Presence in Absence: Personalization of Tangible Intimate Objects for Long-distance Relationships

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ABSTRACT
This paper presents a new way of thinking about designing personalized artefacts for dyads (a group of two people) in long-distance relationships, whether they are family members, close friends or romantic couples.

In this paper I am presenting the idea of a playful, yet useful tangible design for people who are often not able to see their loved ones in person. I strive to ideate a highly personalized and meaningful design through a Do It Yourself (DIY) activity for users, which will give them a chance to personalize the product according to their own needs. For this research, littleBits electronics have been used as a prototyping and DIY material. They allow you to create and connect two devices together and use them for different purposes. User testing with two close friends who live in different countries has been conducted. They received three different half-way done prototypes that they could choose from to build. The results showed that the idea of DIY artefact for presence in absence is worth researching, since the activity creates a meaningful shared experience which adds a bigger value to the device.

Author Keywords
Presence in absence; connectedness; intimacy; long-distance relationships; tangible interaction; DIY; personalization; littleBits.

INTRODUCTION
Nowadays it is nothing unusual to move around the world in order to pursue different opportunities, such as student exchange programmes, internships, better jobs or simply better life. However, your family, good friends and significant others may not be able to always move with you and consequently you find yourself in a long-distance relationship. Even if you move out of your parent's house just to another household the connection between you and your parents loosens and it is harder to find time for each other. Given all the possible ways of communication through smart phones, laptops or computers, people can still miss the sense of intimacy, presence and connectedness to their loved ones. Naturally, for different types of relationships the need for those feelings and their meaning itself is nuanced and ambiguous. Consequently, that gives us an infinite number of problems and solutions.

Furthermore, with devices to mediate intimacy and to create presence in absence, we do not want to substitute the already existing contact and communication that dyads in a long-distance relationship have, but to enrich it and make it more personal and special. We strive to create devices for so called phatic interactions, which are more about the contact than content and help maintain and strengthen an ongoing communication. Phatic interactions are trying "to keep channels of communication open and to maintain the physical, psychological or social contact. Phatic exchanges confirm that communication is in fact taking place (e.g. eye contact, nods, idle chat) and reaffirm connectedness." [20, pp 1]

With phatic interactions we can get continuing and constant feeling of connectedness and presence of the person we are communicating with. Moreover, we can achieve that not only in person but also through devices. If we are sending text messages back and forth, for example, we are socially connected to that person and might get the feeling of her or his presence. Presence in absence is the subjective feeling of someone being close even though separated by time or space, usually while thinking of them, or being in some sort of contact, as in the example above.

In the paper Understanding Remote Presence, Tollmar and Persson [17] emphasise the value of personal objects that have deeper meaning than just a piece of furniture or decoration and that might remind the person about their loved ones. In that way, those objects play a key role in creating the feeling of presence for this specific person.

Howard et al. [8] found it interesting to design devices that are empathizing contact over content in the context of intimate relations. Moreover, they believe that such devices should be "information light", in a way that they do not duplicate the communication that the dyad already has, and "narrow-band", i.e. from a simple message they are able to understand richer meaning behind it.

An interesting research is Communicating Intimacy One Bit at a Time [10], where they create a *Virtual Intimate Object* (*VIO*) for couples to send each other one simple signal in a form of a red circle on their computer. Even though the message was so simple, it could mean different things, e.g. "I am thinking of you.", "Are you awake?", "Call me.", etc. They discovered that one-bit signal is enough to mediate intimacy and it can provide a rich and valuable way for connecting. This can also be said about presence in absence, since some participants got this feeling of awareness when their significant other activated the red circle and they could imagine her or him sitting at her or his computer.

The work outlined in this paper builds on the notion of *VIO* [10], but since the work focuses on the use of tangible interfaces, the notion of *TIO* or *Tangible Intimate Objects* is introduced to refer to the type of artefacts that is the scope of this paper. I think that when the "object" is separated from the smart phone or computer, it can create more significant feeling of presence in absence and intimacy.

Further, I will present the idea of how can the personalization of the devices for presence in absence create a playful user experience. How can users personalize and customize devices and give them more valuable meaning? How can one design product satisfy different needs of long-distance relationships? How can the product be reusable?

For this research project, firstly, a quick online pre-survey was conducted in order to get valuable insights about how different long-distance relationships work, for example when, where and how often do dyads get in contact. Based on that survey and the previous work, the phase of prototyping with the littleBits and different craft material started which later resulted in three working examples of what you can create with those small electronics. After that, a second survey was conducted with intentions to get back opinions on the three prototypes from the potential users. Lastly, one dyad of users in a long-distance relationship tested one of the prototypes in more than a week long period and gave us some valuable results about their experience.

Challenges

Designing for presence in absence and intimacy can be very challenging. First of all, the feelings we are trying to evoke are highly subjective and ambiguous. They depend not only on one person, but on two persons that are closely connected. Intimacy can be, among other explanations, also described as knowing each other to the level where you can understand her or him without a lot of content and explanations, but with simple signs, gestures or a few words.

Secondly, the group of users can be really specific, yet still with very different characteristics. We are aiming towards all sorts of close relationships on a long distance, i.e. family members, romantic couples and close friends. And even within each type of relationships there are quite a few differences in how close two people are, how they interact and function. For example, in a family you have mother-daughter, father-son, mother-son, father-daughter relationships, sibling relationships, mother-father relationships as well as grandparents-grandchild relationships. Moreover, all relationships come with different age groups, so a device in a mother-daughter relationship would be much different if the daughter is school-aged, a teenager or an adult. Naturally they all have different needs and ways of getting and/or staying in touch.

Consequently, if we want to really personalize the design for a specific relationship, users would later not be able to use the same design for another, maybe new, relationship. It might work to some extent within the same family however it depends on how different the relationships are and how personalized the design would be. Kaye and Goulding said in their paper [9, pp 342]: "...if couple were to develop an intimate object for their relationship, it would feel wrong for either member of that couple to use the intimate object to communicate with new significant other ..." In other words, the more the device was personalized and customized for one dyad, the less it would be useful for other dyads. That means that mass production can be really impersonal and too general, and customized and personalized products too expensive and useless if relationship changes its needs or even breaks apart.

Next, we need to consider the communication itself. We do not want to substitute the communication via mobile phones or computers, but enrich it and add a new level to it by not only hearing and seeing each other but also by feeling something physically as well as motivating further interaction with the loved ones. The content of communication becomes less important than contact and reciprocity of it. The language is in most cases short, simple, even coded with symbols or brought to a level of one-bit and wordless communication, i.e. light, pressure or warm signals. It tries to evoke feelings, both emotional and physical as well as encourages users to get or stay in contact with that person.

Lastly, the device is designed for the communication between the two users and nobody else. Except in case of family members, it could be used within the two or more households, meaning more than only two persons, but still connected with family bonds. That leads to the fact, that you can use this artefact to communicate only with one other person, or household, in case of the family. This fact can make the device limited, yet special in a way. From "mass communication" we move to "personal" and "customized" communication.

PREVIOUS WORK

The feeling of presence in absence is ambiguous and hard to define, since people differently understand the awareness of their loved ones while not being collocated. Most often it

is based on the feelings for that special person and the constant contact that you have with her or him. With the communication we share, we become aware of their everyday life and activities.

Howard et al. [8] introduced three themes for presence in absence. They divided it in *contact* (reciprocity), *content* (expressiveness) and *context* (public/private). To create *contact* users need a single shared object to communicate that allows a quick and easy messaging. That theme emphasizes the importance of a personal or meaningful object you share only with your loved one and that communication through the object is not about the rich content, but small reminders of each other. Next, *content* represents the way users can express and understand each other's feelings mediated through the device, whether it is symbol- or signal-based communication. It needs to be clear and easy to adapt, yet secretive and personal for the dyad with as little possibility for a misunderstanding as possible. Third theme is *context* and it talks about how it is important that devices for presence in absence are a closed communication channel, in other words, they are private and intimate. It also suggests that communication should be discrete, so that only the owner is aware of it, as well as spontaneous and without any important purpose than just reminding the loved person that you are thinking of her or him.

Vetere et al. [19] discussed the intimacy in terms of *Antecedents* (conditions for intimacy), *Constituents* (themes of intimate acts) and *Yields* (results of intimate acts), however they stated as well that those themes are still all tightly connected, are overlapping with each other and could be understood on more levels. Conditions for intimacy are self-disclosure, trust and commitment which are different and ambiguous in every relationship. In other words, it deals with being comfortable and open about sharing thoughts and emotions, to trust the loved one to keep some things private as well as sharing the past, having a common world-view and work on the relationship for the shared future. *Constituents* cover the different ways of actions to mediate emotions. It could be physical or verbal, public or private and expressed in many different ways (non-verbal, multi-layered, flirting and playful, ambiguous). The important thing is also the reciprocity of the acts. For example, person saying "I love you" expects "I love you too" in return otherwise the person saying it first might feel ignored and/or rejected. Likewise, not being able to reach a loved one and leaving a missed call suggests that she or he contacts you later asking about it. Even though, in this example, the window of time to return the act of calling is bigger, the trust can be still disturbed if it is too big.

According to Vetere et al. [ibid.], the results of those intimate acts are presence in absence, meaning that because of those *Constituents* people have their loved ones more often in their minds and hearts and therefore present in that way. However, they discovered as well that even those strong relationships can quickly become vulnerable, if the appropriate reciprocity is broken.

During the research process it became quite obvious that designers mostly use tangible everyday objects and turn them into a device for presence in absence. There have been cases, like already mentioned *Virtual Intimate Object (VIO)* that is computer based [10] or many smart phone applications [7], where authors did get some positive results in the research and people are actually using phone application. However, those devices still seem impersonal to many others, since you already use them for all different forms of communication with other people as well. To create a really special and intimate experience the objects need to have a deeper value. Moreover, it is a really good sign if only seeing this object reminds you of loved person, which mobile phone, for example, rarely does. That is why tangible devices, especially created for the communication between two close people, can really make a big difference in how are we aware of loved one's presence while being absent. Having that everyday object, that reminds us of the person and/or shared experience, reminds us more often of each other and in that way it encourages communication. In other words, we are pleasantly and constantly reminded of our loved ones and decide to text or call them more often. Furthermore, it creates even greater meaning of those objects, if they are upgraded in some sort of communication devices that allow constant chatter and reciprocity of signals that two close persons can send to each other.

But on the other hand, even though it would be great if we could personalize and customize objects for each individual dyads, that is not really plausible, since there is a norm in society to spend money on mass-produced electronic devices than pay for expensive customized designs. Will users ever make a switch and prefer devices for "personal communication" rather than devices for "mass communication"? [9] Even though the use of devices for presence in absence is more delicate and intimate, it is still not worth enough to pay for it. Therefore, we are faced with a question of how we can personalize such objects that they would be appropriate for different types of long-distance relationships and could still be based on one design.

Nevertheless, there have been many researches that actually did work on personalization of everyday objects. Even though some concepts never went in to the production, we gained some interesting insights and that encouraged further progress and development of new ideas. Those everyday objects can be a piece of furniture, such as beds, tables, lamps [3, 5, 6, 14, 17], or home decoration, such as picture frames, cups, decoration objects [11, 15, 18, 21], or wearable computing such as jewellery and clothes [16, 19]. Many designers tried to evoke the feelings of presence through some sort of metaphor or sensations of physicality you get as if you would experience it while being collocated with your loved one.

Light is the metaphor for presence of life [17] and is therefore an obvious output of devices for creating peripheral presence of a loved person. It is a way of phatic communication that starts or keeps the contact going and creates a presence in absence by being reminded of the person and being aware that they are at home in that moment. For example, the *Good Night Lamp* [6] is a set of two or more (representing more households) house-shaped decoration lamps with which you signalize to your loved ones that you are at home and available for a call. When you come home you simply turn it on and the representative smaller light at your loved one's place turns on as well. Another light design is *6th sense* [17], which is a sculpture of lights and sensors that respond to movement and send the data to the sister device. The lamp measures the amount of body movement around it, to put it more simply, if there is a lot of movement at his place, the device sends the data to her lamp and it lights up. Similarly, if there is no movement detected, the sister lamp receives the data and dims down.

Kiss communicator [22] also uses light, however, it is a bit different and more abstract artefact. It is a hand-size object in which your significant other blows a kiss which is translated into patterns of lights on the design. The "kiss" is sent to your device and you receive it by holding and squeezing the artefact. The presence here is created by the reciprocity of receiving and returning the "kisses".

Everyday objects, such as beds and pillows are quite often used for the romantic couples since it is common that they share it when they are living together. Designers try to recreate this experience for users that live apart. *sleeppyWhispers* [5] is the concept of combining a picture frame and a pillow. The idea is to share goodnight messages with your loved one by sending a recorded sound. There is a speaker hidden in the pillow and you can start listening by pressing the button on the picture frame. This design is suitable for couples as a bed can be quite an intimate place, however a parent that travels a lot could also record goodnight wishes or bed time stories for their children.

Somnia [14] is also a pillow-concept that tries to improve sleeping quality among the couples on a long distance. When one of the partners goes to bed the pillow of the other partner warms up and encourages her or him to virtually join her or him in bed. In that way they mediate the presence with the warmth sensation, as if she or he would really be there in bed and warm it with the body temperature. However, the users stated that it was a bit disappointing when the other partner did not join in the bed and the pillow remained cold. On the other hand, when they felt the warm pillow, the sensation of presence was big. *The Bed* [3] could be an extension to the *Somnia*, since beside warmth output, experiments also with other senses. For example, it simulates breathing of significant other on a connected bed by swaying of a curtain, translating sounds into colourful shadows on the curtain, transferring motion and presence into a heartbeat pulses and warmth. It tries to get as close as possible to the feeling of having another person lying next to you.

Gustbowl [18] and *the table from the Habitat Project* [21] are somewhat similar in the way that they both project the picture of objects laid in the bowl or on the table to the remote sister device. In that way they show a picture of everyday objects that they use to the loved ones and also signalize that they are at home. Similar to *Good Night Light* mentioned before, except using pictures instead of light. Users also started to use it as a messaging device by leaving notes and pictures and not just everyday objects, for example, leaving keys in the bowl when you come home.

We Are Family [11] is a concept for two or more households where each member gets his own space for a picture in a digital picture frame representing the family portrait. To make it interactive, users can easily take photos ("selfies") with the device and share different moments with the rest of the family by capturing it in a picture. The design connects the family and encourages them to share events of their daily life. This could also be useful for couples as well as friends as a more intimate way of sharing photos than Snapchat or Instagram for example. Similar is *The Picture Frame* [ibid.] although, it is more focused on providing context to talk about via phone. Basically it is sharing pictures through two connected and synchronized digital picture frames, where you can upload pictures you want to show. Via phone call users could browse through the pictures and talk about them together. This concept is presented in a relationship of a mother and a daughter that lives in her own household with her own family. It would be also interesting to use it with children and in that way help to create topics to talk about over a phone call.

There are two attempts in *Hand Holding* device [9] where one tries to simulate the pressure of holding hands by squeezing the central post of your own device and sending the amount of pressure to the other device which contracts the outer sleeve. In other words, "... the tighter the other person squeezes, the tighter your hand is squeezed by the device". [ibid., pp 343] Likewise the other *Hand Holding* device tries to simulate the warmth while holding hands. Each member has a customized soft silicone handprint and when one puts the hand in it the other lights up in the rhythm of the first user's heartbeat. When they both have their hands in the device, it starts to provide the comfortable heat.

The Feather and *the Scent* [15] are somewhat similar artefacts, however with different outputs. Both are designed for the situations when one person is travelling and the other stays at home. Consequently, sending signals in those concepts is one way, from traveller to the significant other at home. The traveller activates the small portable object, a picture frame that signals the home-based device to react. In case of *the Feather*, there is a glass box with electrical fan that lifts up the feather above it when activated. In case of

the *Scent*, a reaction on a home-based object is heating the element at the bottom of an aluminium bowl filled with the essential oil. The scent vaporized in the air fills the space and represents that the traveller is thinking of the loved one at home.

MatchUs Board [2] is a good example of creating a shared experiences and memories over a distance. Users have a display on which they can draw or write and gives them the possibility to co-create since creations synchronously appear on both boards. It could be used as a game or to leave quick notes to each other. The authors emphasize the importance of shared experience and situational awareness to create the sense of togetherness over a distance.

HB Ring [16] is two connected rings that let you see and feel the heart beat of your significant other. The user only needs to tap the ring and she or he receives loved one's real time heart beat. If the connection is not available, user gets the last available heart beat. Interesting is the use of rings as an artefact, since the rings represent commitment, such as marriage. With the sensation of seeing and feeling a loved one's heart beat that piece of jewellery gets even a deeper meaning. *Hug over a distance* [19] is also a wearable design. Their idea was that "a person would be able to initiate a hug causing their remote partner's jacket to emulate" and so simulate the feeling of a hug. It could be used to show signs of affection at anytime and anywhere, however still discretely and private.

PRE STUDY

To get a more clear idea and some new insights and perspectives on the topic of staying in touch in a long-distance relationship, we have executed a quick online survey. Altogether 54 completed surveys have been received, among those 26 participants were in a romantic relationship, 14 were family members and 14 close friends.

The results showed that there are some differences in frequency of being in contact between friends, couples and family members, however they were all mostly satisfied with the feelings of being connected and they felt their presence while being in contact. Most of the couples (76,9%) are in contact *every day*, while family members are in contact more seldom with 35,7% being in contact *around 3 times a week*, 28,6% being in contact *at least 5 times a week* and 21,4% are in contact *every day*. 35,7% of close friends are in contact *every day* and 28,6% are in contact *at least 5 times a week*.

Couples in long-distance relationship are mostly in contact *during the whole day* (35%) and in the *evening* (27,5%), with 17,5% answering *after school/work* and 12,5% during the *night*. That leads to the most common place when they are in contact *at home* with 52% and 24% for *on the way to/from school/work*. Likewise, for family members the most common time to get in contact was *during the whole day* (46,2%) and in the *evening* (23,1%), which also lead to places as *at home* (56,5%) and *on the way to/from school/work* (21,7%). However, considering close friends, they are most often in contact in the *evening* (38,9%), *during the whole day* (27,8%) and *after work/school* (16,7%). Here as well the most common places to get in contact were *at home* with 41,9% and *on the way to/from work/school* with 25,8%.

The results showed that most couples are more frequently in contact than family member and close friends, since their need for closeness is greater. Within all types of relationships the most common places to get in contact were *at home* and *on the way to/from school/work*.

DESIGN CONCEPT: DIY PRESENCE IN ABSENCE

Based on the results from the pre-study, an idea was developed around the concept of personalization and DIY, where the users can create their own devices according to their needs and in that way they can easily personalize it through the functions and through the design itself. For the prototyping, an existing toolkit called littleBits [12] was used. littleBits allow rapid prototyping with electronics, sensors and motors, without the need for programming skills. With them users can easily build together a creation with different inputs and outputs that can be later also connected to the internet via special littleBit module. In that way two creations can be connected together and be activated by each other. Users also design the look of the creation and personalize it with meaningful shapes, materials and decorations. Through this DIY project they also get connected and closer via the shared experience of talking about the ideas of designs, trying them out and creating the final version. It is a fun activity that encourages communication and bonding of two persons. In that way the final product represents:

- the DIY activity where they together create a device (each their own) that reminds them of the loved ones and the fun memories building it; here is a chance of creating presence in absence through shared experience,
- device they have created that enriches their communication and to encourage ongoing communication; it can serve as a device for phatic interactions.

littleBits

littbleBits are small electronics that are perfect for learning and creating with both children and adults as well as for prototyping and creating interactive solutions for almost any DIY projects. The ease of use could be compared to LEGO pieces that you can simply build together in more complex structures. With littleBits you do not need any engineering knowledge and moreover, modules are colour marked to easily distinguish different functions of each piece, such as power modules, input, output and wire modules (see Figure 1). They snap together with magnets and you can also further fasten them together with different accessories. [1]

Figure 1 and 2. Different modules of littleBits and cloudBit module. (Pictures from: http://littlebits.cc/)

cloudBit (Figure 2) is a so called wire module (orange colour), that allows you to connect your inventions to the internet without any programming skills. It acts as an input and output module, meaning that it can both send and receive the signal, depending on how you connect it with other modules. [12] In that way, you can connect two inventions with each other using another cloudBit, or even to the cloud service IFTTT (If This Then That) [13] that facilitates connections to a broad set of internet services. In that way you can choose the action and reaction for your devices by connecting different littleBits modules together in the desired order. cloudBit was so the important part of this research since it allowed us to connect together the two prototypes so they could interact with receiving actions from one device and delivering reaction on their own.

PROTOTYPES

Among many possibilities of creations with littleBits, three instances of *Tangible Intimate Objects* were developed as examples of DIY creations. Each prototype was meant for different category of long-distance relationships, i.e. couples, family members and close friends. Based on the insights from the survey, scenarios for each representative dyad have been made, i.e. mother and student-daughter, close friends and romantic couple. Different prototypes tried to satisfy the needs of each relationship. For example, the couple missed the touch of each other so they got the device that enabled soft vibrations simulating hand holding or hand massage. Student girl could simply and quickly let her mother know she is safe, and close friends could easier let each other know if they had time for a phone call at the same time.

Because most users from each type of a long-distance relationship are often in contact when at home and because of the limits of using littleBits, all prototypes that have been created during this research are home-based. Even many others, already researched artefacts are mostly home based and not portable, such as the Goodnight Lamp [6], the Bed [3], the Frame [11].

Nevertheless, the prototypes are still flexible enough to be used by different type of a relationship. They can be personalized by using different littleBits modules as well as by using different craft material.

Prototype 1: U & Me

U & ME is inspired by designs that let the other owner of the connected device know that you are home and safe by turning on the light [6, 17]. The two lights represent each member and signalize their presence; the red one for you and the green one for your loved one. It is a subtle interaction that reminds you of the other person, for example you see their light on and you think of them and maybe text or call them. Meaning of the light can be chosen by the users. For example, you can turn on the light to let them know you are thinking of them or to let them know you are home and safe or simply that you are awake. Basic setup of *U & Me* prototype is seen on the Figure 3.

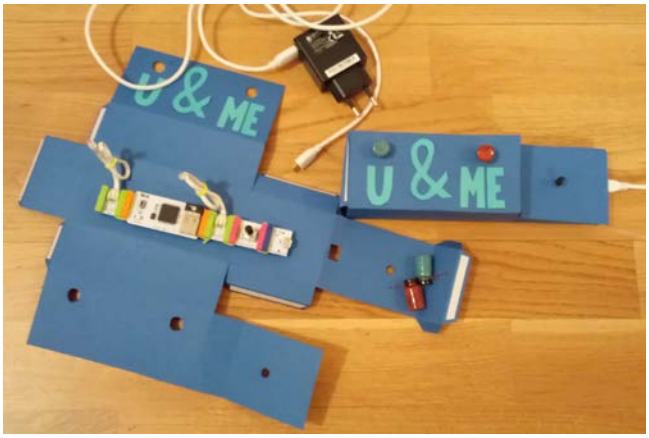

Figure 3. U & Me prototype of two connected devices on the right and basic setup with littleBits on the left.

Prototype 2: The Cloud

The Cloud (Figure 4) strives to mimic the physical feelings when you are with your loved one, i.e. touch. It is inspired by the *Hand holding* devices [9] and *the Hug* [19]. *The Cloud* would be used in the moment when two users would engage in a phone or video call and could, in that way, enrich the conversation with the physical effect. They would press the button and activate the loved one's device to softly vibrate and light up for as long as she or he would hold the button down. Similarly to the *hug over distance*, it involves high level of reciprocity through playful and flirtatious acts.

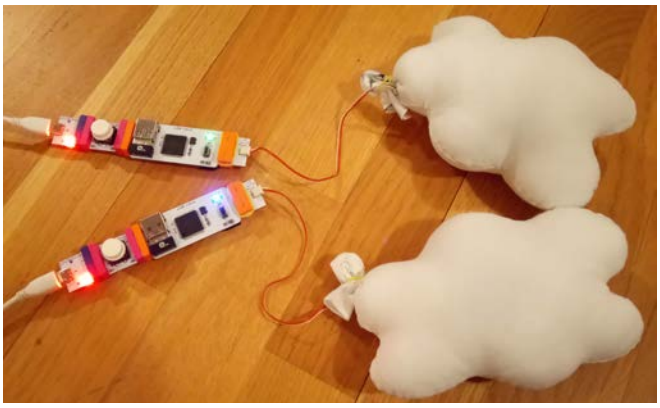

Figure 4. Look of the Cloud; the pillows disguise long LED and vibration littleBits module.

Prototype 3: Call Me Maybe

Call Me Maybe (Figure 5) is inspired by the same ideas as *U & Me*, although it offers more clear purpose via the symbols you can use, for example phone or house sign. The language is not so secretive, but there is less chance for the confusion of the meaning. Furthermore, in that way it is also simpler for children to understand the icons than only the light signals on the *U & Me* prototype.

You signalize the loved ones by turning on the light in the green "window" on their device. In this case the arrow shows the state of your device and consequently your state. Basic setup is seen on the Figure 6.

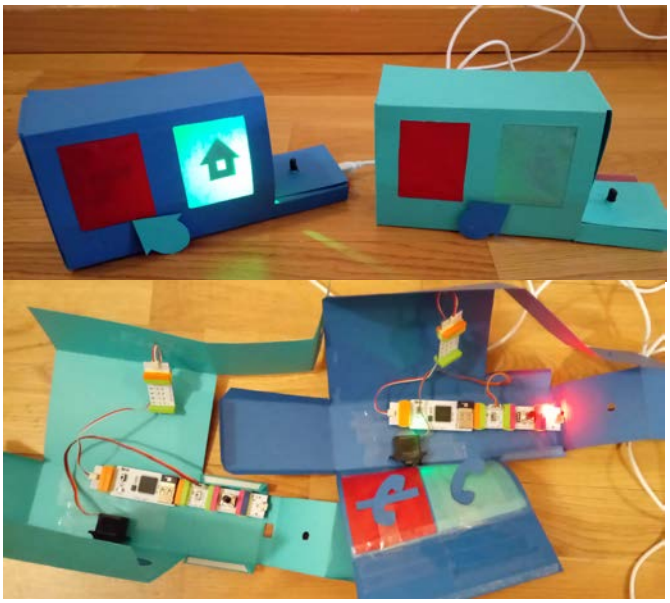

Figure 5 and 6. Above is the Call me maybe prototype with the symbol of the house, beneath is the basic littleBits setup with a phone symbol.

USER EVALUATION

During this research, tangible prototypes were evaluated twice, namely, in online questionnaire that gathered opinions, and through user testing with two close friends that tested one of the prototypes for a bit more than a week.

Questionnaire – concepts evaluation

After the three concepts were created, a second online survey was conducted to gather the opinions on the prototypes. First, the participants were asked about whether they are interested in DIY projects and if they would be interested in DIY project that would help them stay in touch with a loved person. The questions considering the prototypes were mostly an open type and were based on the picture of each prototype and its short description about what it is meant for. The questions following asked them to choose one prototype they preferred and to state why they have chosen that one.

At the end of the survey the participants were asked to leave their email address if they would like to test any of the prototypes and help this research.

User study

Next step of this research was user testing. The goal was to get three pairs of users, one romantic couple, one dyad of family members and one dyad of close friends. For this research the user group is quite specific, meaning that a couple of users should be in some sort of long-distance relationship as well as both of them should be at least a bit interested in DIY (Do It Yourself) projects. Even though I got quite a few email contacts from the two surveys of the users that were interested in the research and might be interested in testing, I got only one dyad of close friends who were ready to collaborate in the end. The female participant lives in Stockholm and the male participant in Reykjavik, aged 25 and 26. They have been friends for eight years and have been in a long-distance relationship for three years now. They are in contact almost every day via texting, however, on average, they have phone or video calls three times a week, but it can be very spontaneous and irregular. The participants are also not big DIY projects enthusiasts, but they do not mind doing it every now and then. They are usually in contact during the time after school or work until night, when they are at home, at work or on the way. Used devices for communication in this relationship are mobile phones and laptops/computers.

Both of the participants received a package with identical material to execute the test. The content is listed in Table 1 and shown on Figure 7. With the material they got they were able to build each of the three prototypes and personalize them in different ways.

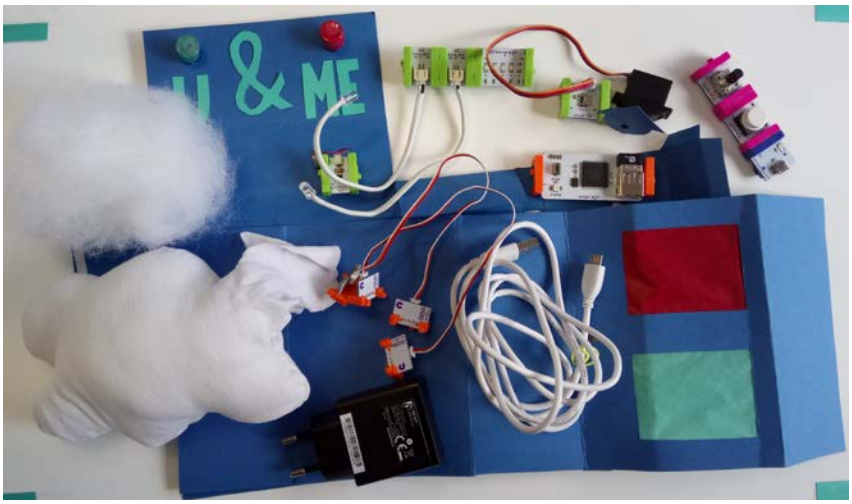

Figure 7. Material that was sent to users for testing.

In the Google Drive I have shared with them a folder with the introduction to the testing, links to instructions on how to build and connect prototypes and links to surveys. It was up to them to decide for one of the prototypes, build it together and later use it in their daily routine. They were also encouraged to personalize the prototypes as much as they wanted or even to create some of their own ideas if they had them and that it would still support the purpose of creating presence in absence. They were also asked to take and share the pictures of the experience.

LittleBits	Craft Material
p3 USB power USB charger Dimmer Button Wire (2x) cloudBit Bargraph Vibrator Long LED (2X) Servo Motor	Pillow in shape of a cloud Pillow stuffing Paper cut-out Call Me Maybe box Paper cut-out U & ME box Two coloured bottles for U & ME Paper cut-outs in different shapes Small elastics Double-sided tape

Table 1. Content of the package sent to users.

I decided to send them the half-way-done prototypes to make the experience easier and to have some material and ideas already prepared to build the device. It turned out as a good idea, since the users barely managed to find time to build it with the half-way-done material. Moreover, in that way the focus was more on the electronic modules and the idea of creating with them than the ability of users to do crafts.

To get some valuable insights I asked them to complete different surveys, such as pre-survey, after-building survey, daily survey and post survey. They were all online created via Google forms. Questions were mostly open type and about the experience, for example, "What was the experience like while building it?", "Was the prototype easy to use? Was it useful and why?", "Did you feel closer to your loved one while using it? In what way?", "Would you prefer finished product or "DIY" product (like littleBits) for the purpose of staying in touch with loved one? Why?"

Participants were asked to use the prototype for a week, although I extended it for a few days more due to their inability to find enough time to build it and test it more than once. Furthermore, since the dyad of users was close friends, I assumed that this relationship has less of a need to engage in contact on a daily basis than the relationship of a romantic couple or even family members. Therefore it was almost unavoidable to have days during the testing when they did not use the prototype. Their basic communication is more spontaneous and there is no huge need or desire for it every day.

RESULTS

Results below are gathered from the two different evaluation phases. First, there are users' opinions on all the *Tangible Intimate Objects* that were created in this research, second, there are insights from the user study with two users, one from Stockholm and the other from Reykjavik.

Results from concepts evaluations questionnaire

On this second online survey only 9 participants replied, however results are still interesting.

Unfortunately, the right user group was not reached as greatly as it was hoped for. The 9 participants were equally divided when answering whether they are interested in doing DIY projects with possible answers *Yes*, *No* and *Maybe*. When asked if they are interested in DIY projects to help them stay in contact with their loved one, 55,6% answered with *Maybe* and the rest equally distributed between *Yes* and *No*.

Based on the picture and a short description of each prototype they stated their opinions about them and later chose which they would build out of the three.

U&Me: Potential users liked its simple design and the freedom to use it for different purposes. They said it is a nice idea with a clear message and that it would be fun building it. However, a few stated that they would not use it, since they could as well just send a text message.

The simplicity of the design could be compared with *Virtual Intimate Object* [10], except that in that case the object is tangible and could be called *Tangible Intimate Object*. Another difference is that the light does not fade out but it is just either turned on or off.

The Cloud: Some of the potential users said that it is a cute design, though more appropriate for the couples, because it seems too intimate and rather uncomfortable and awkward to use it, especially between young adult daughters or sons with their parents for example. Quite a few said they would not use it, because it makes no sense or it is not useful and it is distracting from the conversation itself. On the other hand, someone suggested that it could be fun for the relationship between younger children and another family member, since it is similar to a toy and can be playful to send signals.

Since this design was based on the *Hand holding device* [9], it was in fact meant in the first place for couples, however it was interesting to see that some participants reviewed it as a children's toy. Howard et al. [8] mentioned that the context of the use is also quite important since when the participants in his research had some struggles, the device was not used. Once again, it is an addition to the already existing communication and not a substitute for it, where the content of the communication is not as important as the contact and context itself. Nevertheless, this comment shows an important insight that users are really different in perceiving presence in absence and intimacy.

Call Me Maybe: Most of the potential users recognized that this design is similar to the *U & ME* concept and it was interesting that some reported this was more flexible than *U & ME*, and some thought the opposite. They said it is useful, but it needs to be handled with care without forgetting to turn it off or on. They liked that you can change the meaning with the icons.

The question here rises about how one design can stay interesting and useful as well as reusable for the same dyad. This deals with both how enthusiastic and committed the dyads are to use the product as well as the flexibility of its use.

Most participants (6 out of 9) from this survey decided that they would build the *U & Me* prototype, because of the simple design and freedom to use it. 2 out of 9 decided for *Call me maybe* and only one for the *Cloud*.

To sum up, even though the participants were not from the user group the focus was on, i.e. DIY enthusiasts, the results still showed that some might be interested in doing it. Mostly *U & Me* and *Call me maybe* were recognized as similar, however they preferred the simplicity of design and flexibility of meaning of the signals. From this survey I also got the contact of the two close friends that engaged in user study. Their design of choice was the *Cloud*, even though this design was in the eyes of most participants meant for the couples.

Results from user study

Results from the user testing showed some interesting outcomes. However, it needs to be taken into account that there was only one pair of close friends testing it and therefore, based on the results, a more general discussion is carried out.

Participants agreed right away to build the Cloud prototype, since this design best suited their routine. As they said: *"This is something we can use while we video call, so we don't need to think about it or change our routine and it doesn't force us to do something else than what we already do."* They have built it simultaneously over a video call (Figure 8 and 9) and they both liked the experience and the DIY aspect of it. They created a shared memory and were bonding by talking about it and helping each other to build it.

They decided to use it for recalling the attention from the other person, *"as 'buzz' messenger used to do years ago."* Furthermore, they would use the Cloud to exchange the sensations of physical feelings besides seeing and hearing.

After the building, when the participants have tried it for the first time, they were really excited and enthusiastic. *"It is the first day that we are using it and it is fun to feel that [she] is just touching a button and my device is buzzing, so I am eager to use it from now, without knowing when my device will buzz, aka [she] thinking of me!"*

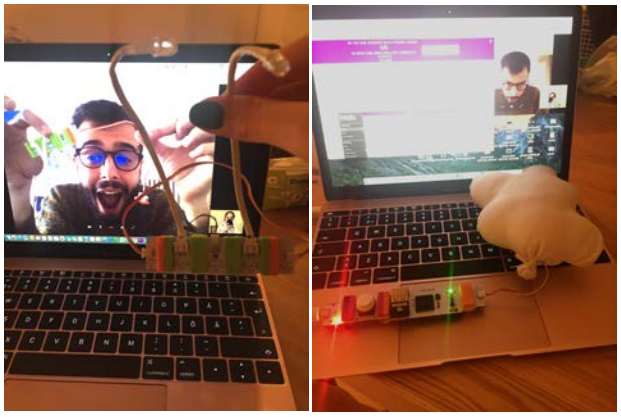

Figure 8 and 9. Users building prototype via video call.

However, due to different schedules in the next days they had problems engaging in a video call. *"I thought of using the prototype, but I didn't have it on me (I spent a lot of*

time outside of home and I went out) and I didn't know if [he] was or wasn't home." They felt a bit frustrated about the portable limitations of the device and that consequentially created the bad experience, which needs to be considered while developing such artefacts. *"It was weekend and we had plans so we couldn't Skype, even. On my side, I thought of using the gadget we created but the fact that it's not something I can carry with me makes it harder. I think that if this prototype was something that I could carry on me, a smaller thing that I could attach to my phone or my keys, for example, I would have loved to use it. I think it can be super cool that it's available 24h/day, anywhere, and I would like to experience it on its own, on the street, anytime. Now it's too big, so it's always home, and we only use it when we Skype so it's not practical at its full potential. I love the idea of it more and more every time, though."*

What is still interesting is that the device, even though not used, still reminded them of each other and in that way created the presence in absence of each other. *"It is true that the idea is so cool, and in fact, since the cloud is always visible, I think more about her (when at home, obviously)."* So here I can confirm that a shared experience of creating an artefact gives that object a deeper meaning and reminds them of that person. Therefore this could be considered as a good way of personalizing the object for presence in absence.

After a good week of testing the participants were asked to complete the post survey with open questions about the experience. They have marked it as a positive experience, however they pointed out the frustrations that occurred. They felt pressured by wanting and also being obligated to test it but simply did not find time to do it. They were rarely at home at the same time and would therefore prefer, as mentioned before, a portable device that could be used almost everywhere. Another thing was the fragile nature of the prototypes that could easily disconnect and they would have to be build again. The structure and reliability of the littleBits was not good enough and the stability of owner's wifi was also very important for them to work undisturbed.

"The best part was the first time we used the device and when we built it together and make it work for the first time. The worst part was the days after that, when we found that we wanted to keep doing the test but we just couldn't make it work."

Nevertheless, when I was asking the participants about the feelings of being closer to each other the answer was positive. They explained in what way they felt closer and it was mostly the ability to have this shared experience and enrichment of the conversation. *"[He] and I have always been very touchy in our friendship, especially when it comes to hands. We both use our hands very much to be more expressive and to emphasize emotions or parts of a speech, so being able to hold this device and feel something was very exciting. Also it was special to know that we were able to do this kind of sign to each other, among other reasons because I felt like we were doing something that others couldn't experience."*

However, the question comes up about how long would the so called "shiny new toy" remain in use and interesting to the dyads of friends, family members and couples? In this case, the priority of having a video call and to use the device was not as high as it could be in the case of a romantic couple or in a child grand/parent relationship. The participants used it because it was new, special and fun and not because they would really need this extra way of feeling connected. Naturally the feelings of presence and connectedness got greater, but it was not worth the effort to build it and deal with the disconnections (Figure 11). *"I have missed the device and I have thought of it many times while the test period was going on: I have been walking on the street and thinking "I wish I could just "buzz" [him]". But the reaction was always, I might as well just text him."*

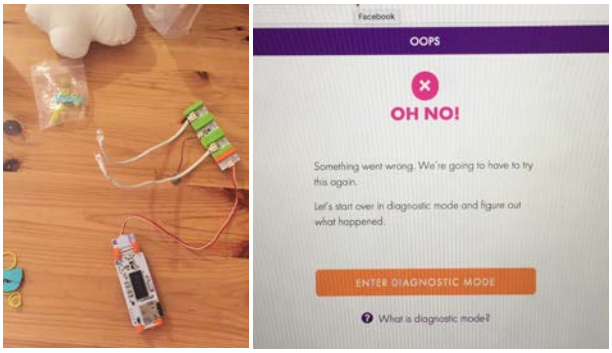

Figure 10 and 11. On the left: The structure of the littleBits can be fragile and not portable. On the right: Users encountered with the disconnection problems.

When asked about if they would prefer the already finished design than build-it-yourself one, the answer was: *"The main thing for me is that this product shouldn't ask me to do anything else than the routine I already have. Having to be home to try it out was a disaster, since [he] and I are rarely home at the same time. LittleBits is super fun, but if I want to play a game or something. If I want to make the stay in touch more special then I want something that works all the time and doesn't require us to build anything or think too much. In the end, writing "Hi, what's up" is not that hard. So I'll do that if the other alternative requires more effort."*

Given those insights, I still believe that this idea should be considered in the further research, where it would be able to test it in romantic relationship and/or with family members. Another improvement would be testing for a longer period of time, to see how it works when the excitement of the new product wears off. That was also observed and pointed out by a user in testing of *VIO* [10].

It would also be interesting to give users as many different littleBits modules as possible and challenge them to design something themselves, without pre-prepared material. Naturally they would be given a short introduction and

some pointers on how they can use different inputs and outputs. Unfortunately, time was an obstacle, participants were hard to find and there was a bit of shortage on material to execute this workshop.

Limitations and flexibility with DIY artefacts

When working with littleBits or some other similar small electronics for rapid prototyping there is always a risk that many people will not like it or enjoy it, since it demands an additional effort to build it and use it. This was mentioned earlier by one of the users that if device fails to meet the user's criteria and they are asked to put more effort in it, they will probably decide for a solution that is easier. In that case, it is easier to send a text message than to build or fix the disconnected device. However, the participants did agree that it was fun to build it, but the time it required and the connection problems created a bad side of the experience.

Therefore user groups for this kind of products can be very limited in a way that both of the users should be enthusiastic about building something themselves. It would be interesting to see how that would work in a romantic relationship, where, as I assume, there is a higher priority to find time for each other. In the same way it would be also interesting to test it in a relationship between a child and grandparents for example. As Feltham [4] mentioned in his paper, it is hard for children to stay focused and to understand the context of the phone call. Having something to do together while having a phone or video conversation, would consequently help them contextualize the call and create the shared experience. That aspect would be interesting to research even more.

Another limit of the littleBits, and similar small electronics for rapid prototyping, is also that they can be quite fragile and in bigger shapes and consequently not portable or too big to be portable without some difficulties. cloudBit, for example, also requires an electric power source and good wifi connection and with that the artefacts are bound to stay at home. Even though most of the users get in contact in the evening when they are at home, there are still many who are in contact during the whole day and do not want to be limited by space. Consequently, they would prefer if the device would be smaller and portable, like the HB Ring [16] for example. In that way they could send each other signals during the whole day and anywhere.

On the other hand, flexibility of being creative is high, as well as you have freedom to customize and personalize your device according to your needs. Consequently, the product can be viewed as reusable, since you can easily rebuild it and create something new. That could solve the problem of product still being interesting after the excitement of the "new toy" wears off as well as it would be able to change and grow with the relationship. With quite a few different inputs and outputs modules of littleBits or similar small electronics you can create your own new ideas as well as recreate many already existing artefacts.

For example, to recreate The Feather [15] you would use the fan and lay over the suitable glass jar, then put in the feather. From the distance you could activate the ventilator to make the feather fly. Similarly you could use the air freshener with the motion sensor, fill it with your perfume for example, and activate littleBits in a way that they would create motion in front of the freshener. This idea is from the Scent [ibid.].

Obviously, those are only two examples and with a bit of creativity you can recreate many others as well and personalize them by your own needs.

DISCUSSION

Long-distance relationships between different dyads, such as family members, romantic couples and close friends can be very different and it is hard to define their needs. However, we can strive to create the best possible experience by letting them participate in the process of creating the device to feel more connected with each other.

People are emotionally attached to certain objects by having a special memory about it. Therefore designers try to use those objects and upgrade them with some sort of interactions. For example, upgraded picture frames with loved one's pictures as in *We are Family* and *The Picture Frame* [11], or the wedding rings with the possibility of feeling and seeing significant other's heartbeat (the *HB ring* [16]). Objects can be also a part of everyday use, but with some deeper meaning to the users, like bed, for example, since they usually share it with partner if they would be collocated. Because of the better experience when the device is not a part of smart phone or computer application, we can talk about so called *Tangible Intimate Objects – TIO*. In this research one participant mentioned that only seeing the object they have created and not also using it, reminded him of his close friend. Therefore the tangibility and also the memories containing the object is one of the important aspects when designing for presence in absence.

I proposed the idea of DIY or "build-it-yourself" electronics to create *Tangible Intimate Objects* to enrich communication between dyads in a long-distance relationship. Building something together with your loved one should give the artefact for personal communication an additional special meaning and that shared experience would help create a greater presence in absence. Even when they would only see the device it would remind them of the person and the memory of building it together. Moreover, the artefact would also be used for encouraging the communication through the one-bit signals that would take different forms, such as light, sound, vibrations, etc. They would have the possibility to really personalize and customize it to their own needs. In addition to that, there is a possibility to rebuilt and redesign the artefact when the relationship and its needs change over time. That makes the

product reusable and it gains ability to change and grow with the relationship.

Similarly, in *MatchUs board* [2] shared experience is created by doing something together. While *MatchUs board* is a screen-device where dyads can draw and write simultaneously and is focused on creating shared memories through the activity, the idea of DIY may have only one-time shared experience like that, however if the relationship needs a new way of additional communication, there is always the possibility to rebuild the creation. The users in this research really enjoyed the experience of building the prototype and the object later reminded them of each other. Because of the new and fun shared experience, they thought of each other even when they were not at home to see the object. However, there was a bad part of the experience, when they wanted to contact each other via device when not at home, but could not due to the portable limits of the artefact.

With the littleBits there is a possibility to create new or recreate most of the already known ideas that were presented earlier. For example, the *Good Night Lamp* [6] and the *6th sense* [17] can be recreated by using button or motion trigger input and light output. In the case of the *Good Night Lamp* where you can have many different smaller house-shaped lamps that represent different people, they still feel less personal, since all have the same shape. So while those finished products are a bit hard to personalize, the littleBits turn out as really flexible here, both in which outputs and inputs you use as well as which material you use for the construction. The examples from this research that based on the design of the *Good Night Lamp* were *U & Me* and *Call me maybe* with the use of a light as a signal.

It is a bit harder to recreate *Hug over a distance* [9], *Somnia* [14] and *The Bed* [3] because of the littleBits limitations on the portability. Nevertheless, in case of the *Hug* and with different inputs and outputs of the upgraded beds, we can still create some workarounds. We could play around with the use of motion sensor as input and ventilator and/or speaker as output model to recreate parts of *the Bed* or maybe even *sleeppyWhispers* [5] talking pillow, however it would be a bit longer work-around to provide warmth, since it is not directly a littleBits output module. The *Cloud* prototype from this research is a pillow that instead of the warmth uses the vibration impulses and so provides the physical sensations. The users enjoyed this prototype since it allowed them to express themselves also in a physical way as well as it served as a "buzz" to remind them that they are still having a video call. The reciprocity of such prototypes can be quite high as in case of the *Hand holding devices* [9] and also in *Kiss communicator* [22] with sending kisses in form of patterns of lights.

The downside of this product is that it might require more effort than finished product and so the user group reduces to those who enjoy the challenges of DIY. Also, electronics, such as littleBits, can be fragile, in awkward shapes when built together and not portable. Even though many devices for presence in absence that I have mentioned in this paper are home-based, there is a higher demand for portable devices, such as smart phones. However, it is preferable that devices to support and enrich long-distance relationship are not a phone application, since it can feel quite impersonal. Even one of the users in this test stated that: *"It seems like some sort of app should be the best alternative but at the same time I loved that it was not part of my phone."*

Below, I am proposing a new way of thinking for further research of presence in absence and how to personalize it. I suggest that devices should be tangible (*TIO*) and that DIY aspect with electronics such as littleBits can be an interesting and useful solution:

1. DIY is a good way to let users personalize the devices.
2. DIY devices create a new shared experience that supports presence in absence.
3. "Build-it-yourself electronics" allow users to rebuild the device and adjust it to the new needs of the relationship that grows over time.

First suggestion follows the idea of having a personal artefact that in this case is something you create yourself and it holds this additional value, as well as having the ability to make own decisions about what inputs and outputs to use that would suit the best for the relationship. Second one talks about creating a shared memories and experiences while creating something that later reminds you of that moment and of the person you created it with. Third suggestion is the result of the flexibility in rebuilding and redesigning the artefacts when the relationship is faced with new needs. It enables that device changes and develops with the relationship and is in that way reusable. That feature supports Vetere et al.'s [19] conditions for intimacy, more specifically, commitment in a way that relationship is ongoing, indefinite and constant work in progress.

With the flexibility to customize the device the pair of users can choose the acts of intimacy [ibid.] to meet the reciprocity, physicality, expressiveness and the level of expressing emotions.

It was already proved before [6, 9, 10, 15, 16, 18, 19, 22] that simple one-bit and/or wordless communication is enough to create stronger feelings towards physically distanced loved ones. Devices should not substitute the already existing communication, but enrich it and make it more special.

CONCLUSION

In this paper I have been stating the questions about how to create the presence in absence for users in some sort of a long-distance relationships and how to personalize the artefacts created for that purpose. The idea was to create a "build-it-yourself" design, with littleBits or similar

electronics for rapid prototyping, to let creative users design their own inventions for their own needs. Since relationships change over time, this solution could be marked as sustainable because users are able to rebuild and redesign the device based on their new needs.

The user testing showed that creating a shared experience over a distance and being able to connect via another device than phone or computer is an important aspect of creating presence in absence. Creating a device for personal communications between two people, even if not used regularly, can increase the connectedness between the two people, since the artefact reminds each other of the other person and the shared experience.

Even though the user testing was executed with only one dyad consisting of close friends, some valuable insights were retrieved and I believe that this aspect of presence in absence and personalization of the artefacts should be considered in further researches.

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