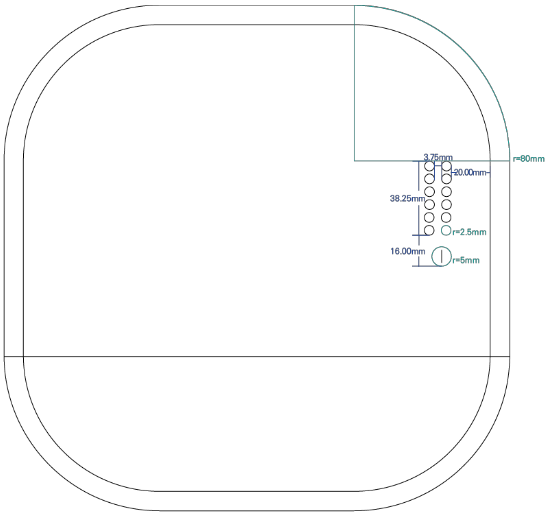
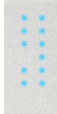
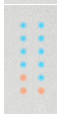
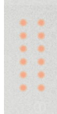


Fig. 1. overall layout for the interface design on Door Dehumidifier.

Door Dehumidifier, which are designed for this study, will also say that it is desirable to pursue glanceable user interface design. Therefore, by utilizing small LEDs for dehumidifiers, users did not perceive it as loud noise in their daily lives and designed it intuitively with simple light intensity and color.
First of all, LEDs are composed of 12 dots to represent dehumidification times of up to 12 hours. These information-transmitting media can be given roles depending on the

wavelength, intensity and continuity of light [5]. Therefore, the color is composed of blue, which is an intuitive reminder of water from washing and dehumidification, and orange, which can be reminiscent of a negative warning image when referring to Figure 2 below, while also calling for user action, such as a positive and meaningful sign of progress, and an indication of dehumidification, and an error.
In addition, the layout of the LEDs and power buttons in this user interface design is closely configured with the handle of the washing machine door so that users can recognize the operation/state of the washing machine door with no significant movement as they open and close the washing machine door.

Table 2. Exact interface designs of each state.

Each State	Explanation of movement	Example image
1.Water level rising	Two dots of LEDs in the same line light up with water level rising.	
2.Washing mode	A dot of 12 LEDs goes out with rotating.	
3.Device filled with water	Dots of LEDs with color of orange rotate quickly.	
4.Dehumidifying	A dot of LEDs with color of blue turn to white per hour.	
5.Error detected	All dots of LEDs with color of Orange.	

3 Experimental Design and Results

3.1 Primary Experimental Design

Previously, a total of five films were prepared by combining the design for each state with the digital model of the product. Questionnaires were also prepared for use later in the experiment.

Fig. 2. Questionnaire.

Prior to the experiment, this study and the Door Dehumidifier were presented verbally. The subjects checked the status of the prepared films on TV screens and conducted a qualitative assessment of the reasons and conditions for each of the processes. After all status checks were completed, a questionnaire was used to provide a quantitative assessment of how each state was perceived by the user.

3.2 Primary Experimental Result

The quantitative evaluation results of the preceding experiment are shown in Figure 3.

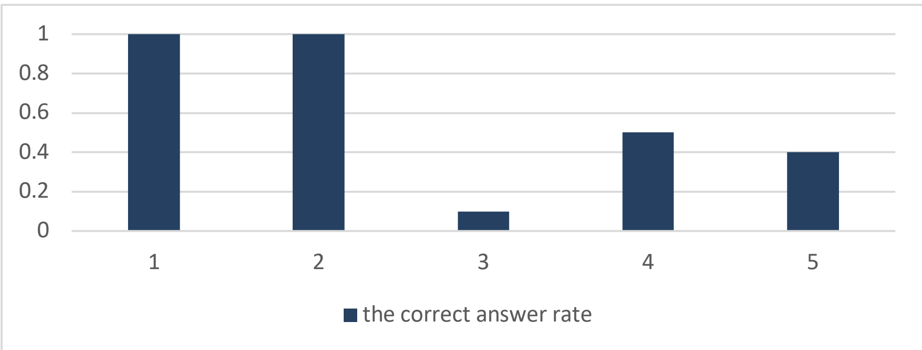


Fig. 3. The correct answer rate of the primary quantitative evaluation

State 1 and State 2 were matched with information presented by all 10 subjects naturally and State 4 also showed half the correct answer rate. However, states 3 and 5 have significantly lower correct answer rates and most subjects match incorrect information.

During the experiment, the results of the qualitative assessment for each state through interviews are as follows. For states 1,2,4, it was confirmed that each state could easily come up with what it meant. However, in the case of state 3, we could identify a tendency to associate orange-colored LEDs with dry conditions and heat, and in the case of state 5, we could predict that a stationary condition would be the completion of a process or, in relation to an orange color, would predict the completion of drying.

3.3 Secondary Experimental Design

Improvement Design. According to the primary experimental results, improvement designs for states 3 and 5 have been devised with more intuitively conveying the meaning. It consists of a motion that stops and blinks without proceeding or rotating to prompt the user to act with audible information. For more specific information transmission, the alphabet "F" was shaped from "Full" to state 3 and "d" was shaped from "door error" to state 5.

Secondary Experimental Design. The second experiment was also conducted in the same order as the first, but instead of the film, the experiment was carried out as a prototype of the real thing. The prototype uses a general built-in washing machine and has a programmed LEDs attached to the 3D printed Door Dehumidifier, which is similar to the actual use environment. In addition, after the questionnaire progresses, we provided a description of the state of Door Dehumidifier to see if the subjects could easily understand the interface design.

Fig. 4. Experimental prototype with LED interfaces attached in built-in washing machine.

3.4 Secondary Experimental Design

The quantitative evaluation results of the preceding experiment are shown in **Fig. 5**.

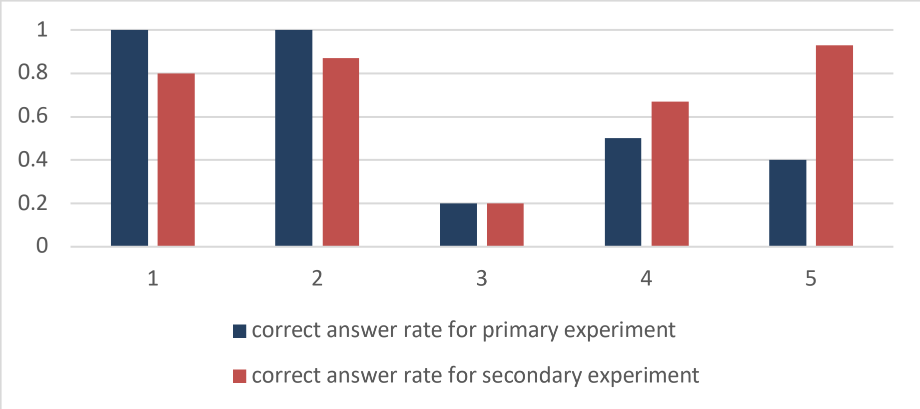


Fig. 5. The correct answer rate of the primary and secondary quantitative evaluations

According to the test conducted on 20 people, states 1,2,4 also showed a high correct answer rate. In particular, it can be seen that the correct rate has increased significantly in the state 5 where the improvement design has been applied. However, state 3 still has a significantly lower answer rate.

The results of the qualitative assessment of the states in which the improvement plan was applied through interviews during the experiment are as follows. In case of state 5, as intended by the design, subjects could easily associate "door" with the alphabet "d", and the tendency to predict a problem with the door could be seen through hearing information such as red-colored LEDs and repeated flickering and warning tones. However, in case of state 3, we could check the tendency of connection with the situation of completion by referring to "Finish" rather than "Full" by the alphabet "F".

4 Conclusions and Limits

The qualitative and quantitative assessment of the first and second experiment indicated that the overall evaluator experienced positive emotions in the design of this interface. In addition, although somewhat less intuitive, we were able to see that the purpose of this interface design was to match the intent of implementing Calm Tech and glanceable designs.

The design of the primary and improved versions of state 5 also confirmed that a clear intuitive design beyond quiet is needed to prompt users to take action. However, both the primary and improved versions of state 3 showed a low correct answer rate. This refers to the lack of intuitiveness to alarming device filled with water. In particular because condition of device filled with water exists only in function of dehumidifiers, research on the state will be needed in the future through a case study on the interface of various type of dehumidifiers.

References

1. Nameui, L., Sung Yeon, K., Frank, B.: Design Guidelines for User-Friendly Washing Machines for Young Single People Based on the Goal-Directed Design Process. In: Contemporary Engineering Sciences, vol. 7, no.21, pp. 1079-1086, HIKARI Ltd, http://dx.doi.org/10.12988/ces.2014.49135 (2014).
2. Minho, K.: Back to the basic. TurnAround inc, Korea (2018).
3. Calm Tech, https://calmtech.com, last accessed 2016/12/21.
4. Tara, M.: Designing and evaluating glanceable peripheral displays. In: Proceedings of the 6th conference on Designing Interactive systems, pp. 343–345. Association for Computing Machinery, New York, NY, United States. https://doi.org/10.1145/1142405.1142457 (2006).
5. Bit-Na, B., Hyeon-Jeong, S. Myong-Suk, K.: Context Information Representation Applying Light Attributes-Representation of Abstracted Context Information Using LED. In: Archives of Design Research, 25(1), pp. 207-218, Korean Society of Design Science (2011).