

UNSLEEPING TV: Always-on-Screen Concept Using Bi-Stable Display

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ABSTRACT

Bi-Stable Display, a paradigm-shifting technology that can utterly change the screen culture, is getting developed. Unlike previous display technologies such as LCD and PDP, this technology does not consume much power nor shorten the apparatus' life, even when the screen is on for a long time. Thus, there is no need to turn off the screen. Always-on-screen presents whole new possibilities compared to previous services and studies. This study presents the concept of Unsleping TV using Bi-Stable Display. Although this concept is applicable to various types of screens, this study focused on large TV screens. By analyzing users of previous large TV through user-centric research methodology, we draw possible areas where Unsleping TV can be used. Also, we propose four concepts in accordance with those areas, which are as follow: Wake up Device, Like a Furniture, Hub, Program Navigator.

Author Keywords

Design, Human Factors, TV, Always-on-TV, black screen, display, tv usage, Bi-Stable display.

ACM Classification Keywords

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

INTRODUCTION

Modern digital culture can be characterized as “screen culture” since all media has been transformed into screen media. Not to mention computers, people read, make phone calls, and listen to music using screen media such as e-book, mobile phones, and MP3 player. In the past, only image media such as movies or televisions depended on screens. However, nowadays, we cannot even imagine media without screen in that all information contents are carried by screen[3].

But most of the screens around us have one thing in common: if you turn off the screen, it immediately becomes useless. All previous studies concerning viewer behavior,

service, etc. have assumed that the screen is on.

However, recent technology development has presented a new paradigm-shifting technology which can change the screen culture: Bi-Stable Display (E-Ink[2], Mirasol Display[5] etc.). Unlike previous display technologies such as LCD and PDP, this technology does not consume much power nor shorten the apparatus' life, even when the screen is on for a long time. This means that the concept of “turning off the screen” disappears, and that the screen will be in “Stand-by” status instead of being turned off.

Although this concept is applicable to various types of screens, this study focused on large TV screens. This is because various user behaviors are expectable since large TV is one of the familiar, traditional screen media, and a lot of people use it together.

By analyzing users of previous large TV through user-centric research methodology, we draw possible areas where Unsleping TV can be used. Also, we propose four concepts in accordance with those areas, which are as follow: Wake up Device, Like a Furniture, Hub, Program Navigator.

RELATED WORK

Bi-Stable Display

Bi-Stable displays, also known as Zero-power displays, can present a text or an image continuously without power. Bi-Stable displays need power only while changing the contents on screen. Cholesteric liquid crystal display (ChLCD) is also a display without power, which is developed by Kent Displays. It can change colors of the contents and maintain screen even when display power is off[4]. Bi-Stable displays have many advantages. As demonstrated, it can save energy efficiently as it needs almost no power to retain the contents on screen. In case of e-book, which uses a Bi-Stable display, 20,000 pages can be read with just two AAA batteries without a charge. Bi-Stable display has excellent readability even when it exposed to sunlight because it is a reflective display. Qualcomm Mirasol Display is a technology used in electronic visual displays that can create various colors via interference of reflected light[5]. The smart watch Qualcomm Toq features this display with 40 frames per second.

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TVX'14, June 25 – June 27, 2014, Newcastle, UK.

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SERVICES USING TURNED-OFF TV SCREENS

The demands for usage of turned-off TV screens are not new. There are few services that provide customization of previous TVs.

Hiddelevision[6] enables people to use turned-off TV as a mirror by installing films with the frames. Also, Framemytv[7] and Mediadecor[8] turn TV into a frame. When the screen is on, it is a normal TV, but if you turn off the screen, the picture installed in advance comes down to cover the whole TV screen. If you turn on the TV, the picture goes up, showing the screen again.

Like this, decoration services such as attaching films on a screen or covering the screen are getting into public favors. This proves that a lot of customers would like to make use of turned-off TV screens.

UNSLEEPING TV

Unsleeping TV, which this study proposes, is a concept of TV using Bi-Stable Display. If one is done watching TV, the TV screen goes into a “Stand-by” status. Since Bi-Stable Display enables the screen to express information regardless of power consumption and apparatus life span, the user can designate any picture to be shown on the screen. Whereas previous TV cannot show any information after it has been turned off, Unsleeping TV using Bi-Stable Display has the advantage of showing some information all the time. Although technology hasn’t yet reached the level of commercialization on large TVs, it is certain that it is not far away. In this study, we will proceed under the assumption that the technology is fully developed for commercialization.

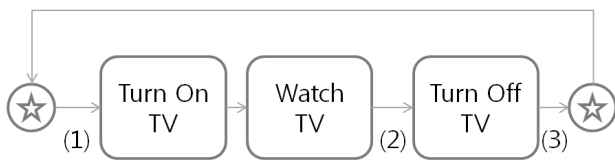


Figure 1. Simplified the TV viewing process

APPROACH

First, we simplified the TV viewing process (See Figure 1). In the simplified process, we intend to research these points:

- (1) The point when the viewer turns on the TV in the intention of watching.
- (2) The point when the viewer intends to turn off the TV.
- (3) After the viewer turns off the TV.

Since this study deals with the usage of large TV screens after it has been turned off, we needed an observation different from previous studies about TV viewing behaviors. Whereas previous studies mostly focused on situations during watching TV, this study needed much more comprehensive observation about external parts.

METHODOLOGY

Participants

Five families were recruited—each group consisted of two parents and two children evenly. Total twenty participants took part in the research. The parents had an average age of 53.3 (SD=3.16). In case of wives, one of them had a job, and four of them were housewives. In case of husbands, all five participants had jobs unrelated to broadcasting, and they did not work on weekends. In case of ten children, half of them were female and the other half were male. The children ranged in age between 20 and 28, with an average age of 23.9 (SD=2.51). One of them was a high school student and others were college students. All five families owned LCD or PDP TVs, larger than 40 inches, and they were not smart TVs.

No.	Group	Role	Age	Sex	Occupation
P1	Family 1	Father	56	Male	Worker
P2		Mother	54	Female	Homemaker
P3		Son	28	Male	Student
P4		Son	25	Male	Student
P5	Family 2	Father	55	Male	Worker
P6		Mother	52	Female	Homemaker
P7		Son	27	Male	Student
P8		Daughter	25	Female	Student
P9	Family 3	Father	55	Male	Worker
P10		Mother	54	Female	Worker
P11		Daughter	23	Female	Student
P12		Son	20	Male	Student
P13	Family 4	Father	50	Male	Worker
P14		Mother	46	Female	Homemaker
P15		Daughter	24	Female	Student
P16		Daughter	21	Female	Student
P17	Family 5	Father	56	Male	Worker
P18		Mother	55	Female	Homemaker
P19		Daughter	24	Female	Student
P20		Son	22	Male	Student

Table 1. Participants

Collecting Pictures Taken Around TV

First, we asked the participants to take and send us the pictures taken around TV to indirectly observe the environment of TV viewing. Participants each took the pictures around their TVs, and sent them directly to the researcher.

Media Diary

We couldn’t visit the participants’ houses and observe their ordinary lives. Thus, we distributed daily log notes and pen asked them to keep a daily record of their usage of electronic devices. Following previous studies, which showed that TV viewer behaviors differ between weekdays and weekends, we asked them to divide weekdays and weekends[1].

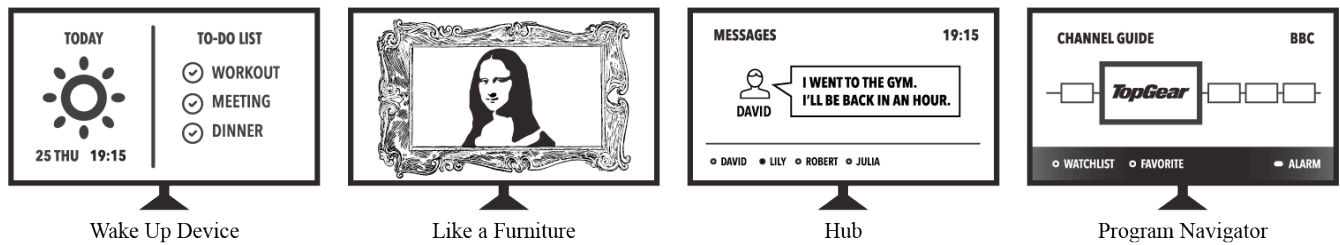


Figure 2. System Proposals for Unsleeping TV

In-Depth-Interview

We conducted in-depth interviews based on the pictures taken around TV and Media diaries. Based on the interview guideline focusing on User, Task, and Environment according to Maguire's (2001) context factors, the interview took a semi-structured form. Based on the media diary, we especially focused on 'the point when the viewer turns on the TV in the intention of watching,' 'the point when the viewer intends to turn off the TV,' and 'the behavior after the viewer turns off the TV.'

RESULT

Environment Around Watching TV

We collected the pictures around TV, and conducted an interview with the participants based on these pictures.

"I put (a large TV) in the living room to watch TV with my family (P2).", "I need large TV to watch the movies, and the rooms are too small for large TV (P9)."

All of the participating families put their large TV in the living room. Also, we could see that they decorated the surroundings with various ornaments, frames, and clocks.

TV Viewer Behavior According to the Viewing Process

The Point When the Viewer Turns on the TV in the Intention of Watching

The point when viewers start watching TV demonstrated a regular pattern. Participants most frequently turned on TV in the morning. Family 1, 2, 4 were using TV for morning alarms. They set the TV to automatically turn on at about 7 AM, and all the family members woke up to the noise from TV. Then, they prepared to go out while watching the morning news.

Each participant watched TV at a fairly regular time. This was because their quitting time from work was regular, or they wanted to see certain TV shows.

The Point When the Viewer Intends to Turn Off the TV

These are the reasons why users turn off the screen: A lot of users (P1,P2,P4,P5,P6,P9,P12,P15,P18) responded that they worry about electricity bills generated from turned-on TV.

"If you keep the screen on, you have to pay electric charges for that. Since it has larger screen, I assume that the charges will be higher (P6).", "I sometimes even get the plug out when I don't watch TV (P18)."

P3 and P19 responded that they do not have any particular reason for turning the TV off, except habits. *"I just turn it off because I don't watch it now. I can't do other things if I keep it on because of the noise and light(P3).", "I turn it off because no one is watching it. I don't have any reason to keep it on... (P19)."*

P7 and P17 responded that they worry about the TV's life span. *"I always turn it off because keeping it on for a long time makes it break down soon."*

In conclusion, users responded that they turn off the TV habitually without particular reason, or because they worry about electricity bills and the life span of TV. In a lot of cases, people turned TV off due to realistic reasons such as money or life span of the machine.

After Turning Off the TV

Participants mostly turned off TV right before going out or going to bed. Other reasons varied too much to draw out a specific pattern. It is noteworthy that some users did not turn off TV even when they aren't watching it (P8, P14).

"The house feels empty without TV, but I don't actually watch it (P14).", "I always keep TV on when I'm alone. It's kind of lonely and scary when I'm alone, but with TV on I'm fine (P8)."

These viewers used TV as a method to make the atmosphere of the house livelier, rather than a media for watching. There also was a viewer who turned on the TV in the living room when he was alone, or even when he was in other rooms.

CONCEPT PROPOSAL

Based on the observations and findings, we propose four usage possibilities of turned-off TV.

Wake Up Device

"Anyone who wakes up first turns on the TV in the living room (P6).", "I volume up the TV in the morning to wake up (P14)."

Three out of five families start their days by turning on the TV. Also, they use it to gather information such as weather and news.

"I always check the weather and recent news (P13)."

Also, the type of information that the participants were expecting to obtain by turning on the TV in morning was

quite clear. In general, they were information that could predict the day – weather, schedule, news, stock, etc.

We propose an interface that provides simple information in the form of a dashboard when the TV is turned off. Users can quickly obtain information they want, and can reduce inefficient activities such as waiting for the weather forecast for simple weather information.

Like a Furniture

“I paid more attention since TV is like the face of a house (P2).”

“I hung a frame around TV to decorate the living room (P5).”

“It feels kind of empty when TV is the only furniture (I put a flowerpot beside.) (P10).”

TV is not only a home appliance, but also an important interior piece. In the pictures that the participants sent, we could find that the TV was located on the wall of the living room, the most noticeable place, and that ornaments, frames, and flowerpots decorated the wall around TV.

However, when the TV screen is off, it is merely a big, black screen, which messes up the interior design.

Thus, what we propose is a TV screen that shows an image such as family pictures or celebrated pictures when it is off. This idea can transform large screens that have been abandoned when it is off to a magnificent ornament.

Hub

“I do things in my smart phone or do the laundry while watching TV (P18).”

“When I am in the living room, I can see which member of the family is home (P7).”

“It’s in the living room because it’s the place where everybody gathers together (P1).”

All the families in this experiment put their large TVs in the living room. Since it is the largest place located in the middle of normal houses, the living room serves the role of a hub of family members and home appliances. Using the advantage of a large display in the living room, TV can help active communication between family members and between home appliances. Family members can leave messages to each other through TV, or the status of all home appliances can be shown on TV.

Program Navigator

“I usually don’t watch TV, but I always watch “Infinite Challenge” in the weekend (P11).”

“I sometimes forget the channels for the shows I watch (P4).”

“I used to read the newspaper, but nowadays I surf the Internet for broadcasting information (P17).”

Although the purpose of watching TV and the TV program to watch is clear, it takes a considerable amount of time to turn on the TV and go to that specific channel. Thus, we propose a solution to approach the contents more quickly when the TV is off. First is to provide an EPG (Electronic Program Guide). The user can designate the channel before turning on the TV, and can move to the channel as soon as he/she turns on the TV. Second is analyzing the viewer pattern to recommend frequently viewed contents. This way, users will be able to watch TV programs they like without missing, at the exact time.

DISCUSSION

This study considers the usage of TV screens, which is a topic not dealt with previously. This is a different paradigm with previous studies, which have only considered turned-on screens. Also, this study analyzed the viewer behaviors of 4-member families of various ages through user-centric research methodology, and proposed four concepts.

However, since Bi-Stable Display technology is not yet commercialized, this study is only an initial study assuming the application of this technology. Also, since the range of screens is too broad, the limit of this study is that it only focused on large TV used by 4-member families. Moreover, evaluation of proposed concepts will be needed.

We expect that further studies will make an approach to various screens other than large TV, thus drawing out much more diverse forms of usage scenarios and concepts.

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