Vasque: A Privacy Preserving Casual Communication System using a Circle Mirror Metaphor

Hitomi Tsujita
Interfaculty Initiative in Information Studies
The University of Tokyo
7-3-1 Hongo, bunkyo-ku,
Tokyo 113-0033 Japan
tsujita@acm.org

Kensaku Kawauchi
Interfaculty Initiative in Information Studies
The University of Tokyo
7-3-1 Hongo, bunkyo-ku,
Tokyo 113-0033 Japan
kawauchik@acm.org

Jun Rekimoto
Interfaculty Initiative in Information Studies,
The University of Tokyo
7-3-1 Hongo, bunkyo-ku,
Tokyo 113-0033 Japan
Sony Computer Science Laboratories, inc.
3-14-13 Higashigotanda,
Shinagawa-ku
Tokyo 141-0022 Japan
rekimoto@acm.org

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Abstract
Although an always-on video communication system would have potential to increase the opportunity for casual communication between separated people, privacy concern prohibits it to be widely used. To address this problem, a new configuration for remote communication is proposed. With a wide-angle lens that faces the ceiling, this system allows an "always-on" connection while protecting privacy of unintended people and because the background scenery will naturally be out of the line of sight. Users can start communicating by simply peering down towards a display. Moreover, a circle mirror metaphor allows both local and remote users to participate in the conversation as if they were at the same round table.

Author Keywords
Video Communication, Privacy, Casual conversation, Circle Mirror Metaphor, Daily life

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

General Terms
Design, Human Factors

Introduction

Many people have desires to communicate with people who are separated by long distances as if they were in the same place. There are many consumer grade video conferencing systems, such as Skype[1] and FaceTime[2], as well as expensive commercial grade systems such as Cisco TelePresence[13] and HP Halo[14]. While these systems allow people to communicate more easily with friends and families living apart than before, there are still problems and limitations in remote communication.

The frequency and opportunity for casual communication between remote people:
Many people who usually use video conferencing initially negotiate the time of the call via an email or phone call. Given this extra step, traditional video conferencing systems lack a method for light hearted communication. Furthermore, when scheduling and/or negotiating a time, people will tend worry about the other's state and time. On the contrary, an always-on media spaces would have the potential to reduce the technical work needed to establish a connection since the connections are always ongoing and thus are effective for remote communication between households [15, 16]. Although these researches also reported very few privacy concerns arising, which should be surprising for an in-home always-on video broadcasting, the cause of this was usually due to the close relationship between the users. As such, it is still considered difficult to start a casual conversation, as if in the same room and sitting down at the same table, amongst different or unfamiliar people.

[1] http://www.skype.com/

[2] https://www.apple.com/ios/facetime/

Figure 1. The Vasque is a video communication system which is "always-on" while protecting privacy issues naturally and allowing users to increase the opportunity for casual communication. Moreover both local and remote users can participate in the casual conversation as if they were at the same roundtable.

Privacy concern:
When people initiate video communication at home or in a relaxed space in the workplace, it tends to display background features such as bystanders, incongruent landscape and other unnecessary and distracting visual images. Therefore, people tend to consider the place in a home or workplace where a video conference would take place. Not only video and background images, but a similar amount of care is given to sound and other noises, both emitted and received, when people consider locations.

Connectedness Communication:
Existing video systems are mainly designed for communications between two locations. Although they

support communication between multiple locations, the system usually places images on the screen and thus distinguishes the local and remote participant creating a sense of less connectedness. There is a lot of research going on which try to solve for these problems [1, 2] in the formal meeting.

In business meetings, it is not as important to deal with the distinction of local and remote people since they have determined agenda. In these cases, they require higher quality images and/or audio. However in the case of casual communication, the distinction between local and remote participants becomes more important in order to feel intimacy and the togetherness of presence. It will be important that both local and remote users can participate in the conversation as if they were at the same roundtable.

To address these problems, we propose a new system called the Vasque. This allows users to connect with multiple locations and increase the frequency and opportunity for casual communication between remote people. Using a wide-angle lens that faces the ceiling, the system allows an assumed “always-on” video communication state while protecting privacy issues naturally. User can start communication by simply peering down towards a display whereby both local and remote users can participate in the conversation as if they were at the same roundtable.

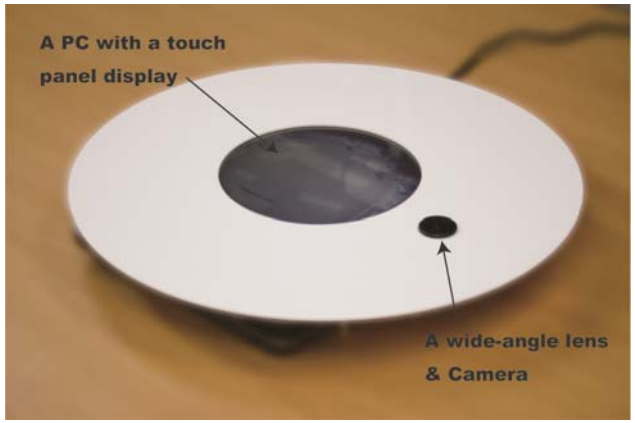

Figure 2. User can start communication by peering down towards a display using the wide-angle lens and camera that faces the ceiling.

VASQUE

The Vasque can connect multiple locations and communicate with multiple people as if they participating from the same location. As seen in Figure 1, this system supports casual communication by maintaining an “always-on” state while protecting privacy by placing a wide-angle camera oriented towards the ceiling. The system design includes a circular mirror interface that incorporates a wide-angle camera and a touch panel display. By orienting the camera towards the ceiling, the user only sees and hears the remote person’s video image and only shows local image when people peer down towards the display. This symmetry minimizes privacy concerns because the amount of the information sent to both parties is exactly the same. Moreover, by assuming an “always-on” video communication, it may increase the frequency and opportunity for casual communication

between remote people similar to communication which was missing before. In addition, by designing a circular mirror interface, users can join and start conversation as if they were at the same roundtable. Some people may worry that peering down for long periods of time will become somewhat tiresome. We feel our system is suitable for increasing the frequency and opportunity for casual communication between remote people.

Privacy

Due to the wide angle of view provided by the 170 degrees wide-angle lens, people reflected in the camera's field of view can be defined by the distance from the camera. With this design, it avoids the camera carelessly taking unnecessary images of background landscape and figures (Figure3).

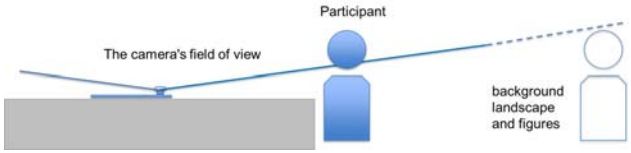

Figure 3. Due to the wide angle of view of the wide-angle lens, people reflected in the camera's field of view can be defined by the distance from the camera.

Furthermore, when there is no object moving within the field of view of the camera and/or a person is not within a certain distance, the system will automatically mute the voice channel. This minimizes privacy concerns by avoiding the picking-up of inadvertent communication.

Thus, the participants themselves can easily control the amount and timing of the information which is sent to the remote participants. Information about one another's video image is only transmitted when the participants peer down towards the panel. Therefore, there is a certain expectation on the receiving end about an image when they are also doing the same thing, thereby reducing the general annoyance towards the system. People may feel that they are being spied on when a system transmits more information on daily activities than is received from others.

Boyle, et al.[18] mentioned that privacy relates to three control modalities: autonomy, solitude and confidentiality. To address privacy concerns, it is important to allow autonomy or control over what people know about oneself and choosing when and how to participate in a media space. Moreover InPhase[5] mentions the transmission of the same amount of information is effective for remote communication. Our system also uses this principal to transmit and exchange their state, as this architecture is an “always-on” system. User can communicate only when they want to communicate and start a casual communication by peering down towards a display and feeling intimacy and togetherness as if they have a chat in same location during a coffee break or dinner.

Depending on the state or relationship of other people, people may not see their whole figure, just faces or background. Therefore, we propose the following function. By adjusting the field of view using a “pinch” gesture on the touchscreen as seen as Figure 4 and Figure5, the user will be able to limit their field of vision to be shared. This also ensures the privacy of the surround background.

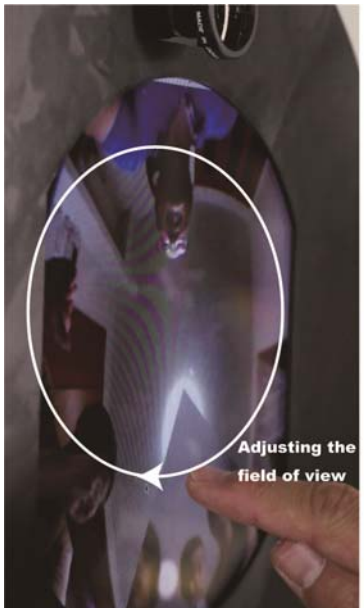

Figure 4. By adjusting the field of view using a "pinch" gesture on the touchscreen, the user will be able to limit their shared view.

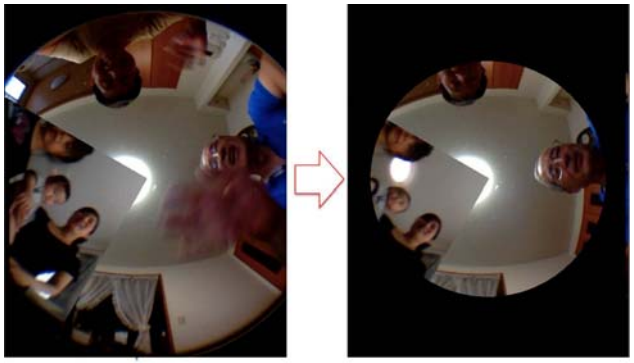

Figure 5. Screen shots showing the adjusted field of view using the "pinch" gesture on the touchscreen. With this function, user also can control privacy concerns explicitly.

Circle mirror metaphor

This system cuts out each point of the image in pie slices and puts them on the circumference of the circle while sharing it on the main screen (Figure 6). It leads users into the perception of peering down into the same mirror and thus creating a sense of togetherness. In the case of casual communication, the distinction between local and remote participants may become more important in order to feel intimacy and the togetherness of presence. Both local and remote users can participate in the conversation as if they were at the same roundtable.

Moreover, in the case with multiple people in multiple locations, this design is suited towards arranging the remote and local participants equally leading to a shared sense of unity.

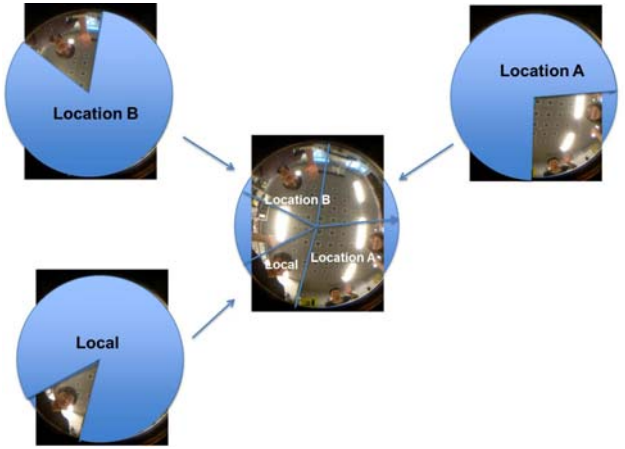

Figure 6. This system cuts out each point of the image in pie slice and puts them on the circumference of the circle while sharing it on the main screen.

Visualize relationship

User can select each "slice" of image freely and arrange visual relationship for each participant by dragging the image accordingly. Therefore, it is possible to arrange the visualize relationship, for example, into conversation metaphor for a real space conversation. In this example, a face-to-face arrangement, it is a more formal conversation and as such, the placement is made adjacent in order for a more intimate conversation (Figure 7 and Figure8).

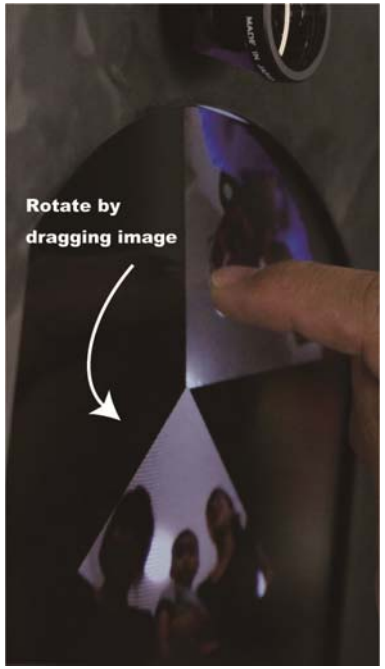

Figure 7. User can select each image "slice" freely and arrange visual relationship for each participant by dragging the image accordingly.

Figure 8. Screen shots show the example where it is possible to arrange the visualize relationship by dragging the image slices.

Other function

This system architecture will also enable us to create various kinds of applications. The Hyperbolic tree browser [17] is technique for visualizing and manipulating large hierarchies. Using this technique, we believe the system will enhance communication. If many people join this system, the circle becomes crowded and there may not be enough space for adding additional remote people. In this case, we adjust the image of the people by resizing it. Usually the image is smaller, but the size of the image is dynamically changed based on the amount of the persons speaking and volume.

In addition, it only expands in specific areas they touch. By using these gesture operations, the user is able to selectively transmit information such as a computer file to the other participants more easily.

IMPLEMENTATION

We developed the Vasque system to connect multiple locations and communicate with multiple people simultaneously assuming an "always-on" state. The Vasque system is a very simple architecture which consists of a wide-angle lens camera and a PC with touch panel display.

We used a wide-angle lens with a 170 degree field of view. After a few experiments, we found that 170 degree was the most suitable field of view for this system. We then designed the circular mirror interface by attaching the wide-angle lens to the camera. We used a PC with a touch panel display for displaying the system and operate the system. By using touch panel, any user can easily operate the system. In addition, for more high quality image, we used a USB camera even though the PC had a built-in camera. In order to cut out each point of the image in a pie slice and placing them on the circumference of the circle, we used the Open CV library. This displays the image carrying the image of the other that was cut by the polygon in one image and shares it with the remote location.

Usage Scenario

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

At home: The Vasque system can connect to the grandparents' home and their daughter's home together. They place the Vasque system on their dining room table. The grandmother is having a dinner by herself when her granddaughter finds her and starts a casual and spontaneous conversation. At the daughter's house, they also start to have dinner. They all enjoy dinner while talking using the Vasque system. At first the grandmother feels lonely, but she is finally happy to feel like they are having dinner together. At that time, another daughter and her child also join the conversation.

At workplace: This company has several office. They connect during each break. Two men are talking while drinking coffee. At that time, in another location people will occasionally peer down towards the system and find

his friends. He was happy to see for the first time in a long time. He joins the chat and they promises to go out drinking later.

PILOT USER EXPERIENCE

Following the design and implementation of the Vasque system, we conducted a pilot user experience to learn how much effect in the circle mirror metaphor and what merits and demerits the wide-angle camera would have as well as how the user felt about the peering down posture and other functions users wanted.

We recruited a total of 12 participants, 8 students from our research laboratory and a family with 4 people including one child (7 years old). We grouped them into three groups (with each group including 4 people) called Lab A, Lab B and Family A. We divided each group with one person in a room (called the remote participant) and the three others in another room. Participants who utilized the system had a free conversation for 10 minutes between the two rooms. We monitored the test by recording video and conducting interviews/questionnaire after the test.

DISCUSSION

We discussed the results of the user experience and organized the participant's opinion and the method by which they matched the original predictions.

How much effect in the circle mirror metaphor?
Some participant in Lab group mentioned that because they could see all the other participants' face on one screen equally, it was easier to communicate with them simultaneously. Other participants mentioned they had feelings being in the same location regardless of being either at the remote location or local like sharing the same table. One participant in the Lab B group said he felt closer to the remote people, but ironically, felt distant towards the local people. Some local participants felt the remote people had positive impact on the joined conversation.

For this reason, we thought the following: Most participants in Lab B and Family A mentioned that the direction and perspective of the eyes of the remote participants were more natural looking and thus were able to make more eye contact. Due to this feeling, we think the participant felt distance between participants had diminished.

Merit with a wide-angle lens
The participants in family group mentioned they use FaceTime via an iPad in their daily life. Usually, the child dominated the device all by herself by placing the camera very close to her face. Therefore, even if the remote participant wanted to see other people, it was not always possible. However, when they used the Vasque system, the same child placed her face similarly close to the display, but the shared image view was not monopolized. The remote participant said they were able to see the other faces freely and equally. They also mentioned that they usually have to initiate two separate video sessions to communicate with each of their two daughters separately. With the Vasque system, they said they were happy that they can communicate more easily, naturally and simultaneously with their daughters.

Demerit with a wide-angle lens
However, when using a wide-angle camera, the display image resolution is overall lower than the original image. Some participants in Lab A group mentioned the need for a higher display resolution. If a user requires a higher

quality image for formal business meeting or wants to see clear face details, this system may currently not be suitable for such use. In this test, due to the limited hardware architecture, but we would like to combine our system like a large tabletop display for solve this problem.

Some participants mentioned that the imaging splicing could be improved to better represent the relative position at which they are sitting at. In this test, due to the limited software, the position of the remote and sitting persons may have appeared upside down as visualized by the remote party. Since this system utilizes mirrors, depending on where the participant is sitting and the camera positioning, the direction of horizontal movement of things such as hands movements tend to move in the opposite direction of the actual movement. Participants sitting down towards a wide angle lens pointed out that the problem of reflection symmetry was not as noticeable or bothersome than anticipated. However, in the future, we hope to map and solve this through programing.

Conversation by peering down

Many participants said it is not problem with the act of peering down to have a conversation. Some participants, in fact, liked this "peering down" style. However, some participants also mentioned that it becomes somewhat tiresome to have conversation while peering down for long periods of time.

We think it may be possible to improve this problem by using a larger display with higher resolution, but we also feel that our system is suitable for increasing the frequency and opportunity for casual visual communication between remote people that does not require the level of investment or effort of making a phone call or composing an email in the daily life.

Avatar vs. Actual Image

Some reader may feel that it's enough to utilize an avatar in a virtual space if privacy is of such concern. Chirstian Licoppe et al.[13] mentions that the background in a video conversation is accountable and inspected by the recipient. Thus, in our system, we allow for the adjusting of field of view and also do not completely eliminate background images. We considered that while the camera's field of view is defined by the distance from the camera, the remaining background image such as overhead lighting as well as the person's facial expression are important to understand the surroundings as well as the person's state in casual communication. Our system allows users to easily start a communication session while addressing privacy issue.

RELATED WORK

Video communication in Home

There are several research projects related to video communication system in the home which assume an "always-on" system [8, 10, 11, 16]. Family Window [16] and Family Portals [10] is an "always-on" video media space which provides shared video between remote locations. User can obscure their video feed by adjusting slate blinds using a slider. SmoothCurtain [11] enables users to control privacy and flexibly change the communication style by opening/closing a curtain. Neustaedter et al. [8] presents design of a home media space design by providing feedback of the achieved privacy level through audio and visual cues, rendered on both physical displays and on the screen. In these systems, user can set privacy mode by pushing a button or operation physical curtain. We use natural placement and the simple peering down action for addressing privacy.

There is also research aimed at supporting specific activity instances such as asynchronous video communication in the home [12, 19, 20]. Shear Table [20] supports and enriches long-distance interaction between parents and children and; Family Story Play [19] supports grandparents reading books together with their grandchildren. VideoPal [12] is an asynchronous video communication system through the exchange of video messages. In the case of our system, we provide a casual synchronous communication mechanism.

Media Spaces in the Workplace

t-Room [1] is a video collaboration system which shares video screens projected on another room's screens. MM-Space system [6] uses dynamic displays that augment the motion of the human head for multiparty face-to-face conversation. Hydra [2] supports four-way videoconferencing and each remote participant's image is placed in one quadrant of the screen of a single monitor. These are systems for formal business meeting and/or are suitable in the case which starts meeting session explicitly. We propose the system in order to support casual communication.

HyperMirror [9] and Reflexion [12] are systems which both local and remote participants appear together on a shared video wall. VIDEOPLACE [7] is a system which combines a participant's live video image with a computer graphic world. We may combine these technologies with our system which enables us to create additional applications.

CONCLUSION AND FUTURE PLAN

In this paper, we proposed a multi locations video communication system called the “Vasque” for the support of casual communication. By orienting a wide-angle camera towards the ceiling, participants will only see and hear the remote participant’s video image and local image only when a person peers down towards the display. This “always-on” state leads to an increase in the frequency and opportunity as if they are having a chat in same location. Although, we didn’t analyze privacy concern in an actual home for a long period of time (but through a pilot user experiment), we iterated the design to address a variety of needs that appeared based on observation and feedback. In the future, we are planning to carry out several long-term experiments using multiple people in various life situations and improving our system while analyzing privacy concern and how communication among participant’s family had changed. In addition, we would like to consider additional features such as leaving some sort of indicator or persistent image of recent participants in order to increase the opportunity to communicate.

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