EyeCatcher: a digital camera for capturing a variety of natural looking facial expressions in daily snapshots

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Abstract. This paper proposes a novel interactive technique, the EyeCatcher, which helps photographers capture a variety of natural looking facial expressions of their subjects, by keeping the eyes of the subjects focused on the camera without the stress usually associated with being photographed. We develop a prototype system and verify the effectiveness through evaluation and discussion.

1 Introduction

As digital cameras have become increasingly popular in recent years, people have come to take more pictures in their daily lives. In particular, people often take snapshots of their families, friends or pets. However, many people experience difficulties in capturing the natural facial expressions of their subjects for several reasons: many subjects become stressed when facing a camera, while other "camera-wise" subjects –those accustomed to being photographed– often make stage faces. Moreover, it is often quite difficult to take pictures of children, since they often look away from the camera.

This paper proposes a novel interactive technique, the EyeCatcher, to help photographers capture a variety of natural looking facial expressions by keeping the eyes of subjects focused on the camera without the stress of photography (Fig. 1).

2 EyeCatcher

The main concepts of the EyeCatcher are as follows:

1. Keeping the eyes of the subjects focused on the camera
2. Reducing the stress associated with being photographed
3. Extending existing digital cameras

First, the EyeCatcher can help to keep the eyes of the subject focused on the camera. Some people who are not comfortable with being photographed

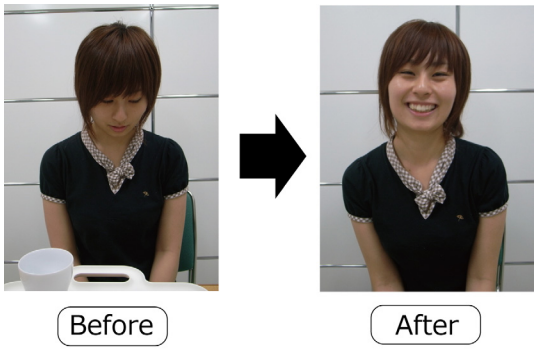

Fig. 1. The goal of the EyeCatcher is to help photographers capture a variety of more natural looking facial expressions of subjects by keeping the eyes of the subjects focused toward the camera without stress.

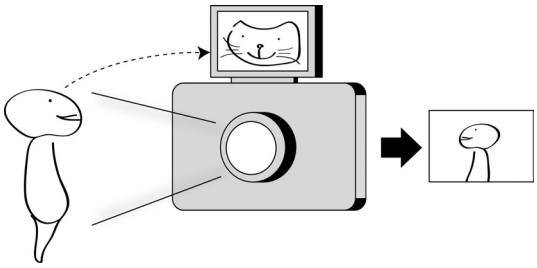

Fig. 2. The basic concept of the EyeCatcher is to keep the eyes of the subjects focused toward the camera, while turning their attention to the content shown in a small display attached above the lens on the front of the camera.

often turn their eyes away when they are faced with a camera. Moreover, since children tend to move around restlessly, photographers often experience difficulty in keeping their eyes towards the camera.

Second, the EyeCatcher can reduce "camera-stress" on subjects. When photographers take pictures of subjects, many subjects become stressed since their attention is centered on the camera; other "camera-wise" subjects –those accustomed to being photographed– often create stage faces, and their faces look almost the same in every picture.

To solve these problems, we attach a small display to the front of the camera. By presenting images or videos (e.g., friends, pets, or animation characters) on the display, we can (1) keep the eyes of the subjects focused toward the camera, and (2) turn their attention to content shown in the display and away from the stress of being photographed(Fig. 2).

Third, we can extend the versatility and practicability of existing digital cameras. Since many photographers have their favorite cameras, it is likely they

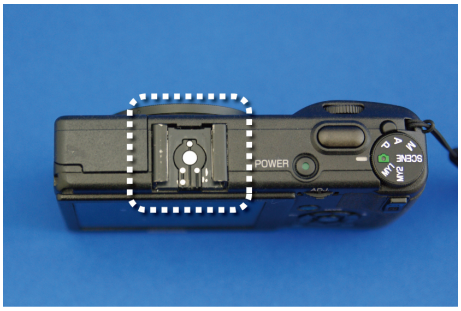

Fig. 3. Hot shoe connector of a high-end compact digital camera (Ricoh GR Digital2). There are 5 signal terminals at center, and ground terminals on each side.

would like to apply this innovation to their current cameras rather than use completely new ones. For this reason, we designed the system so that the small display can be attached to existing digital cameras using a "hot shoe connector". The hot shoe connector is an extension connecter mainly used for strobes by experienced photographers on many digital cameras; both single lens reflex cameras and high-end compact cameras (Fig. 3).

The function of the hot shoe connector is to connect the camera with an external device both "physically" and "electrically". For example, when a strobe is attached to the camera via the hot shoe connector, the camera can transmit many commands to the strobe via electrical signals, thereby controlling apertures, shutter speeds, zooms, shutter button status, and so on.

Using a hot shoe connector to attach our novel device, we can not only stably fit the device on the camera, but also detect input signals from the camera (e.g., shutter button status) and use them to control the device. Moreover, we can avoid parallax problems using the hot shoe connecter since it is usually located directly above the lens, as will be explained in greater detail in the "discussion" section.

3 Implementation

In this section, we explain the implementation of the EyeCatcher prototype. First, we selected a high-end compact digital camera (Richo GR Digital2) for attachment of the EyeCatcher. The GR Digital2 is famous for its picture quality, and is used extensively as the camera of choice by professional and semiprofessional photographers. Fig. 4 shows an image of the prototype.

The prototype system consists of three main components: (1) a presentation component on the front, (2) a selection component on the back, and (3) a control component located between the two.

The presentation component consists of an organic EL display, 4D Systems uOLED-160-G1 (Fig 5 bottom left). The uOLED-160-G1 is a full-color organic

Fig. 4. The prototype EyeCatcher.

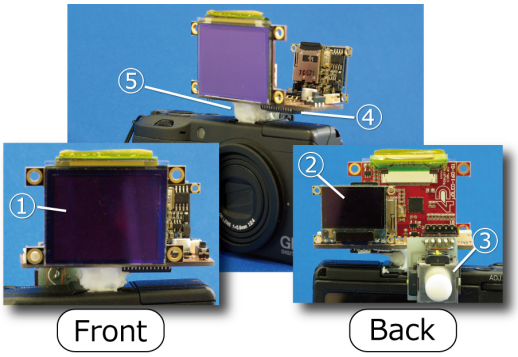

Fig. 5. The system architecture of the prototype. 1. organic EL display (uOLED-160-G1), 2. organic EL display (uOLED-96-Prop), 3. joystick, 4. micro controller(PIC18F2550), 5. hot shoe connector.

EL display. The resolution and size are 160 x 120 pixels and 32mm x 40mm, respectively. It has much higher visibility than ordinary LCDs; i.e, it is much brighter and has a wider angle of view (about 180 degrees). Dots, lines, shapes, text, and image or video content can easily be displayed by sending several bytes of commands via a UART communication link. Moreover, it has a micro SD slot as an external memory, so we can easily update content using an everyday personal computer. We use the uOLED-160-G1 for displaying various content to the subjects.

The selection component consists of an organic EL display, 4D Systems uOLED-96-Prop, and a joystick, CTS 252A103B60NA (Fig. 5 bottom right). The uOLED-96-Prop is a full-color organic EL display, with specifications almost the same as those of the uOLED-160-G1, apart from resolution and size (96 x 64 pixels and 23mm x 25.7mm). The joystick detects the movement of the stick with 2 variable resisters, and outputs 2 analog signals. It also works as a

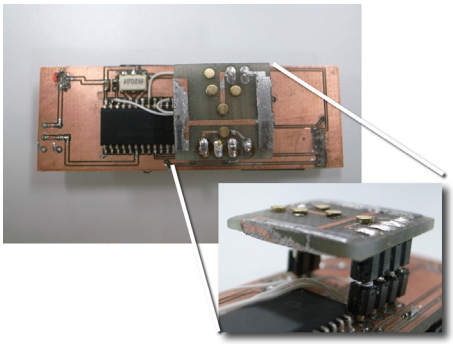

Fig. 6. The control board and hot shoe connector for the prototype

push button by pressing the stick. We use the joystick and the uOLED-96-Prop EL display for selecting content for visual feedback, as will be explained in detail in the following section.

The control component consists of a micro controller (Microchip Technology PIC18F2550), an original hot shoe connector, and peripheral circuits (Fig. 6). The size of the board is about 22mm x 65mm[1]. The hot shoe connector is designed for the hot shoe socket of the GR Digital2 shown in Fig. 3 [2]. As mentioned above, the hot shoe connector works (1) to physically attach the EyeCatcher device to the camera and (2) to electrically connect the signal lines between the two components. Thus, the EyeCatcher can detect several camera operations (e.g., the pressing of the shutter button only halfway) by analyzing signals from the hot shoe connector. The control component is connected to the presentation and selection components via pin headers, and controls these devices via the micro controller. We use a lithium ion battery (3.7V) as a power supply[3].

Finally, we developed the outer package of the prototype using ABS plastics. Since we have integrated all components into the outer package, the EyeCatcher device can be easily be connected or removed like an external strobe.

3.1 Content

In this section, we explain the content shown in the EyeCatcher. We define the conditions for selecting content as follows:

[1] This size is smaller than the upper surface of the GR Digital2

[2] The layout of the electrical contacts of the hot shoe connectors vary between manufacturers. Although this prototype works only with Richo cameras, we believe it would not be difficult to support cameras from other manufacturers by designing corresponding connectors.

[3] We initially planned to supply power from the hot shoe connector, since there was a contact that supplies about 3V. However, since this voltage was not sufficient to operate the organic EL displays (which need 3.6V), we passed over this idea in the current prototype.

1. Content for attracting the attention of subjects
2. Content familiar with subjects
3. Content for producing various expressions or poses

The first point is to attract the attention of the subjects at a glance. For example, displaying images of human faces is better suited to keeping the subjects' attention[1]; whereas animation is usually more attractive than still images (Fig. 7 left top). Moreover, since the display size of the current prototype is relatively small, a simple composition may be more desirable than a complex one.

Secondly, EyeCatcher uses content that is familiar to the subjects as an attempt to invoke the most reaction. For example, the system uses pictures of friends or associates rather than those of complete strangers (Fig. 7 top right). The system also uses pictures of actors, artists or animation characters which are well-known to many people.

The third point is that some contents may help people produce various expressions or poses. For example, silhouettes of poses may trigger unique poses (Fig. 7 bottom right), while face icons may help subjects produce similar faces (Fig. 7 bottom left).

Figure 7 shows examples of the content which meet the above conditions.

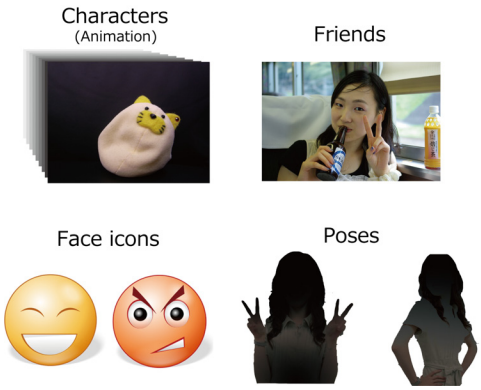

Fig. 7. Examples of content for use in the EyeCatcher.

Next, we explain how users select the content to present to subjects with EyeCatcher. We designed a virtual matrix menu suited for control with the joystick. Users can directly select the menu by moving the stick in any of 8 directions. The menu consists of 2 hierarchies: there are 8 category folders and each of them has 8 options (Fig. 8).

The procedures for selecting and presenting content are as follows:

1. First, the photographer browses the categories for content by moving the joystick in any of the 8 directions. The category title and a typical image of the selected category are shown in the back display.

2. When the joystick is kept in the same direction for a few seconds[4], the category folder opens.
3. Next, the photographer can browse the options within the selected folder by moving the joystick again. The title and image of the selected option are again shown in the back display. The user can return to the category menu by pressing the joystick.
4. After selecting the content for display, the photographer points the camera at the subject, and presses the shutter button halfway. Since the status of the shutter button is automatically detected by the system, the selected image is shown in the front display (Fig. 9)[5]. Moreover, since the selected content is shown to the subjects just before the picture is taken, the photographer can easily capture the reactions of the subjects.
5. A few seconds[6] after the shutter button is pressed, the content shown in the front display is cleared.

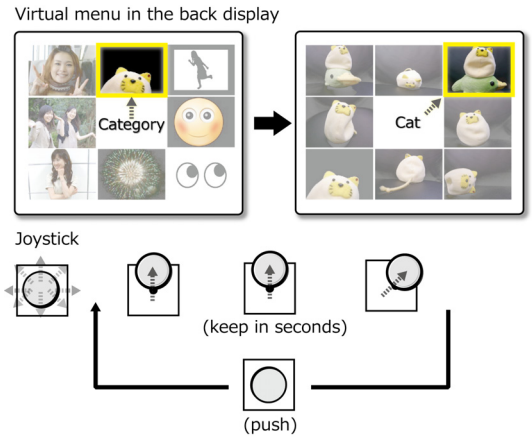

Fig. 8. Procedure for selecting content. Users can browse contents in the matrix menu by moving the joystick in 8 directions. They can select a content option by keeping the stick in the same direction for a few seconds. Information regarding the current category or content is shown in the back display.

We have designed these control procedures to be easily used with the thumb when the photographer is holding the camera in his or her hands. Moreover, when the photographer learns the menu structure, he or she may select content

[4] 1 second in the current prototype.
[5] Before this step, content is only shown in the back display; alternatively, several animated lines, like a screen saver, are shown in the front display.
[6] 2 seconds in the current prototype.

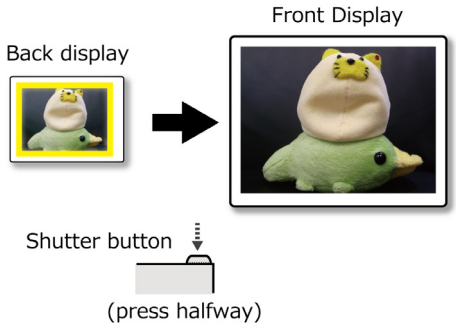

Fig. 9. Procedure for displaying content. After previewing a selected content option in the back display, the user can show it in the front display by pressing the shutter button halfway.

without looking at the back display. Therefore, this method may also be useful for single lens reflex cameras, which are mostly used with optical finders [7].

4 Evaluation

We evaluated the effectiveness of the EyeCatcher prototype with regard to two aspects: (1) "How the subjects feel about the EyeCatcher?" and (2) "How people feel about the pictures captured using the EyeCatcher?". First, we took pictures of subjects while showing content using the EyeCatcher, and then obtained subjective feedback from the subjects via a questionnaire. Next, we conducted another questionnaire survey to examine impressions of the captured pictures. We define the subjects of the first evaluation as "subjects" and the subjects of the second evaluation as "respondents" to avoid confusion.

4.1 Photography evaluation

Method We selected eight test subjects (7 female and 1 male) from among the members of our laboratory who had never used the EyeCatcher before. Their ages ranged between 22 and 52. All participants use of digital cameras (including camera-equipped cell phones) on a daily basis.

The experimenter took each subject into a room, seated her/him on a chair, and seated himself across a table from the subject. The distance between the subject and the experimenter was about 1m. This distance was decided in consideration of the characteristics of the digital camera used in the current prototype (GR Digital2). As the GR Digital2 is equipped with a wide-angle fixed-focus

[7] In future implementations, we intend to include feedback functions using clicks or vibrations.

lens (28mm), subjects in the pictures taken from farther than 1m appeared too small for our purposes.

The procedure for this evaluation was as follows. First, the experimenter took pictures of each subject using the GR Digital2 without the EyeCatcher. Next, the experimenter took pictures using the EyeCatcher while showing eight content options in a random sequence. The content options used in this evaluation are shown in Fig. 10[8].

Fig. 10. The contents used in the evaluation. 1. Food (cake), 2. Face icon (surprised), 3. Japanese actor (Kenichi MATSUYAMA), 4. Animation character, 5. Associate (professor), 6. Pose (hands on the waist), 7. Japanese entertainer (Harumi EDO), 8. ID photo (man wearing a suit)

These content options were selected based on the conditions mentioned in the "Content" section. That is, (1) all content should have a clear composition for attracting the attention of subjects at a glance, (2) some of them should be familiar to the subjects, and (3) others should help the subjects produce various expressions or poses. We selected content 1, 3 and 4 based on the condition (2), and content 2, 6 and 8 on condition (3). Content 5 and 7 were selected as fulfilling both condition (2) and (3). Since the subjects were mostly young women, we selected "cake" as a food, and a "young male actor" as an actor taking into account their preferences.

The experimenter did not engage in any verbal communication with the subjects to reduce variables other than the effect of the EyeCatcher. To begin, the experimenter told each subject "Please act as you usually would, and don't be nervous about the experiment.". After starting the evaluation, the experimenter did not speak to the subjects apart from briefly replying to the subjects' ques-

[8] Content 4 was a simple animation, and all others were still images.

tions. When the evaluation was finished, the experimenter obtained subjective feedback from the subjects both by questionnaires and discussion.

Figure 11 shows pictures taken using the GR Digital2 without the EyeCatcher[9].

Fig. 11. Pictures captured without the EyeCatcher.

Results First, we attempted to characterize the subjects by asking them two questions: (1) "How comfortable are you with being photographed? (1: very uncomfortable - 5: very comfortable)", (2) "How emotionally expressive are you when photographed? (1: very unexpressive - 5: very expressive)" [10] . Figure 12 shows the distribution of the subjects in terms of their response to these two questions. The subjects were found to be divided into three main groups: (1) subjects E and G were "comfortable with being photographed" and "expressive", (2) subjects B, F and H were "uncomfortable with being photographed" and "inexpressive", and (3) subjects A, C and D fell between those in groups (1) and (2). We will refer to subjects E and G as "camera-wise subjects" and subjects B, F, and H as "camera-shy subjects," and discuss the results based on these terms in the "Consideration" section.

Next, we explain the results of the subjective questionnaire. We set four questions and scored the answers on a scale of 1 to 5 as follows: (1) "Was your

[9] Pictures shown in this paper are cropped for greater visibility.

[10] All questions and answers presented in this paper are translations from the original Japanese.

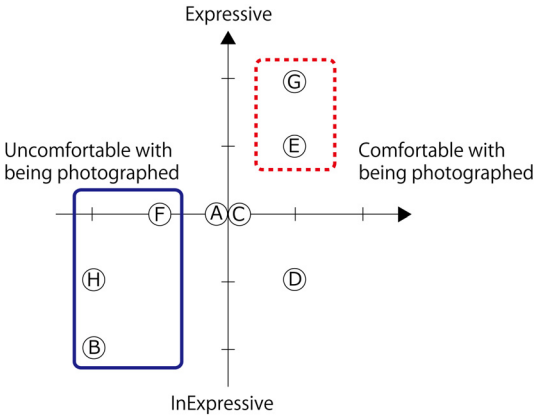

Fig. 12. Character distribution of the subjects.

focus on the camera reduced? (1: not reduced at all – 5: drastically reduced)", (2) "Was the photography process pleasant? (1: very unpleasant – 5: very pleasant)", (3) "Were your faces captured differently? (1: not different at all – 5: completely different)", (4) "Would you want to always use the EyeCatcher in the future? (1: would never want to – 5: extremely want to)".

Figure 13 shows the results of this questionnaire. For question (1), 7 of 8 subjects answered that their attention to the camera was reduced (avg= 3.75, S.D.=1.39). For question (2), 7 of 8 subjects said the photography process was pleasant (avg=4.25, s.d.=1.03). For question (3), 7 of 8 subjects felt their faces were captured differently when the EyeCatcher was used (avg=4.13, s.d.=0.99). For question (4), 7 of 8 subjects answered that they would want to always use the EyeCatcher in the future (avg=4.25, s.d.=0.71). In addition, 2 of the 3 camera-shy subjects answered 4 or higher for all the questions. The self-reported characteristics of the subjects as assessed initially appeared not to affect their responses to the questions that they were asked after the experiment. Thus, we argue that the EyeCatcher was effective from the subjects' perspective.

4.2 Impression evaluation

Next, we evaluated people's impression on the resulting images to verify the effect of the EyeCatcher on the captured pictures.

Method First, we showed respondents (1) pictures taken without the EyeCatcher ("regular pictures") and (2) pictures taken with the EyeCatcher ("EyeCatcher pictures") at the same time, and obtained feedback regarding their impression of the EyeCatcher pictures compared to the regular pictures. We prepared 64 EyeCatcher pictures (8 subjects x 8 content options) and 8 regular pictures (8 subjects). The sequences in which the pictures were shown were

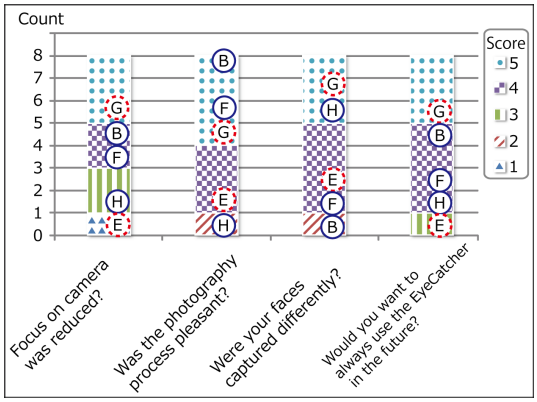

Fig. 13. Results of the subjective evaluation.

changed randomly. The respondents were not shown the content used in the photography evaluation. We selected 9 respondents with ages ranging between 21 and 37 who were not included as subjects in the earlier evaluation.

Results We asked 2 questions and scored answers on a scale of 1 to 5 as follows: (1) "Do you notice any difference between the EyeCatcher pictures and regular pictures? (1: not different at all – 5: completely different)", (2) "Do you feel the EyeCatcher pictures are less strained compared to the regular pictures? (1: very strained – 5: very unstrained)". We calculated average scores and standard deviation for all pictures.

The results for question (1) are shown in Fig. 14. The horizontal axis shows EyeCatcher pictures, and the vertical axis shows average score. First, almost all of the pictures of subjects A, E, and G obtained high scores (above 4.0). Most of the respondents felt the EyeCatcher pictures were "5: completely different" or "4: rather different" to the regular pictures. Second, scores for the pictures of subjects C, D, F and H were varied, particularly, those for subjects F and H for whom some pictures were regarded as "different"(above 4.0) whereas others were regarded as the "same"(under 2.0).

Next, The result of the question (2) is shown in Fig 15. First, 7 of 8 pictures of the subjects E and G obtained high score (above 4.0). Most respondents felt their EyeCatcher pictures "5: very unstrained" or "4: unstrained". Second, almost all pictures of subjects A and D obtained reasonably high scores above 3.5. Many respondents felt their pictures to be "4: unstrained". Third, scores for the pictures of subjects C, F, and H were varied. There were both "unstrained" pictures (above 4.0) and "little strained" pictures (under 3.0) for each subject. In particular, some pictures of subject F were felt to be "strained" (under 2.0).

Meanwhile, pictures of subject B obtained low scores for both questions. We couldn't observe any effectiveness of the EyeCatcher for subject B.

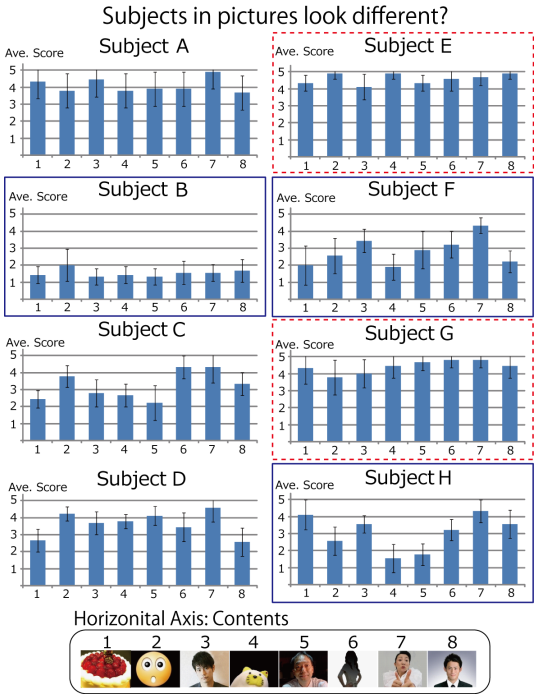

Fig. 14. Do you notice any difference between the EyeCatcher pictures and regular pictures?

We have also asked the respondents about their relationships to the subjects. We found that 4 knew all subjects, 2 knew some of them, and 3 respondents hardly knew them. Although we have not fully analyzed the results by group, no significant differences appear to exist.

4.3 Consideration

In this section, we consider the results of the evaluations. The EyeCatcher pictures that obtained (1) higher and (2) lower scores in the impression evaluation are as follows: (1) pictures of content 7 (Japanese entertainer, Harumi EDO) shown in Fig. 16 and (2) pictures of content 8 (suited man) shown in Fig. 17.

First, we consider the result of the impression evaluation based on the self-reported characteristics of the subjects shown in Fig. 12. For camera-wise subjects (subjects E and G), most pictures obtained high scores (above 4) both in terms of "difference" and "unstrained". This result indicates that the EyeCatcher helps a photographer capture various natural expressions of camera-wise subjects. In the regular pictures (Fig. 11), camera-ready subjects made stage faces and paid much attention to the camera. In contrast, they reacted to most of the content shown using the EyeCatcher since they were very emotional. For

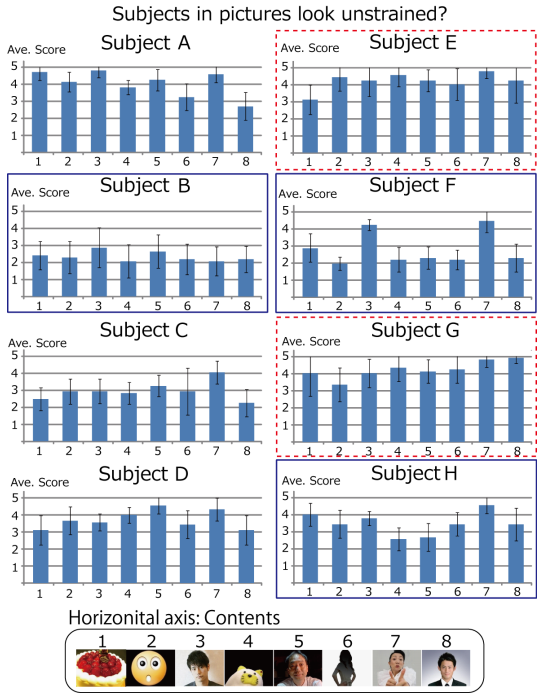

Fig. 15. Do you feel the EyeCatcher pictures are less strained compared to the regular pictures?

this reason, we could capture various expressions and poses for these subjects. In response to content 7 (Fig. 16), for example, subjects E and G struck a similar pose to that of the entertainer [11]. Meanwhile, we selected content 8 (Fig.17) for taking pictures suited to use on ID cards. However, the attention of most subjects was focused on "who is this person?", and they became confused. For this reason, the scores of the impression evaluation were lower[12]. Although subjects E and G also felt the same impression, they reacted dynamically: subject E bent forward to the camera and made a confused face; subject G began laughing helplessly. For these reasons, even the pictures taken using content 8 obtained high scores. Although we didn't expect these reactions, we thought them to demonstrate the interesting effects possible using the EyeCatcher.

Next, we discuss the camera-shy subjects (subjects B, F and H). The scores for the pictures of subjects F and H were spread. For example, for the "difference" question, pictures taken using content 4 were felt to be "hardly different" from the regular pictures (below 2.0); whereas the pictures taken using content 3, 7

[11] Although subjects A, C and D also struck a similar pose, subjects E and G did not only strike a similar pose, but also made a similar face.

[12] Only subject D understood our intention and stood erect.

Fig. 16. Examples of high-scoring pictures (content 7, Japanese entertainer).

(both subjects F and H) and 1 (subject H) were felt to be "different" from the regular pictures (above 3.5). For the "unstrain" question, pictures taken using content 4 and 5 were felt to be a "little strained" compared to the regular pictures (below 2.7); whereas pictures taken using content 7 (both subjects F and H), 3 (subject F) and 1 (subject H) were felt to be "unstrained" (above score 4.0). Thus, we could capture natural and unstrained faces when certain content (3 and 7 for subject F; 1 and 7 for subject H) were shown (Fig. 16). In summary, (1) the faces of subjects F and H were strained in the regular pictures (Fig. 11) since they were uncomfortable with being photographed and (2) they did not react to all the content since they were unexpressive. However, when the preferred content (e.g., cakes, actors, and entertainers) were shown, the EyeCatcher could help the photographer capture natural smiles even on camera-shy subjects.

Next, we consider subject B. As mentioned above, the EyeCatcher was not effective for subject B. We think that there were three reasons for this: (1) subject B was the most unexpressive and the most uncomfortable at being photographed; (2) the content options were ill-suited to subject B as his sex and age (male, 52) were different from those of the other subjects; and (3) subject B did not change his face intentionally since he misunderstood the instruction to "please act as you usually would" as asking him " not to change his expression from his usual look". However, in the subjective feedback, subject B did respond by saying that "his focus on the camera was reduced" and "photography process was pleasant". Thus, we believe the EyeCatcher can capture natural and unstrained expressions even for subject B in future by providing more suitable content and communicating verbally with the subject.

Fig. 17. Examples of low-scoring pictures. (content 8, suited man).

Thus, the EyeCatcher can help a photographer (1) capture various natural expressions and poses of camera-wise subjects and (2) capture the natural smiles of camera-shy subjects by showing preferred content.

5 Discussion

In this section, we discuss the basic performance of the EyeCatcher and communication during photography.

5.1 Visibility of display

The performance of the EyeCatcher in the field is somewhat influenced by the visibility of the front display. Therefore, we tested the EyeCatcher under several sets of conditions and verified the visibility of the display. We selected the 4 content categories (characters, friends, face icons, and poses) shown in Fig.7 and examined the distance at which a subject could easily recognize the content. The subject had normal eyesight. Results showed that the subject could easily recognize all contents from 2 m in a room lit with fluorescent lamps, 1.5 m outside on a sunny day but without direct light, and 1 m outside on a sunny day with direct light.

Since most snapshots are usually taken from 1-3 m, the visibility of the current prototype appears to be practicable.

5.2 Correspondence of eyes

Generally, in systems equipped with both cameras and displays (e.g., TV conference systems), the focus of the eyes often becomes a problem since the location of each device is different[2]. As it was thought that the EyeCatcher may experience a similar problem, we discuss this topic here.

Minami[2] reported the detection limit of correspondence of eyes is about 2 degree and the allowable limit is about 9 degree. In the EyeCatcher, since the distance between the lens and the display is about 6 cm, the allowable limit is crossed when a subject comes closer than 38 cm. However, we think that this will not become a significant problem since few photographers take photographs of their subjects at such close range. For example, when the distance between the EyeCatcher and a subject is 1m, the parallax is about 3.4 degrees, which is much smaller than the allowable limit. Moreover, there were almost no pictures taken during the evaluation in which we can observe problems associated with the focus of the eyes.

5.3 Communication in photography

Finally, we discuss communication during photography. When taking snapshots of people, communication between the photographer and subject is quite important since the photographer cannot control the subject's face directly. For example, professional photographers do not only require various photographic techniques, but also communication skills to reduce stress or indicate the pose he feels will be most attractive.

The goal of the EyeCatcher is to capture various natural expressions of the subject, and it supports communication between the photographer and subject by creating a new communication channel via the visual content. For example, it's usually quite difficult for photographers to pose subjects similar to that seen in content 6 or 7 in Fig.10 with only verbal instruction. The EyeCatcher offers useful solutions for such situations. Meanwhile, from the comments received during the photography evaluation, some subjects would like to receive verbal instructions such as "Please mimic it!". Thus, verbal communication is also important for photography using the EyeCatcher.

6 Related Work

From the results of PC-based experiments, CheeseCam[3] reported unconscious reactions of subjects when watching face icons. Based on this research, Samsung released a digital camera (DualView TL225) with a front display[4]. Similarly, Howdy[5] is a unique digital camera that looks like a photo frame. It can capture pictures of the subject and the photographer at the same time using small cameras attached on both sides of the frame. Since they can look at each others faces, the photographer can capture less strained images of the subject. These approaches share the same goal as that of the EyeCatcher, reducing the degree of

attention that the subject pays to the camera and thereby capturing the subject ' s natural expression.

The uniqueness of the EyeCatcher is that (1) it is easily attached to existing digital cameras and (2) it allows subjects to produce various expressions by the easy changing of displayed content.

There are several digital cameras that have integrated sensors. ContextCam[6] proposed a context-aware video camera that provides time, location, person presence and event information. Likewise, WillCam[7] helps the photographer capture various information, such as location, temperature, ambient noise, and photographer 's facial expression, in addition to the photo itself. Capturing the Invisible[8] designed real-time visual effects for digital cameras using simulated sensor data. The EyeCatcher focuses on photography process itself, and intends to capture the various natural expressions observed in our daily lives.

7 Conclusion

This paper proposed a novel interactive technique, the EyeCatcher, which helps photographers capture various natural expressions on their subjects, by keeping eyes of subjects focused toward the cameras without the stress often associated with being photographed. We developed a prototype system that can be attached using the hot shoe connector found on existing digital cameras. Moreover, we verified the effectiveness of the EyeCatcher through evaluation and discussion. Our study population was small in scale, unbalanced in composition and consisted solely of members of our laboratory, so that they might have been unduly supportive of the system. Nevertheless, our findings offer positive, if only preliminary, data regarding the potential value of the EyeCatcher system.

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