Digital Love Letter: A Handwriting Based Interface for Non-instant Digital Messenger

So Jung Bang, Yoonji Song, Jae Dong Kim, Kiseul Suh, Chung–Kon Shi, Graham Wakefield*, and Sungju Woo*

Graduate School of Culture Technology, KAIST, Daejeon, Korea
{sojungb,keyofsky,jaedong27,kiseul.suh,chungkon,
grrrwaaa,woo1016}@kaist.ac.kr

Abstract. The instant messenger has developed as an important communication media platform. However, because of the nature of instant communication, instant messenger services place many limitations on communicating with nuance. We believe that the easy nature of digital communications tends to weaken serious aspects of personal communication such as patience and commitment. On the basis of critical perspectives, we designed the digital messenger 'Digital Love Letter' (DLL)': a mobile messenger in which the expressive *process* of interaction is more important than the final output. The main concept of DLL is to share the process of communication using a non-instantaneous and non-multitasking interface, so that users can share their time with some similar nuances to face-to-face communication. Both writing and reading messages require concentrated attention. Thus, this paper suggests a new system of digital messenger, that is also a new method of computer-mediated communication (CMC).

Keywords: Affective Messenger, Computer Mediated Communication (CMC), Social Presence, Instant Messaging.

1 Introduction

Instant messaging (IM) has become an effective and convenient means to communication over a distance. This digital technology has made it easier for us to contact others immediately and instantly, however messaging services predominantly focus on quick information delivery. Even when messages can be complemented with diverse emoticons and attached files, there are many limitations on communicating with nuance.

Many scholars have criticized communication mediated with digital technology because the instant nature of digital communication tends to weaken serious aspects of personal communication such as patience and commitment.

George Myerson [1] critically analyzed mobile phone communication using the philosophical paradigms of Heidegger and Habermas. In Heidegger's approach,

* Corresponding authors.

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communication is about the listener's understanding. For Habermas, to communicate means to make the speaker's desires understood, not to pursue their immediate fulfillment. That is to say, communication is not a one-way information transmission, but a shared *effort* toward mutual understanding; a *process* of reaching in which two parties share their existence.

Sherry Turkle [2] suggested that multitasking and rapid responses in online interactions can make us obsessive about our numerous connections. Quick connections mediated with digital technology become a measure of self-esteem. Walter Kirn [3] also describes the everyday "dumbing down" effects of online multitasking, with reference to fMRI studies.

Instant messaging has developed into a dominant means of communication in modern society, so these criticisms should not be disregarded. We suggest addressing some of the drawbacks of instant connection based communication by realizing, with digital technology, aspects of emotional interactions requiring effort and concentration.

There have been many previous studies aimed at improving the richness of emotional interaction through digital technology. Affective Computing aims to realize emotional interaction through digital technology, but it is predominantly focused on improving interactions between humans and computers such as the automatic recognition of human emotional information [4]. There have been digital messaging services based on affective computing which help to convey emotion effectively [5], however, the systems to detect and deliver emotion are mainly limited to measuring physical responses, that are not necessarily directly associated with specific emotional states. These types of automatic interfaces can also reinforce the problems of effortless aspects of digital communication.

Human Computer Interaction (HCI) has become concerned with critical theory and reflective thought [6]. Philip Agre [7] advocated the development of "critical technical practices" in which technology development becomes a way to reflectively explore attitudes towards and premises about technology and humanity.

On the basis of the above critical perspectives and theories we designed the mobile messenger 'Digital Love Letter' (DLL),' which presents an original reflection on digital technology and interpersonal communication. It is a mobile messenger with a handwriting-based interface in which the expressive process of interaction is more important than the final output. The main concept of DLL is to share the process of communication using a non-instantaneous and non-multitasking interface, so users can share their time in a similar way to real world communication: with empathy. The central concept is that both writing and reading messages requires concentrated attention.

We performed an experimental study to see how people interact with each other through DLL. The concept of 'social presence' (see section 2.2) was used to evaluate this system. Social presence is a theoretical model used to analyze computer-mediated communication (CMC). This is usually explained as "the degree of salience of the other person in the interaction", but is also interpreted as empathy and mutual understanding in psychological involvement.

2 Related Work

2.1 CMC with Emotion

Computer-mediated communication (CMC) is increasingly used to maintain relationships, so people need to communicate emotionally through digital technology. Although researchers have offered a plethora of definitions of emotion, they are generally centered on a mental process related to affective states such as sadness, anger, fear, happiness, joy, and love. The term affect comes from the Latin word '*affectus'*, which means passion or emotion. Affective information is complementary to cognitive information, which has a rational basis [8], [9]. Despite origins in rational thinking, technological developments increasingly allow affective communication through electronic and digital devices, so many authors regard emotion as an important factor in CMC.

Riordan, M [10] examined how people choose specific channels for socio-emotional communication over others. Three channels such as email, instant messaging (IM) and face to face (FTF) were assessed. Two types of positive emotions and negative emotions were assessed depending on channel choice. This study showed that the prominent reason for choosing FTF over email or IM was the existence of more emotional cues. It appeared that people rely on nonverbal and emotional cues when they communicate. However, Derks, D [11] suggested that there is no indication that CMC is a less emotional or less personally involving medium than in F2F. The conclusion was that emotions are abundant in CMC.

Hancock, J [12] analyzed how people express and detect emotions during text-based communication. It was found that disagreement, negative affect terms, punctuation and verbosity, were used by most communication partners to distinguish between positive and negative emotion in a textual communication context. Pfeil, U [13] investigated how empathy is expressed and facilitated in an online community for older people (SeniorNet). The qualitative content of 400 messages from an online message board about depression was analyzed. It was shown that empathy is an important aspect of online communication. Harris, R [14] also studied message cues in CMC that promote the transfer of affective information. Emotion words, linguistic markers and paralinguistic cues were shown to be factor for higher perceptions of emotions in CMC.

2.2 Social Presence

Interactive media systems for inter-communication can be evaluated through social presence. Social presence has been defined as the "sense of being with another in a mediated environment". It is increasingly known as an important factor for understanding effects of interactive media [15]. Hwang, H [16] analyzed the gratification utility of instant messaging from a social presence standpoint. This study showed that social presence plays an important role in communication through instant messaging services. It also shows that communicative competence is positively related to CMC through social presence [17].

There have been many proposals for the measurement of social presence. Short, J [18] proposed measuring social presence according to four dimensions: personal-impersonal, sensitive-insensitive, warm-cold and sociable-unsociable. High social presence is correlated to factors of how personal, sensitive, warm or sociable the presence is. Biocca, F [19] approached social presence with a networked-oriented measure, grouped with three areas: co-presence, psychological involvement and behavioral engagement. Co-presence is mutual awareness, psychological involvement is mutual understanding with empathic senses, and behavioral engagement refers to interdependent action. Nowak, K [20] differentiated co-presence from social presence, in that co-presence refers to the perceived sense of being with each other, while social presence refers to a broader concept that concerns the consequent salience of the interpersonal relationship. Nevertheless it was found that dimensions of co-presence and social presence were highly and significantly correlated.

2.3 Affective Messenger

There have been many attempts to design technology and systems for communicating emotional information through media, including delivering emotion through instant messaging aided by affective computing interfaces. Some authors have designed tactile interfaces to convey emotional contents. 'TCONs' [21] is a device that includes tactile output and input systems: vibrating motors, pin actuators, heat oil, pressure sensor, button and LEDs. The aim of this research was to support expression with an intuitive, tangible way through a Digital Messenger. 'iFeel_IM!' [22] is a system that integrates a 3D virtual world with affective computing haptic interfaces. It used automated emotion recognition from text messages, and haptic feedback, providing nonverbal communication through physical sensors. 3D avatars are visualized with automated emotion sensing by affective haptic devices, which include *HaptiHeart*, *HaptiHug*, *HaptiButterfly*, *HaptiTickler*, *HaptiTemper*, and *HaptiShiver*. 'HIM' [23] is also made by haptic instant messaging framework. They designed '*hapticons*' and haptic IO devices to augment the communication of text messages.

Besides haptic interfaces, emotion detection by computers has been used for mobile messaging systems, such as 'eMoto'. With eMoto users can compose messages through emotion related input, influenced by body gestures, and it renders a background of colors, shapes and animation [24]. 'Conductive Chat' [25] is an instant messaging system that incorporates user's skin conductivity levels, including emotional arousal, into a dialogue interface. 'FAIM' [26] is a 3D avatar based messaging system for empathic communication. It is a messaging application that shows each person as a 3D character who can express emotion through facial expression.

There are also non-academic, commercial online messengers that help people communicate privately and intimately. 'Snapchat' is a photo messaging application that allows users to set a time limit for how long recipients can view messages. 'Paintchat' is an online chat room that participants can draw together in real time with their partner.

3 Digital Love Letter

We authored the mobile messenger application 'Digital Love Letter' (DLL) for smart phone and tablet PC using the HTML5 standard. The interface was made to show users the whole, gradual *process* of writing the message in real time, so users do not just deliver information, but can focus on sharing the communication as it unfolds in time. In order to block one-way communication and multitasking, users cannot send a message if the receiver is not actively ready to receive it. Messages are not stored in the application, so users can only view a message once. The purpose of these constraints is to make an environment requiring patience and commitment. Users can also send an image and write or draw with their fingers to facilitate nuance through multi-layered communication. The client interface also offers an optional style with a blurred background images, emulating the personal, ephemeral atmosphere of drawing on a steamed-up window created from someone's breath. When the sender draws lines, the original, underlying image appears vividly (Fig.2).

The usage process outline is:

1. A sender turns on the mobile messenger application 'Digital Love Letter'.
2. The sender chooses a receiver and awaits the receipt.
3. The receiver accepts the connection.
4. The sender takes or chooses an image and writes or draws on the image.
5. The receiver sees every process that a sender writes or draws.

The server application for DLL was developed using Flask, a Python-based web framework, while the client used HTML5 and JavaScript. We designed 'DLL' using web technologies to operate on any mobile device.

As a user draws lines in the client web application, the application sends each frame update at regular intervals to the server using a web protocol. The server stores the every frame until their partner's client web application request it from the server. If the receiving client receives the images, it will be displayed in the web application (Fig.1).

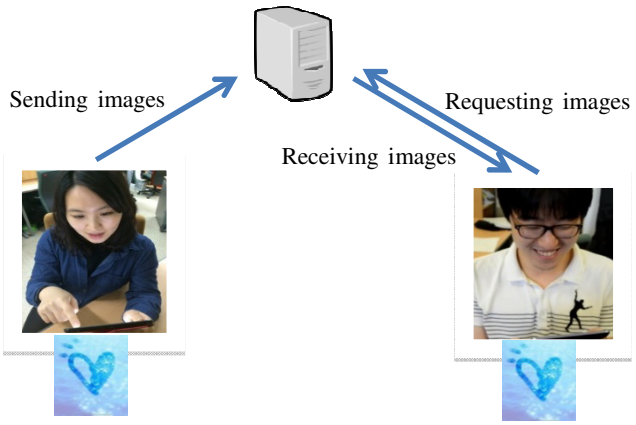


Fig. 1. System Architecture

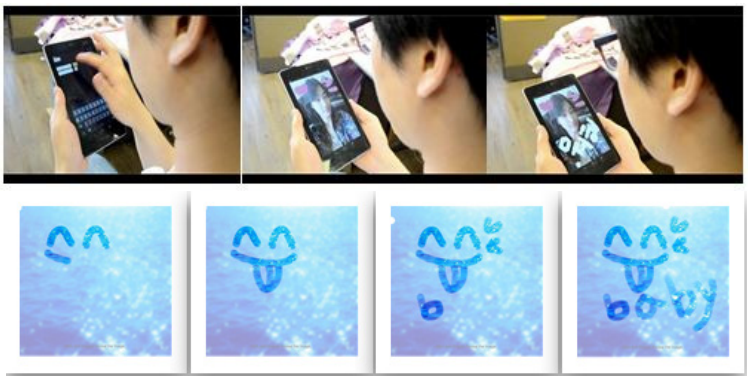


Fig. 2. Time-lapse screenshots

4 Experimental Study

4.1 A Preliminary Test

We performed a preliminary test with thirty people (17 female, 13male; 5 undergraduate students, 20 graduate students, 5 full-time employees). We let them use the 'Digital Love Letter' once or twice with randomly-assigned partners in a testing room, followed by a survey. The survey included 10 items of multiple-choice and 3 items of short form answers. We asked people how they commonly communicate through digital technology and compared it with the way of communication through the DLL prototype. Through questionnaires, the differences between non-instant and instant communication mediated by computers were analyzed. The most commonly reported method of communicating emotion in other messaging services was through the use of emoticons and participants were asked to compare that with their emotion communication experience using DLL. Most people responded that sharing of the writing process is the main attraction and dominant feature of DLL compared to other messengers. The feedback on the overall experience of using DLL was generally positive.

5 User Study

5.1 System Setting

Based on feedback from the experimental study we developed the hypothesis that an interface that shows the process of writing in real time will result in users having a higher perception of social presence. To test this hypothesis we developed a secondary user study using variations of the DLL system.

We compared two types of handwriting-based messenger writing interfaces that utilize a simplified interface with a black pen on a white screen (Fig.3). The first variation was the visually simplified version of type DLL, which still shares the process of writing with a partner in real time. The second variation, which we called 'Digital Letter' (DL),' was designed such that the process of writing is not shared, so the receiver only sees the final output image.

Our hypothesis is that the average score of the sense of co-presence in the DLL will be higher than that of the DL (Hypothesis 1). Also, DLL will result in a higher sense of psychological involvement in user experience than DL (Hypothesis 2).

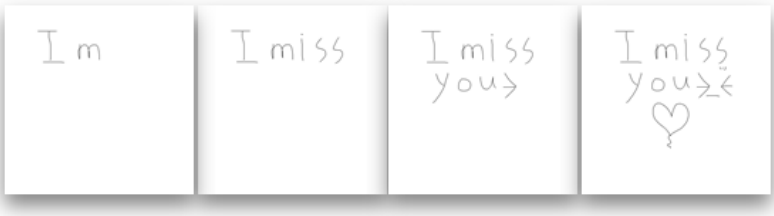


Fig. 3. Process time-lapse for the simplified application variations used in the second user study. In the first variation (DLL), the receiver also sees the whole process of writing as it unfolds. In the second variations (DL), the receiver receives only the final image, none of the intermediate stages.

5.2 Procedure

We conducted a user study with couples that identified themselves as being in a romantic relationship, to evaluate private and intimate communication through DLL. Ten couples were recruited using a university online message board and given monetary compensation. All participants were university students, ranging between 21 and 27years of age. Two couples had been in relationship for three or more years, two couples for two to three years, and six couples for one to two years. Participants used the DLL and DL variations for ten minutes each, with their partner in a separated room, and were asked to complete the questionnaire about co-presence and psychological involvement of social presence. The task they were given was to express love to their partner by drawing affectionate figures or writing some short text. We let them suppose they were not within close range of each other. Five couples were asked to use the DL first and the other five couples to use the DLL first. The participants were requested to fill the questionnaire after they used our messenger. When one experimental session was finished, we did an interview with the couple together.

5.3 Measurement

The co-presence measurement developed by Nowak, K [20] was used to measure participant's perceptions of social presence. The twelve items of the co-presence questionnaire were measured by 5-point Likert scale (Strongly agree=5, Strongly disagree=1, Cronbach`s alpha=.85). The psychological involvement measurement of social presence included two sub factors: empathy and mutual understanding. The psychological involvement questionnaire had twelve items estimated by seven-point Likert scale (Strongly agree=7, Strongly disagree =1, Cronbach`s alpha =.91) [19]. All participants were asked to complete the questionnaire of the co-presence and the psychological involvement after they finished the task with DL and DLL.

5.4 Usability Test

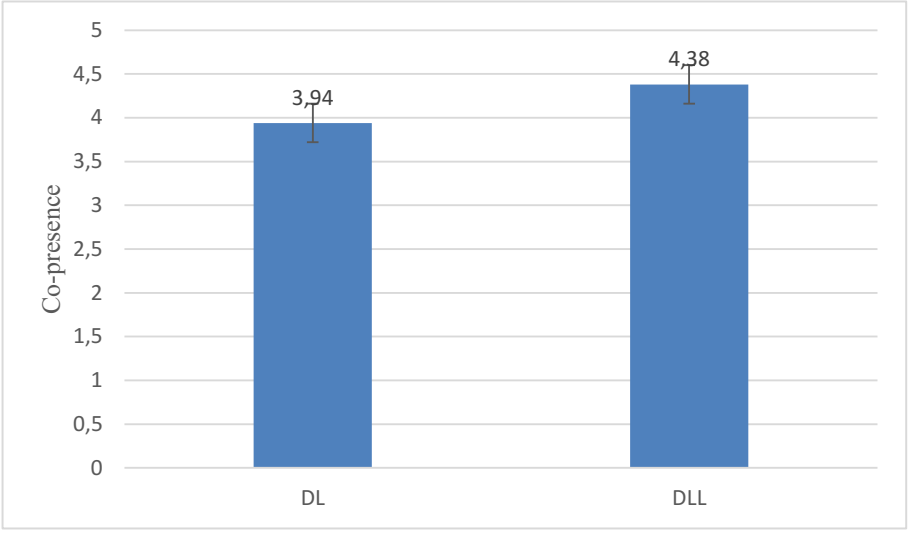
The usability of DLL was measured through The Post-Study System Usability Questionnaire (PSSUQ) with a seven-point Likert scale. The PSSUQ includes three sub scales: System Usefulness (SYSUSE), Information Quality (INFQUAL) and Interface Quality (INTERQUAL) [27]. In this study Information Quality was not measured because the DLL prototype did not include support information or documentation. Participants were asked to complete the questionnaires regarding the usability when they finished the testing process.

6 Results

6.1 Social Presence

We conducted a paired t-test with data from eighteen participants. Answers from two of the original twenty participants were deemed unreliable due to inconsistency in inverted questions. It was found that there was a statistically significant difference of perception of co-presence between DL (M=3.94, SD=.96) and DLL (M=4.38, SD=.91) ; two-tailed paired t test, $t(17)=3.01$, $p<0.01$. Therefore, hypothesis 1 was supported. However, no significant difference was found for sub factors of psychological involvement between the two groups. Hypothesis 2 was not supported.

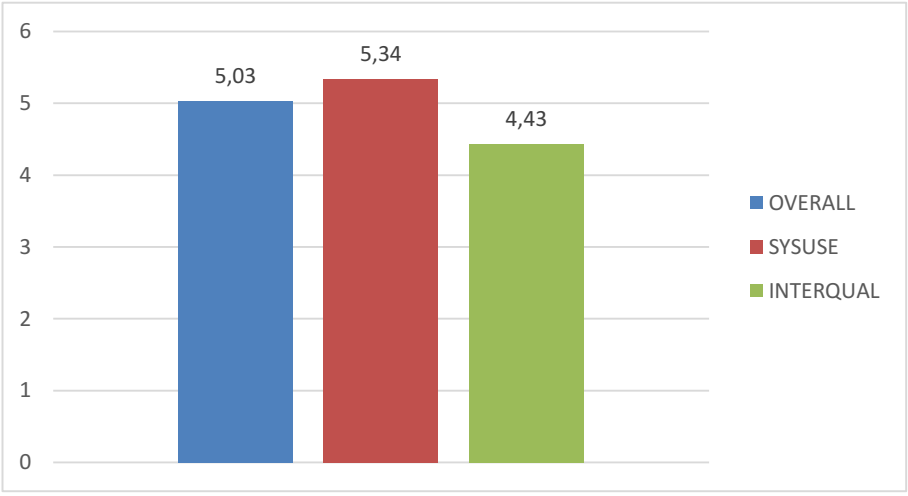
Table 1. Comparison of co-presence between DL and DLL. Co-presnece is measured by 5-point Likert scale (stronly agree=5, strongly disagree=1).



6.2 Usability Test

We measured the satisfaction of the participants through The Post-Study System Usability Questionnaire (PSSUQ) with a seven-point Likert scale. High scores are better than low scores due to the fixation used in the 7-point scales [27]. Results showed that overall satisfaction score was 5.03 and System Usefulness (SYSUSE) score was 5.34 and Interface Quality (INTERQUAL) score was 4.43.

Table 2. Usability test



7 Discussion and Conclusion

We made the digital mobile messenger DLL with a handwriting-based interface that shares the process of communication non-instantaneously and without multi-tasking. The DLL application, where messages are not stored for later retrieval, requires concentrated attention from users while they write and read messages. We tried to reflect on the digital messaging service and CMC through this system from a critical perspective.

We compared a DLL prototype with DL, where the process of writing could not be shared, via a co-presence and social presence questionnaire. The difference of co-presence between DL and DLL was significant, but a significant difference in psychological involvement was not found. We also did a usability test through PSSUQ. The overall satisfaction and system usefulness score was found to be high but the interface quality score was relatively low, suggesting an area of improvement for future versions.

It was found that sharing the process of writing on a messaging service was effective to perceive co-presence. However, there were limitations on measuring psychological involvement such as empathy and mutual understanding precisely

because the experiment duration was too short to build emphatic and mutual communication. The reasons of low interface quality score were revealed through the users' interviews. The user interface was not designed aesthetically to support sensorial communication. Thus, there are many necessary improvements for the interface design, including an erasing function and diverse colors.

Many participants showed different attitudes when functioning as a sender to being a receiver. They felt burdened by the fact that their partner could see their entire writing process, because they had to be more cautious and conscious. In contrast, they showed much interest in seeing their partner's writing process and even tended to enjoy observing their partner's hesitations and difficulties. In future research, we plan to differentiate emotional response between sender and receiver through a longitude experiment with a more developed DLL design.

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