# Smiling Makes Us Happier: Enhancing Positive Mood and Communication with Smile-Encouraging Digital Appliances

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**ABSTRACT**
William James, the noted psychologist and philosopher, believed that smiling has a positive effect on our mind. James' view, which was confirmed by several psychological studies, was that we become happier when we laugh. In this paper, we propose a new digital appliance that encourages the act of smiling in our daily lives. This system is designed for people who may not always realize when they are in low spirits and/or have difficulty with smiling. In addition, we believe that this system will foster casual conversation and prompt communications with other people. Our appliance, called the HappinessCounter, combines visual smile recognition, user feedback, and network communication. We conducted two trials of the HappinessCounter system, the first with a single occupant and the second with a couple living together. The system had positive effects on user's mood and prompted communication among family members, thereby increasing their positive mood as well.

**Author Keywords**
Smile, Happiness, Mental mood, Health, Communication, Daily life

**ACM Classification Keywords**
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

**General Terms**
Design, Human Factors

## INTRODUCTION

William James said, "We don't laugh because we're happy – we're happy because we laugh." [2] His theory, called the James-Lange theory of emotion, states that life experiences produce a direct physiological response via the human autonomic nervous system, including increased muscle tone and heart rate, perspiration, and dryness of the mouth. Therefore, emotions occur because of these physiological changes, rather than being their cause. Tomkins mentions that facial movement can influence one's emotional experience [12][13]. For example, an individual who feels compelled to smile during a social event will actually come to find the event more enjoyable. Kleinke *et al*. [3] conducted an experiment on the influence of facial expressions on mood. They found that the participants in the study experienced an increase in positive mood when they created positive facial expressions, and a decrease in positive mood when they created negative facial expressions, even when the facial expressions were only mimicked. Kleinke *et al*. also found that these effects were enhanced when the participants viewed themselves in a mirror. Based upon these results, we believe that putting a smile on one's face, even when one is not in a good mood, may lead to a more positive disposition.

On the other hand, many people live alone for various reasons, including social situations, age, and diseases such as autism and depression. There are more than 31 million one-person households in the United States, which amounts to roughly 27% of all households [16]. For those people, it may be difficult at times to realize when they are in low spirits and do not have a smile on their faces. Without positive reinforcement, this condition could lead to more serious mental health problems. Medication might be one treatment option, but there are often side effects that should be considered.

To address these problems, we propose a new system called the HappinessCounter. This device facilitates the act of smiling in one's daily life and thus promotes a more positive mood. By providing feedback to users about their smile in combination with other tools [e.g., communication tools, social networking services (SNS), or applications], the system makes it easy for users to smile and thus leads to happiness. Moreover, the benefits extend to family members living together; the system may help to improve relationships with other family member by increasing their positive mood and enhancing communication.


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## HAPPINESSCOUNTER

The HappinessCounter detects a user's smile, counts the number of smiles, and records the user's mental state. After detecting a smile, the system displays visual feedback in the form of a "smile" icon in the corner of a mirror, as seen in Figure 1. If users do not smile regularly, the system notifies them by displaying a "sad" icon. As previously mentioned, Kleinke [3] pointed out that the effects were enhanced when participants viewed their smile in a mirror. We believe that if users are provided with feedback about their smile, they will be able to understand their feelings better. In other words, users will realize what is making them feel bad or good based on their corresponding smile response.

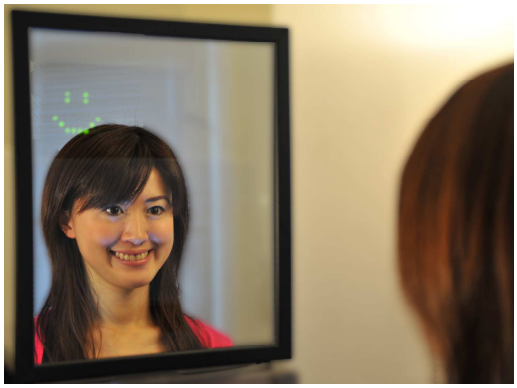

**Figure 1. The HappinessCounter encourages users to smile in their daily lives by providing feedback about their smile and combining other reinforcing tools. The system detects a user's smile using the smile-recognition engine, and it displays the smile icon as visual feedback in the corner of a mirror.**

We developed the "HappinessCounter Box" for this purpose. We enclosed a digital camera, an LED matrix display, and a light sensor inside the box. These devices enable the system to detect a user's smile and provide the necessary visual feedback, as seen in Figure 2. Moreover, we attached the HappinessCounter box behind a one-way mirror, as seen in Figure 3, to detect the user's smile throughout his or her daily life. By incorporating the tools that most people use on a daily basis, such as a vanity mirror, we established an environment in which the system would be used in a natural and sustained manner, thus encouraging the user to smile regularly.

However, depending on the user's mental state, he or she may not smile positively when provided with only visual feedback. Combining the system with other tools, therefore, encourages the user to smile more frequently and helps the user to be happier. Several applications can be combined with the HappinessCounter system.

We use this system in two modes. The first mode, called "Smile Awareness," simply recognizes and acknowledges when people smile to increase their awareness of smiling. The second mode, called "Smile Gateway," promotes a user's smile more actively. The system places light limits on certain routine actions performed in daily life, such as opening a door or turning on a TV, until the user's smile is detected.

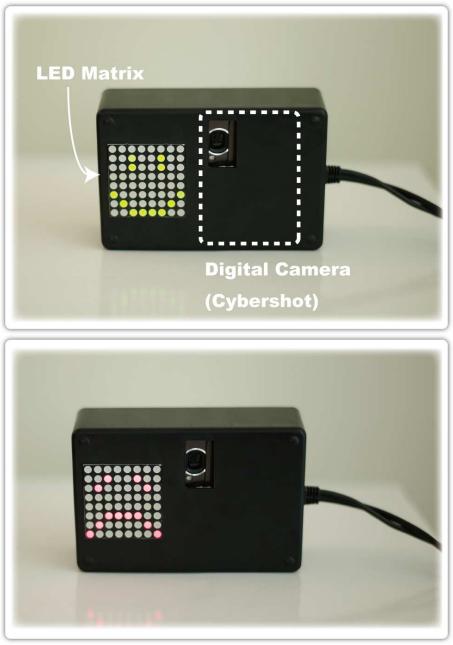


**Figure 2. The HappinessCounter Box consists of a digital camera, LED matrix display, and light sensor.**

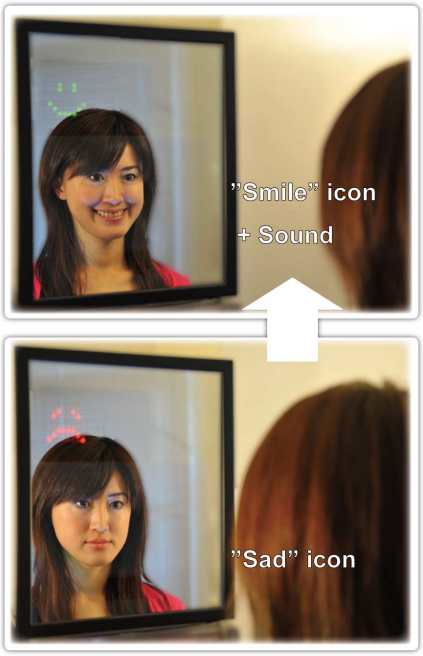


**Figure 3. If the user has not recorded many smiles, the system displays a "sad" icon. When the user smiles, the system displays a "smile" icon accompanied by a happy sound. Note that the mirror is half-silvered; the camera attached behind the mirror can see through it for facial recognition.**

**SMILE AWARENESS**

In our proposed system, Smile Awareness mode provides a supportive method that encourages smiles. Positioning the HappinessCounter in a commonly used location, such as a vanity mirror, and combining it with the following applications, leads to a natural and sustained use of the system. This, in turn, will encourage the user to smile regularly.

*Sound feedback:*

When the system detects a user's smile and displays the smile icon, the system will provide audio feedback in the form of a happy piece of music. This cheerful music, combined with the visual feedback, may make the user feel better and happier. The music player can be set up to play the user's favorite music only when a smile is registered. Encouraging smiling by using sound feedback may cause the user actively to produce more smiles.

*Send the smile picture to a digital photo frame:*

The system can be connected with other communication tools and automatically send out a picture of the user smiling. When the user tallies enough smiles, the system will take a picture of her smiling face and automatically send it to family members' digital picture frame and/or e-mail. Because the system does not require complex operations, even elderly people living alone who are unfamiliar with a PC can send their pictures to their family just by smiling. The system also enables an elderly person's family to monitor his activity or mental health easily. When a picture is sent, it may prompt other forms of contact, such as a telephone call. Thus, the elderly have an incentive to smile because it will encourage communication with their family members. Young people living apart from their parents may feel that it is a bother to contact them too frequently. At the same time, parents worry about their children and wonder if they are staying healthy. By using this system, children can reassure their parents about their well-being without much hassle, and their parents will feel relieved.

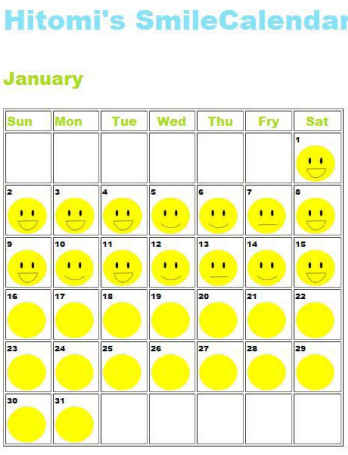


**Figure 4. Screen shot of the smile calendar. Users can use their smile icon to keep track of how many times they have smiled.**

*Display the smile results on a calendar:*

After the user's smiles and the number of actual smiles per day are recorded, the results can be displayed on a Web-based calendar application, as seen in Figure 4. The user's smiles are represented with three icons—happy, normal, or unhappy—depending on the number of smiles counted on a particular day. In addition, when the icon is clicked, the user can see the particular smiles recorded that day. By viewing his smile results on the calendar, the user (and potentially his social network) can easily understand how often he smiles, and how he felt on a given day compared to the previous day, week, and/or month. This organized feedback-based trend line may also lead the user to a more positive self-assessment.

*Post on SNS (e.g., Twitter):*

Connecting the system to an SNS will enhance interaction, and a user can easily share her feelings and emotional state with family or friends. The HappinessCounter system will automatically check the number of smiles for the day/week. For example, the system could automatically post a tweet such as, "Alice laughed 20 times today!" If the user does not have enough smiles recorded for the week, the system could automatically post a tweet such as, "Alice seems to be feeling blue." When family members or friends read such a message, they can call or send a message to the user. When another person provides this sort of encouragement, the user may feel better and be able to smile under conditions in which she could not smile by herself. Furthermore, the user could compare the number of her smiles to that of a friend. Thus, the system may motivate the user to smile more. The system may also lead to a new form of communication through smiles. For example, for elderly people living alone, the ease with which they can share this information with people around them may lead to a reduced burden on all individuals, thus leading to a more effective treatment in which the elderly can ultimately feel more reassured.

**Smile Gateway**

Smile Gateway mode provides a method in which access to something can be forcibly limited. Depending on the individual or his mental state, he may not positively make smiles under normal situations. Therefore, by creating an inconvenient situation, we believe the system may prompt smiling more effectively. Thus, we focus on the following method.

*Disallowing use of a daily appliance or piece of furniture without first smiling:*

To create an inconvenient situation, we focused on the appliances and furniture that people use frequently in their daily lives. If there is a shortage of smiles, the system notifies the user by making furniture and other appliances more difficult to use. We assume that the user will smile more positively when provided not only with visual feedback but also with a sense of force. As examples of

daily appliances/furniture, we propose a door, refrigerator, cabinet, TV, and electric pot. These are central items in our daily lives, and the system can make them harder to use when there is no smile registered. For example, the system can make it slightly harder to open items such as doors, refrigerators, and cabinets, and it can make it harder to turn on the TV. The system controls them until the user smiles, at which point the system returns them to their normal state (Figure 5). Obviously, the system does not go so far as to make these things completely unusable, as that could actually make the user feel sadder or even angry. In this type of inconvenient situation, when the user can use the desired items smoothly, she feels lucky or happier; conversely, when she cannot use these items easily, she will be made aware of her feelings and the fact that she is not smiling enough on their own.

Several applications, beyond the ones mentioned above, can be connected with the HappinessCounter system. Along these lines, through this research we will try to determine the best method to use to generate as many smiles as possible by determining when rate-limiting and -encouraging applications should be used and what order and frequency the stimuli should be applied.


**Figure 5. We combined the HappinessCounter Box with an electric magnet and attached it to the refrigerator door.**

### Usage Scenario

When this system is utilized, the following scenarios can be envisioned.

Scenario 1: A grandmother living apart from her family. She notices that she has not smiled recently based on the icon displayed on the mirror. When she tries to make a smile, the system automatically detects her smile and sends her smile picture to her family to be displayed on their digital photo frame. When the family sees it, they feel happier because her smile looked good. Afterward, they call her and have a conversation. The grandmother feels happier because she was able to communicate with her grandchild.

Scenario 2: A wife had only a little time due to housework. She was very busy and did not realize she looked cranky. When she tried to open the refrigerator, she could not open it smoothly. At that time, she noticed that she had not smiled. She "woke herself out of her trance" and made a smile. She could then open the refrigerator smoothly. After making a smile, she felt better than before. Minutes later, she met her husband, who had just come home. He said, "Did you have a good day today? You look great." When she heard that, she felt happy.

## IMPLEMENTATION

We developed the HappinessCounter system to detect a user's smile in daily life and make it easier for the user to smile regularly. The HappinessCounter system consists of two components—the "Smile Awareness" system and the "Smile Gateway" system, which control an appliance and/or a door using an electric magnet.

### Smile Awareness System

We developed the HappinessCounter Box to detect a user's smile and provide visual feedback. We enclosed a digital camera, an LED matrix display, and a light sensor inside the box. We enclosed a Sony Cyber Shot digital camera[1] in the box because it has a built-in smile-recognition engine. In addition, we enclosed an LED matrix display[2] to show the happy or sad icon. This LED matrix is connected to a computer via an Arduino[3].

We used a light sensor to detect when the system takes a picture in real time. Thus, sensors are connected to a computer via a Phidgets Interface Kit[4]. By attaching the sensor behind the camera display, we can monitor the brightness of the display (Figure 6). We put the CyberShot digital camera in the "smile shutter mode," in which the camera automatically takes a picture when a smile is recognized. Thus, we can detect when it takes a picture because the brightness of the camera's display changes significantly after the shutter is pressed, as seen in Figure 6. Using this function, when the system detects a user's smile, the system displays the smile icon on the LED matrix and plays a happy sound.

We also attached a servo motor into the HappinessCounter Box to enable constant use of the "smile shutter mode" (Figure 6). We found that the smile shutter mode timed out automatically over a certain period, and we therefore developed a mechanism to constantly re-enable the mode. For this purpose, the servo motor continually selects the smile shutter mode icon on the camera touch panel. This

[1] Sony Cyber-Shot DSC-T99

[2] http://www.sparkfun.com/products/759

[3] http://www.arduino.cc/

[4] http://www.phidgets.com/

servo motor is connected to a computer via an Arduino[5] interface.

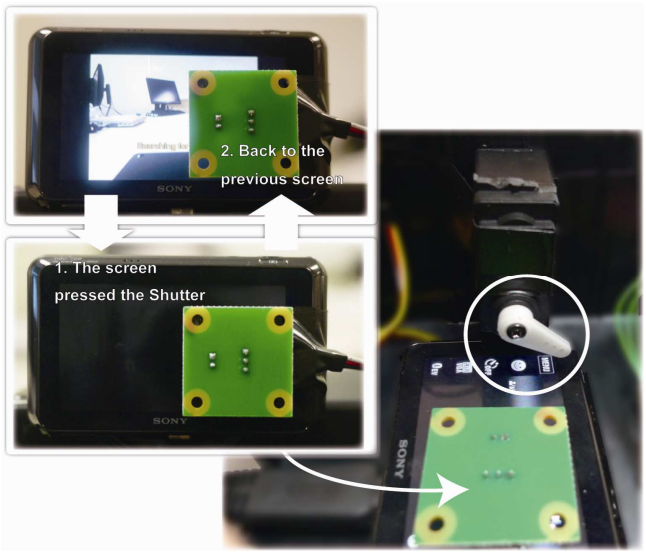


**Figure 6. For facial recognition, we attached a light sensor to a camera's monitor screen. When the camera detects a smile and automatically triggers a shutter, the brightness of the monitor screen also changes, and this change can be detected by the light sensor. In addition, we attached a servo motor into the HappinessCounter Box to enable constant use of the "smile shutter mode." The servo motor continually selects the smile shutter mode icon.**

Moreover, using an Eye-fi card,[6] the system automatically takes a picture and transmits the image wirelessly to a PC, which is then uploaded to Flickr[7]. The system counts the user's smile for the day. After a certain number at the end of the day, the system uploads these states to a Web server. The system logs the user's smile status while the other applications refer to the state on the Web server.

After recording the user's smile and the number of actual smiles per day, we displayed the result on a Web-based calendar application, as seen in Figure 4. The user's smiles are represented as three icons—happy, normal, or unhappy—depending on the number of smiles recorded on that particular day. We decided that if the number of smiles is more than 10, the icon is happy; if the number of smiles is fewer than five, the icon is unhappy. Anything else is considered normal. In addition, when the icon is clicked, the user can see the particular smile pictures taken that day. These pictures are retrieved from Flickr[8] and displayed on the Web-based page. By viewing his smile results on the calendar, the user can easily understand how often he smiles, and how he felt on a given day compared to the previous day, week, and/or month.

### Smile Gateway System

As an example of a method by which we can limit access to something, we developed a system that can control the refrigerator door using an electric magnet. If the user does not have enough smiles, the system makes the refrigerator door harder to open by using an electric magnet to hold down the door. An X10[9] controller is used in this device. The X10 uses the power line as a means of communication and can easily control AC powered devices. Given that the X10 uses the power line as a means of communication, any electrical device within a residence can be conveniently controlled via this method.

Likewise, other devices such as room lights, fans, and air filters can be potentially controlled using this method. The host program monitors the Web server state. By smiling, the user unlocks the refrigerator door, allowing it to be opened smoothly.

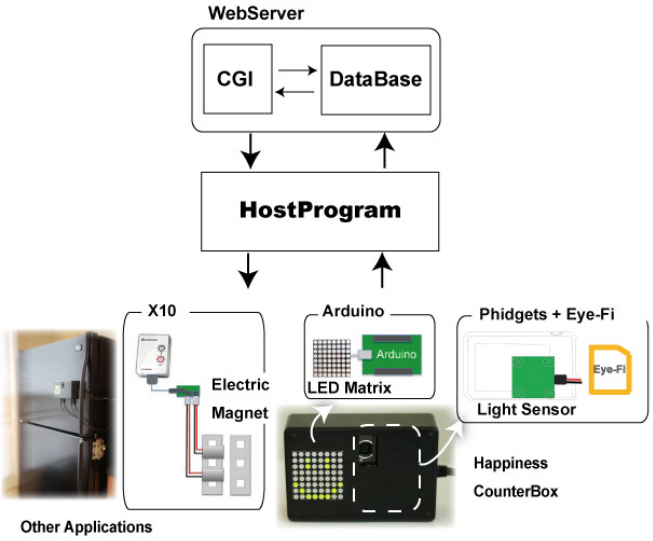


**Figure 7. Overview of the HappinessCounter components.**

## FIELD TEST

To determine the effectiveness of the system, we conducted two field tests, one with a person living alone and the other with a couple living together. Both tests used an application that limited access to a refrigerator. We wanted to know how the system was received and how limiting access would change a user's behavior, whether the subject was a person living alone or a couple living together.

[5] http://www.arduino.cc/

[6] http://www.eye.fi/

[7] http://www.flickr.com/

[8] http://www.flickr.com/

[9] http://www.smarthome.com/2000.html
POWERLINC SERIAL/TW523

**Field Test with a Person Living Alone**

To determine the effectiveness of the system in daily life, we conducted the following field test in an actual home during a two-day trial.

*The aim of the field test*

The aim was to investigate the following:

· How will the system work with a person living alone in daily life?

*How the field tests were conducted*

We attached the HappinessCounter Box and an electric magnet to a refrigerator door. In this scenario, if the user did not smile at the box, the refrigerator door became somewhat harder to open. It only became possible to open the door normally when the user smiled, at which point he also saw the smile icon and heard the smile chime.

For this field test, we installed the system in a home with one occupant (a participant), a 39-year-old male. He used the system for two days in his home. During this time, the participant used the refrigerator naturally several times a day.

*Observations*

During the field test, the number of recognized smiles totaled 33, with an average of 16.5 smiles per day in front of the refrigerator door. The participant cooked on both days and used the refrigerator most often in the morning and evening. He was surprised by the number of smiles because he thought he usually did not smile that often (we describe this in detail in the DISCUSSION section).

**Field Test with a Couple Living Together**

To determine the effectiveness of the system in everyday family life, we conducted the following field test in an actual home during a 10-day trial.

*The aim of the field test*

The aim was to investigate the following:

· How will the system work with a couple living together in an everyday family setting?

· Did the system prompt other forms of communication?

*How the field tests were conducted*

The participating family was comprised of two participants, participant A (male, 64 years old) and participant B (female, 62 years old). The participants are rarely at home during the day because they work outside the home.

We attached the HappinessCounter Box and an electric magnet to their refrigerator door (Figure 8). In addition, we installed the smile calendar system so the participants could check how many smiles they made during the day by watching the calendar on the web. We asked the participants to keep a daily journal to provide feedback on the system. We recorded separate detailed system logs of the field test.

**Figure 8. We attached the HappinessCounter Box with an electric magnet to the participant's refrigerator door.**

During the trial period, we asked the participants to use the refrigerator naturally. The participants mainly used the refrigerator in the morning and night because they usually had breakfast and dinner at home.

*Observations*

This section presents the findings from the captured log data.

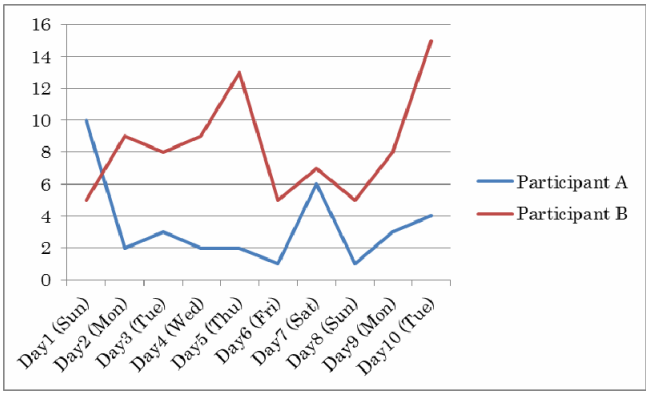


**Figure 9. The number of recognized smiles per day and average.**

Figure 9 shows the number of recognized smiles per day and the average number per day during the field test period.

As can be seen from the figure, the number of recognized smiles from participants A and B per day did not change dramatically during the field test.

During the field test, there was an average of 3.4 smiles per day for participant A and 8.4 smiles for participant B.

Participant B had a larger number of smiles than participant A. Participant B cooked every day and therefore used the refrigerator more often. Participant A usually used the refrigerator to get drinks such as milk or beer.

On days 1 and 7, the number of smiles by participant A increased more than any other day. On these days, participant A stayed home all day and therefore had more chances to use the refrigerator. In addition, participant A sometimes used the refrigerator intentionally like a game (we describe this in detail in the DISCUSSION section).

On days 6 and 8, the number of both participants' smiles was lower. This was due to the participants eating out and spending a lesser amount of time at home, which meant they did not use the refrigerator as frequently.

Figure 10 shows the participants' pictures taken during the field test. Pictures A and B were taken on day 1. Pictures A' and B' were taken on day 10. As seen in the figure, it looks like both participants initially forced an artificial smile expression. However, by the end of the trial, they made smile expressions naturally (we describe this in detail in the DISCUSSION section).


**Figure 10. A part of the participants' pictures taken during the field test. Pictures A and B were taken on day 1. Pictures A' and B' were taken on day 10. We found that the participants' smiles became more natural compared with those recorded earlier in the field test. At first, participants smiled by forcing themselves. Eventually, however, they could smile unconsciously.**

## Discussion

We will discuss the results of the field tests and the method by which they matched the original predictions.

*How did the system work for a person who lives alone?*

As described in the Observation section, the person living alone was surprised by the number of smiles because he usually did not smile that often. In the interview, the participant mentioned that it was good exercise for his facial expression. He also said the following:

*"I tried to make more smiles than usual because I felt happy when I heard the smile sound and saw the smile icon after making a smile."*

At first, the participant made a smile as a form of good exercise. Eventually, however, he felt happy by continually trying to make smiles. Although this test was very small in scale and duration, we think the idea of facilitating smiles for a person living alone has potential.

*How did the system work for a couple living together?*

In the interview, the participants mentioned that they tried to make more smiles than before the field test. When we informed the participants of the number of recognized smiles during the field test, they were a little surprised because they thought they had made more smiles. Participant A, in particular, felt that he had made more smiles than the actual number recorded. For that reason, we considered the possibility (as we will discuss in detail later) that participant A had made smiles in the general vicinity without actually standing in front of the refrigerator. Therefore, although participant A attempted to smile, the system did not recognize his smiles.

In addition, participant B mentioned her change in feelings as follows:

*"When I felt a bit down, not in a good mood, or was busy with things to do, I stood up in front of the refrigerator and found myself trying to feel good. I then changed my feeling by making a smile and recovered my presence of mind and could continue cooking." (Participant B)*

Participant B also said the refrigerator had become a place to smile.

*"Early in the field test, I didn't know how I should smile and therefore made smiles intentionally. However, by making a lot of smiles in front of the refrigerator, I became used to making smiles and learned how I should make a smile. Eventually, when I stood up in front of the refrigerator, I could make smiles naturally. Therefore, I began to associate the refrigerator as a place to feel relieved." (Participant B)*

As seen in Figure10, we found that participant B's smiles became more natural compared to those recorded earlier in the field test. At first, participant B made a smile by forcing herself. Eventually, however, she could make smiles unconsciously. Although participant A did not mention it, it is clear that participant A's smiles started looking more natural.

As Kleinke *et al*. [3] mentions, we think the results show that the participants experienced an increase in positive mood when they created positive facial expressions and a decrease when they created negative facial expressions. However, even if the facial expressions were only mimicked, the participants could eventually make smiles naturally.

We believe that the Smile Gateway mode worked well for the participants as it encouraged making smiles and improved their positive mood.

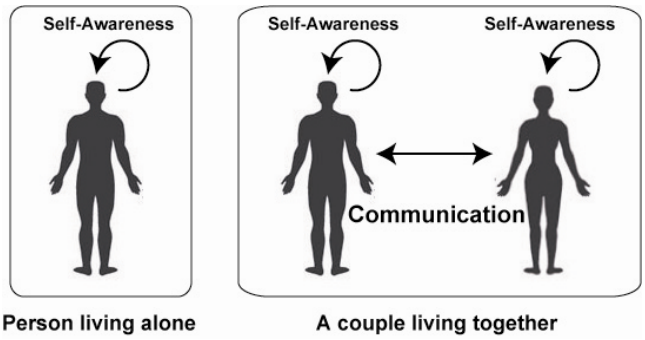


**Figure 11. The person living alone made more smiles and thus felt that his mood was improved. For the couple living together, making more smiles prompted communication among family members, thereby increasing their positive mood as well.**

*Did the system prompt other forms of communication?*
The participants' journals indicated that the system led to the start of conversations. Participant A mentioned the following:

*"I was happy to hear the smile sound when my wife made smiles and therefore started talking to her." (Participant A)*

When participant A was in the living room, he could hear the sound. Although he was not in front of the refrigerator, he felt good and started conversations such as, "What's for dinner?"

Moreover, in the interview, participant B mentioned that at first the system did not recognize her smile at times. When participant B said, "Um, the system doesn't recognize my smile," participant A then came in front of the refrigerator and said, "I can do that instead of you." This led to another conversation. In addition, participant B said:

*"When we used the system together we had fun, like a sense of playing a game together."(Participant B)*

*"I thought my husband had fun with the system like a game. After starting the field test, he came to the refrigerator more often without having anything to do."(Participant B*)

In the interview, participant A mentioned he didn't think his behavior changed. However, as pointed out by participant B, the data log (Day 1 and Day 7) displayed in Figure 9 shows that the number of recognized smiles increased. We believe that when the system was used with multiple people, it prompted communication among family members, thereby increasing their positive mood.

*Other*
In the field test involving the person living alone, sometimes the system took a little longer to recognize the participant's smile, and thus he had to wait before seeing the smile icon and hearing the chime. During these times, he felt a little stressed by this delay. Furthermore, he did not want to give up until his smile was detected. Based on this finding, we need to improve the detecting technology using other tools and/or methods. It is very important that the user's smile be detected immediately.

In the field test involving a couple living together, participant A also mentioned wanting feedback about how he was smiling.

*"I want to get feedback about how I am smiling, such as with a mirror, because I don't know what kind of facial expression I am making now."(Participant A)*

At times, the system did not recognize the participant's smile even though he thought he made one. He wanted to know what kind of smile was receptive to the system. Depending on the person, we found that there were types of faces that were easily recognized and others that were harder to recognize. Although we developed a system combined with a mirror, the version installed on the refrigerator did not include a mirror. Based upon the results, it may be appropriate to attach a mirror to all systems in order to provide feedback. Moreover, we used the built-in smile-recognition engine from the camera mentioned in this paper. However, in the future we hope to use technologies for detecting smiles in which we can adjust the level of smile detection based on the person.

In the interview, the participants mentioned that the smile calendar was not used very often. In fact, participant B never saw it, because she did not use the computer in everyday life and thus had no chance to see the calendar. In addition, participant A only saw it once or twice. We considered that it might be appropriate to display the smile calendar in the same place as the HappinessCounter Box so that the user can see it without using a PC.

The participants also expressed some concern about privacy issues. Specifically, they were both used to using the refrigerator after taking a bath. Participant A did not wear any clothes on his upper body and worried a little about pictures being taken of him in such situations. However, the participants became less concerned about this issue as time went on. We need to consider such privacy issues and ensure that the system takes pictures of only the user's face.

*"Smile Awareness" and "Smile Gateway" mode*

In these field tests, we chose a "Smile Gateway" application that limited access by creating an inconvenient situation if the appropriate smiles were not made. As a result, the system had positive effects on the user's mood. However, depending on the user's mental state, the system may not have the desired positive effect. For example, when users are having a bad day, they may not make smiles and the system may lead to the user feeling worse. In this situation, it might be more appropriate to assist the user by, for example, having the refrigerator door open automatically. On the other hand, when the user does not make smiles, the system could make these things completely unusable and make the user feel even angrier. Because there are several approaches, as mentioned above, we need to consider the best method to generate as many smiles as possible by determining when rate-limiting and -encouraging applications should be used, in what order, and what frequency the stimuli should be applied.

## POTENTIAL

This system architecture may have potential uses in therapy situations. As previously mentioned, the researcher Strack [11] pointed out that facial expressions affect one's emotions. Some people focus on these theories and describe "smile therapy" to encourage and make smiles in daily life. In addition, some people describe the effects of "laughter yoga," which refers to traditional physical, mental, and spiritual disciplines that originated in India. We believe that making smiles continually in daily life may improve mental health.

This system architecture will also enable us to create various kinds of smile-inducing appliances. The following are some examples of interactions that are connected with existing products based on this architecture.

*Built-in HappinessCounter system into a digital photo frame or Chumby-like device:*

By attaching a camera to a digital photo frame or Chumby [10] device and installing the HappinessCounter system, a user can easily send smile pictures to the digital picture frames of remote family or friends and/or a remote Chumby device by just making a smile. Users can exchange their daily feeling and may inform others of their health and mental state as determined by the picture of their smile.

*Using the camera on a tablet or mobile phone:*

By using the existing camera on a tablet or mobile phone, the HappinessCounter system can control access to phone calls or e-mail with a "smile gateway." For example, only the user is required to smile before being allowed to call another person. In addition, when the user does not smile enough, e-mail they send or receive may be delayed. Conversely, when the user smiles a lot, they are allowed to send/receive e-mail normally.

*PC-based interaction:*

The HappinessCounter system installed on a user's PC will use the PC's Web camera to monitor the number of smiles the user makes while using the computer. If the number of smiles the user makes is below normal or not enough, the system can alert the user or force another action. For example, if the smile count is below normal, applications can become noticeably slower. This type of feedback system is not only useful at home but also within the workplace. For example, the HappinessCounter system can be attached in front of a meeting room of a workplace. When the user makes a smile, that user can then enter the meeting room.

Increasing the number of smiles in the workplace will enhance the atmosphere for everyone. Conversely, if someone is irritated or bothered by something, slowing the system down will allow the user to calm down and reconsider before doing something he might regret later. By making the user smile in this situation, it will help him to overcome whatever made him angry in the first place.

## RELATED WORK

There are many research projects related to smile detection [5][17]. We used the built-in smile-recognition engine from the camera mentioned in this paper, but in the future, we will use these technologies, and we believe we can install and combine several applications without a special camera. McDuf *et al*. [7] proposed a system that could measure health indicators just by putting a person in front of a low-cost camera. Relax to Win [6] is a game that measures the player's galvanic skin response and uses the data during the playing of the game. Emotional Flowers [8] also harnesses the player's emotions. Within the game, the player's facial expression or emotion is used to control the growth of a flower. We try to enhance mental happiness by encouraging users to smile in daily life.

EyeCatcher [15] is a system that helps photographers capture a variety of natural-looking facial expressions of subjects by presenting images or videos (e.g., friends or animation characters) on the display attached to the front of the camera. Cheese Cam [4] uses a camera that can induce unconscious facial reactions in a photography subject by displaying a small facial expression icon on its screen. Based on this research, Samsung released a digital camera (DualView TL225) [10]. These studies aimed to make several natural facial expressions when the user takes pictures by using several previously displayed images or icons. We focused on increasing smiles in daily life to increase happiness.

Several researchers have focused on monitoring the activities of the elderly for the benefit of their family. Digital Family Portrait [9] is an electronic picture frame

[10] http://www.chumby.com/

that can display the daily activities of an elderly person who lives far from his/her family. I-pot [18] is an electric pot that sends an e-mail to family members when the power switch is turned on or the water is being poured. Family Planter [1] is a pair of artificial flowerpots with sensors, lights, and actuators that indicate the proximity of people in houses that are located far apart. SocialMedicineBox [14] is a communication system for the elderly that uses a medicine chest and notifies family members of the status of the elderly person taking medicines, as well as sending pictures to the family. These devices use e-mail to inform the family members of an elderly person as to his or her behavior or activity. Our research used the "smile" as a trigger and led to an enhancement of other communication.

## CONCLUSION AND FUTURE PLAN

In this paper, we proposed a system called the "HappinessCounter," which facilitates smiling and improves positive mood. After detecting the user's smile, it provides visual and auditory feedback. In addition, the system can be connected to other applications that can prompt the user to make a smile. We conducted two field tests, one with a person living alone and the other with a couple living together. Both tests were conducted in actual homes. In both tests, the system limited access to the refrigerator. Both sets of participants mentioned that they tried to make more smiles than before the field test and thus felt that it improved their mood. In addition, the system prompted communication among the family members, thereby increasing their positive mood as well. Our field test was small in scale, so the participants may have been positively biased toward the system. Nevertheless, our test managed to deliver results, and we hope this will help others to enhance their systems to better support and improve users' feelings and prompt communication among family members.

Currently, we can only detect a user's smile in a specific location. In the future, we would like to detect smiles nonintrusively, automatically, and combine the system with various potential applications.

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