cubble: A Multi-Device Hybrid Approach Supporting Communication in Long-Distance Relationships

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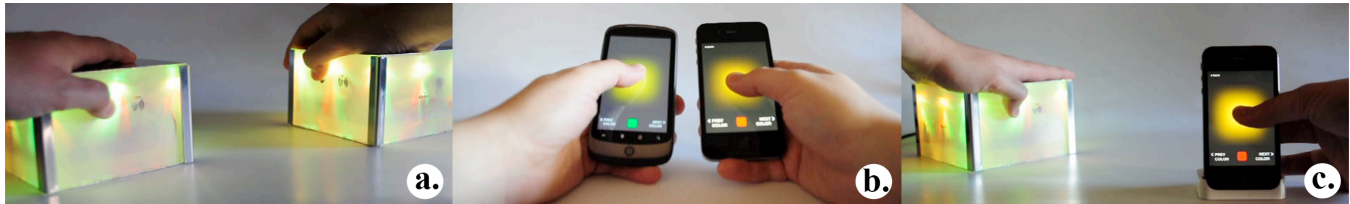Robert.S.Kowalski@gmail.com, {Sebastian.Loehmann, Doris.Hausen}@ifi.lmu.de

Figure 1. *cubble*'s hybrid interaction (holding hands). a. hardware only. b. mobile only. c. hardware and mobile combined.

ABSTRACT

Couples in long-distance relationships (LDR) want to keep in touch, share emotions and feel connected despite the geographical distance. Current approaches to solve this problem include dedicated objects, common communication channels and mobile applications (apps). To combine the advantages of all three approaches, this paper introduces a hybrid approach called *cubble*. *cubble* enables partners to share their emotions, simple messages and remote presence. The prototype offers color signals augmented with vibration patterns and thermal feedback. We performed qualitative user explorations, which show that users favor the hybrid communication concept and found that this fostered their intimate communication by providing emotional closeness.

Author Keywords

Long-Distance Relationships, Hybrid Interaction, Intimate communication

ACM Classification Keywords

H5.2. Information interfaces and presentation (e.g., HCI): User Interfaces.

General Terms

Design, Human Factors

INTRODUCTION

Intimate communication is important for mental, emotional and physical health [3]. Maintaining emotional closeness is especially hard for couples in long-distance relationships (LDR). Currently, there are three approaches to support couples in this matter: (1) Physical objects, ranging from functionally extended everyday items to objects mimicking physical interactions like hugging, (2) mobile smartphone

applications offering a dedicated omnipresent channel for couples and (3) traditional communication channels such as calls, emails or instant messaging (IM). These solutions come with advantages and disadvantages. While physical objects offer something tangible when a partner is away, people often do not want to carry extra items around [11]. Mobile apps are easy to bring along, but lack any physicality and are limited by the capabilities of the hosting device. Traditional channels can help couples to feel connected, but are not effective at facilitating intimate communication [7].

To leverage the advantages and overcome the shortcomings, we propose *cubble*, a hybrid communication concept. It consists of a stationary home-use object as well as a mobile application for on-the-go use (see Figure 1). The combination of these two client types offers a continuous, bidirectional (sending and receiving anytime, anyplace), exclusive (in contrast to social media which might even damage a relationship [18]) and private channel for couples. To examine this approach we implemented *cubble,* using colors and haptic tap patterns as ambiguous and self-assignable message and emotion templates for intimate communication. To provide a feeling of closeness, both partners can "hold hands" by simultaneously pressing one of their devices. To gather first impressions on *cubble* and the effects of the hybrid approach, we handed the systems to seven couples in LDRs. We found that users embraced *cubble* as it fostered their intimate communication over a distance and allowed them to experience emotional closeness.

RELATED WORK

Based on Howard et al.'s [6] requirements for devices mediating intimacy, we designed *cubble* to support self-disclosure, privacy, communication of emotion, a feeling of presence in absence, ambiguity, expressing love, private languages and mutual exchanges.

In reference to *cubble's* design space, numerous works on modalities of presence indication and emotional message exchange utilizing light, haptics and virtual elements are available. FeelLight [16] is a palm sized semitransparent

button, providing one bit communication through predetermined colored light supported by haptic feedback. In contrast, *cubble* allows users to select the color themselves from a given palette and a multi bit communication via haptic patterns. LumiTouch [1] transmits emotional content and a partner's presence by its ambient multi-color glow, but lacks heat- and haptic feedback as well as mobility support. Further projects focusing on presence indication through light include Casablanca [5] or 6th sense [17]. Projects considering haptic augmentation address the imitation of hugs [3, 9], stroking [4, 12], kisses [14] and hand pressure [2]. Virtual approaches comprise the Virtual Intimate Objects [7] as a desktop application for one bit presence indication and video chat systems [10]. Smartphone applications like Feel Me[1] or Pair[2] aim at connecting partners as well.

DESIGN PROCESS

133 participants from various countries, backgrounds and professions answered our initial online questionnaire. The gender ratio was balanced and the age ranged from 19 to 58 years (avg. 27). We performed a Condorcet Ranking based on the Schulze method [15] to determine the order of the most popular communication channels: phone calls, SMS (texts), IM, email, video calls and letters. (Video) calls are personal and direct but require scheduling and are rather time intensive. SMS and IMs are simple, fast and always available but lack a personal touch and the feeling of closeness. Finally, letters are perceived as a tangible and bonding gift from the partner, but take long to be created and sent.

Most of the time, people communicate via mobile phones from home or work since typing texts (SMS/email) is less favored on the move. Additionally, filling empty moments provides a great opportunity to feel close [8] and partners also like to share presence, emotions and events. A question about color-message mappings resulted in versatile assignments, showing no common links between these two properties, but supporting an ambiguous messaging approach.

In the second step, we collected initial design ideas through a brainstorming process based on the prior findings with three researchers from our lab. The results of this step were the foundation for step three, a morphological analysis [13] generating over 100 single in- and output user stories. In step four, we aggregated these experiences to multi input/output stories, which we filtered with the help of stakeholder discussions (e.g. researchers from the community and couples in LDRs) in the fifth and final step.

CUBBLE CONCEPT

cubble's hybrid approach establishes a continuous, bidirectional, exclusive and private channel for couples via light, vibration and heat. Depending on client activity logs, the messages are received on either the home or mobile client. *cubble* provides three message types. (1) "Nudge" is a short emotional ping from a partner. It consists of a color, which

1 Feel me: http://www.cs.uic.edu/~mtriveri/Marco_Triverio/Feel_me_app.html
2 Pair. http://trypair.com/

is selected by touching the sides of the hardware or according buttons of the mobile interface. It is sent by a single tap on the hardware's front or mobile device's screen and received as a single color flash (matching the color previously determined by the sender) and a simple vibration. (2) "Tap patterns" offer a more diverse exchange and the creation of private languages. They are presented as repeated light bursts and vibrations in the rhythm as entered. (3) "Holding hands" creates a live connection as both partners touch *cubble* at the same time (see Figure 1), resulting in a yellow pulsation and a warming-up of the clients.
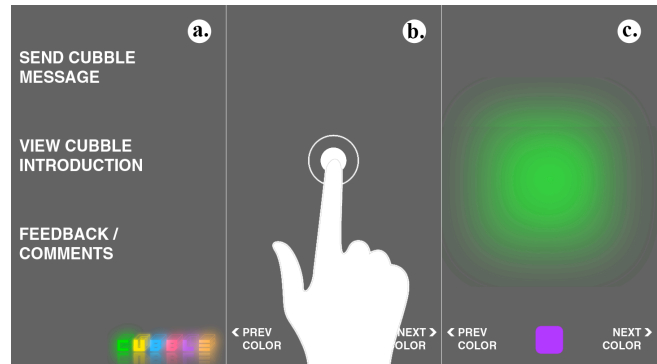

Figure 2. *cubble* mobile GUI (Android). a. main menu.
b. message input & send/receive screen. c. received message.

IMPLEMENTATION

We implemented the backend in Java as a REST web service running on the Google App Engine. It accepts messages, stores them, determines the receiving device based on activity logs and pushes a notification to the partner's smartphone. If the message is determined for the stationary device, the server delivers the message on the hardware's next message request cycle, occurring every ten seconds.

We developed the mobile application for iOS4 and Android 2.3. Apple's push messaging and Google's C2DM services trigger the smartphone to request the current message from the server via HTTP. The GUI follows a simple and clean design focusing on fast and easy use (see Figure 2). We designed the mobile applications to "feel" native on the according platforms, while looking as similar as possible to prevent biases in the initial user exploration.

We based the implementation of the hardware on the Arduino microcontroller platform. The interior electronics comprise a WiFi module, a capacitive touch sensor IC, two heating resistors for warmth generation on *cubble's* top, a temperature sensor protecting against overheating, a LED driver IC and RGB-LEDs, a vibration motor and a suppressor diode to protect the circuits against power spikes.

INITIAL USER EXPLORATION

To get first insights, we performed an initial user exploration with three different *cubble* setups: (1) mobile only (4 couples), (2) semi-hybrid: one partner mobile only, the other partner mobile and hardware (1 couple), and (3) hybrid: both partners having both mobile and hardware (2 couples). All participating couples were not related to our lab.

Procedure

Since emotional closeness is a subjective experience, we focused on qualitative results. In the beginning, each partner received an introduction and answered questions about communication habits and how the currently used channels support emotional communication. Next, the *cubble* prototypes were used for one week, during which couples were free to use *cubble* as much and in any way they wanted. We further gathered quantitative data by logging the content of each message (meaning message type, color, and if applicable the tap pattern), how many, when and by whom the message was sent. When users were equipped with both devices (mobile and hardware), we also logged which device was used. After this week, we conducted a final questionnaire and a semi-structured interview.
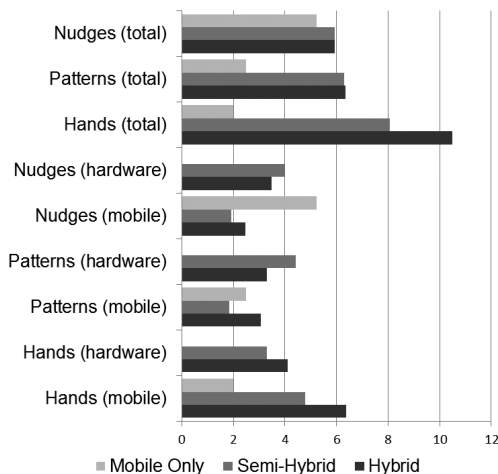

Figure 3. Messages sent with cubble (avg./day).

Mobile Only

Four couples used the mobile only version. Participants had technical as well as non-technical professions. Their ages ranged from 24 to 31 (avg. 27) and their relationships lasted between 11 months and 11 years, whereas 5 to 12 months were already spent in a LDR. All couples liked the application's ease and swiftness of use as well as the ambiguous character of the concept, providing opportunities of self-expression. On average, the couples held hands twice a day (in total for each couple: 34, 28, 5, 4 times) and exchanged 5.2 nudges (in total: 107, 36, 3, 16) as well as 2.5 tap patterns (in total: 30, 14, 21, 13) per day (see Figure 3). Asked about the influence on their usual communication, two couples stated that they substituted a noticeable share of their SMS and IM texts with *cubble* messages. One couple used *cubble* as an enrichment of their IM experience by using both channels in parallel. Also, during the final interview, one participant started to hold hands via *cubble*. When we addressed this observation, the interviewee figured it as some kind of automatism since (s)he was thinking about the partner at that time.

Semi-Hybrid: Mobile Only and Mobile+Hardware

This setup was installed for a couple aged 23 and 25 years with non-technical backgrounds and 4.5 years relationship (3.5 in a LDR). They liked using the nudge (avg. per day: 5.9) and tap patterns (avg. per day: 6.3) to communicate and appreciated the holding hands feature (avg. per day: 8) as well as the "playful and romantic character" of *cubble*. When comparing the total number of sent messages, we observed that the male partner with both prototypes sent more nudges (40, in comparison to 15 from the mobile only female partner) and patterns (35 to 22), whereas the holding hands ratio is more balanced with 42 hand holding initiations from the mobile+hardware partner and 48 from the mobile only one. The couple in this setup strongly increased communication frequency from once every three to four days without *cubble* to an average of 28.9 messages per day while using the prototypes. They explained this with *cubble's* "spontaneous element", which contributed to their strong feeling of closeness. The mobile only partner stated to have loved to use the hardware as well. Furthermore, both partners mentioned independently from each other that for the first time since the introduction of texting (via SMS) they smiled again on an incoming (*cubble*) message.

Hybrid: Mobile+Hardware

Each partner of both couples participating in this setup was equipped with the hardware as well as the mobile device. Again, participants had various backgrounds and were between 22 and 28 years old (avg. 25). Their relationships lasted 5 and 6 years and both have been in LDRs for 3.5 years. The couples sent 5.9 nudges daily (in total the first couple sent 44 and the second 28), 6.4 tap patterns (38 and 20) and held hands 11 times (42 and 75) on average. Due to the simulated body heat on the hardware and knowing that the remote partner is doing the exact same thing at this moment, the holding hands feature has been described as a bonding and "truly great feeling". The participants appreciated *cubble's* fast, effortless and fun way to communicate, although the hardware was considered a bit more complex to handle than the app. Participants in this condition stated to have a constant feeling of emotional closeness and one also noted the absence of "awkwardness" when substituting short IMs such as "I miss you" with *cubble* messages.

DISCUSSION

When comparing the average numbers of sent messages (see Figure 3), nudges are almost equally often used across all setups. However, tap patterns were used more than twice and holding hands more than four to five times as much with the semi-hybrid as well as the hybrid approach. As we observed in the semi-hybrid condition, the partner equipped with both – mobile and hardware – clients sent more messages, suggesting that the increased number of nudges and patterns is based on the hybrid character. The feeling of closeness also increased with the hybrid approach. On a five-point Likert scale (1-strongly disagree to 5-strongly agree) couples in the mobile only and semi-hybrid condition rated their feeling of closeness with a median of 3 and 3.5, respectively. In contrast, couples using the full hybrid setup rated it at 4.5. Concerning enrichment of existing intimate communication, scores are equal. A reason may be

the difference in joy of use, which is 3 for the mobile app, but 4.5 for each of the hybrid versions. This shows that users not only prefer the hybrid approach and perceive it as enriching, but that it encourages a more frequent message exchange resulting in a stronger emotional closeness.

All couples color-coded their messages. These ranged from inside jokes over wellbeing and longing to intimate actions. These assignments and the messages themselves varied between couples, showing no correlation. However, *cubble*'s haptic properties have been used non-rhythmically for message amplification by all but one couple, which used it to gain the partner's attention. Finally, holding hands and especially the hardware's thermal feature was used to extend (video) calls with an additional element of closeness.

Further observations include that users adopted the original *cubble* concept but also extended it by using it to coordinate their regular communication and to unobtrusively keep in touch while going out with friends. The sent messages, in correlation with time and origin (hardware or mobile device), suggest two messaging contexts for each of the hybrid's interaction endpoints: The first is "on the go", which is most often used asynchronously throughout the day from the mobile phone for signals like "Thinking of you". The second context is stationary or "home related", synchronously used for "cuddling" or other intimate interactions.

FUTURE WORK AND CONCLUSION
We presented the first mobile and stationary hybrid communication approach for couples in long-distance relationships. Though the limited number of participants and short study durations do not suffice for statistically reliable quantitative results, we still consider, especially in the context of emotional closeness, our subjective findings as valuable for further research in terms of hybrid systems, assisting couples in LDRs. For that reason, future work includes long-term evaluations of the hybrid approach with more couples to collect statistically reliable data. Furthermore, effects such as different time zones and the novelty effect were not subject to this evaluation and have to be considered in the future as well. Additionally, suggestions like an "emotional answering machine" functionality and the hardware usage as an interior design piece will be taken into account. Besides the presented promising indications that *cubble* supports couples in experiencing emotional closeness and that it fostered their intimate communication, our favorite finding was that *cubble* made people smile.

REFERENCES
1. A. Chang, B. Resner, B. Koerner, X.C. Wang, and H. Ishii. Lumitouch: an emotional communication device. *CHI EA*, (2001), 313–314.

2. A. Chang, S. O'Modhrain, R. Jacob, E. Gunther, and H. Ishii. Comtouch: design of a vibrotactile communication device. *DIS*, (2002), 312–320.

3. C. DiSalvo, F. Gemperle, J. Forlizzi, and E. Montgomery. The hug: an exploration of robotic form for intimate communication. *ROMAN*, (2003), 403–408.

4. E. Eichhorn, R.Wettach, and E. Hornecker. A stroking device for spatially separated couples. *MobileHCI*, (2008), 303–306.

5. D. Hindus, S.D. Mainwaring, N. Leduc, A.E. Hagström, and O. Bayley. Casablanca: designing social communication devices for the home. *CHI*, (2001), 325–332.

6. S. Howard, F. Vetere, M. Gibbs, J. Kjeldskov, S. Pedell, K. Mecoles, M. Bunyan, and J. Murphy. Mediating intimacy: digital kisses and cut and paste hugs. *BCSHCI*, (2004), 45–48.

7. J.J. Kaye, M.K. Levitt, J. Nevins, J. Golden, and V. Schmidt. Communicating intimacy one bit at a time. *CHI EA*, (2005), 1529–1532.

8. D. Lottridge, N. Masson and W. Mackay. Sharing empty moments: design for remote couples. *CHI*, (2009), 2329–2338.

9. F.F. Mueller, F. Vetere, M.R. Gibbs, J. Kjeldskov, S. Pedell, and S. Howard. Hug over a distance. *CHI EA*, (2005), 1673–1676.

10. C. Neustaedter and S. Greenberg. Intimacy in long-distance relationships over video chat. *CHI*, (2012), 753–762.

11. S. O'Brien and F.F. Mueller. Holding hands over a distance: Technology probes in an intimate, mobile context. *OZCHI*, (2006), 293–296.

12. Y.W. Park, C.Y. Lim and T.J. Nam. CheekTouch: an affecttive interaction technique while speaking on the mobile phone. *CHI EA*, (2010), 3241–3246.

13. T. Ritchey. Fritz Zwicky, Morphologie and Policy Analysis. *EURO*, (1998).

14. H.A. Samani, R. Parsani, L.T. Rodriguez, E. Saadatian, K.H. Dissanayake, and A.D. Cheok. Kissenger: design of a kiss transmission device. *DIS*, (2012), 48–57.

15. M. Schulze. A new monotonic and clone-independent single-winner election method. *Voting matters 17.1* (2003), 9-19.

16. K. Suzuki and S. Hashimoto. Feellight: a communication device for distant nonverbal exchange. *ETP*, (2004), 40–44.

17. K. Tollmar and J. Persson. Understanding remote presence. *NordiCHI*, (2002), 41–50.

18. X. Zhao, V.S. Sosik and D. Cosley. It's complicated: how romantic partners use facebook. *CHI*, (2012), 771–780.