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# HiveToHive: Creating Connectedness Over a Distance

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**Abstract.** With social distancing becoming the norm in society as a result of the COVID-19 pandemic, the need for connectedness is more important than ever. While current communication technologies such as the smartphone and email connect us with others, they don't necessarily create a feeling of connectedness. To explore alternative ways to promote such feelings, we developed 'HiveToHive', a wall-mountable interactive device intended to increase connectedness to distant loved ones using short text messages. HiveToHive consists of individual, connectable, hexagon-shaped touchscreen devices called Hives. Each Hive represents a one-to-one connection between the user and a loved one. During the user evaluation, we found that HiveToHive increased participants' feelings of connectedness with others.

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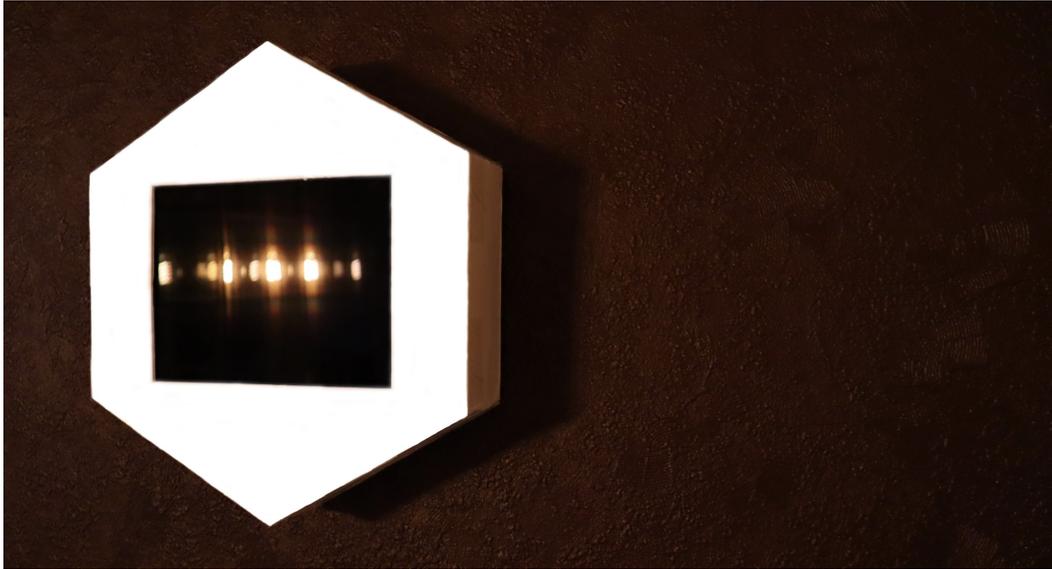


Figure 1. *Prototype of HiveToHive.*

## Introduction

Separation between loved ones has become a progressively common phenomenon in recent years, as a result of divorce, displacement by crisis (Shen et al., 2019), or long-distance relationships (Hassenzahl et al., 2012; Singhal et al., 2017). Consequently, this has produced an interest in telecommunications to cultivate connectedness (Shen et al., 2019; Moss and Schwebel, 1993; Kelmer et al., 2013; Canary and Dainton, 2003; Tollmar et al., 2000; Neustaedter and Greenberg, 2012; Timmerman, 1991) by using technology to maintain relationships with loved ones. The most current technologies' primary aim is not intended to facilitate emotional communication, but rather explicit information excluding qualities such as closeness, intimacy, and love, all of which are important to psychological well-being (Hassenzahl et al., 2012). In this paper, we introduce 'HiveToHive', a wall-mountable interactive device intended to increase connectedness to distant loved ones using short text messages. We also describe the conceptual and technical components of 'HiveToHive'.

## Background

### The Importance of a Short Personal Message in Feeling Connected

One way of socially connecting with others is through text messages. Rettie (2016) introduces a form of text messages called one-liners, short messages without salutations, e.g. 'Have a good day'. They are a way to stay connected even though the sender and receiver are apart and express feelings regardless of age. Using one-liners, you can let someone know that you are thinking about them without

interrupting them. Additionally, one-liners can create a feeling of connectedness between sender and receiver, which can have a positive effect on their connection. Rettie's research supports the emotional importance of text messages in romantic relationships, among close friends, within families, between parents and children, and between siblings (Rettie, 2016). Based on Hassenzahl's earlier mentioned claim, this could mean that one-liners improves a person's life satisfaction and well-being. Köbler et al. (2010) performed an explorative study on people's usage of status messages on Facebook. The study suggested that users who shared personal information using status messages felt a deeper sense of connectedness. The more they shared, the more connected they felt. Furthermore, they found that even messages between users containing no significant information, only mundane and routine subjects, increased their feeling of social connectedness.

Inspired by previous works (Hassenzahl et al., 2012; Rettie, 2016; Köbler et al., 2010; Shen et al., 2019), our motivation for this study is to acquire a deeper understanding of how interactive devices can be used to increase connectedness remotely using one-liners. Because of the current COVID-19 pandemic, this research topic particularly resonates with many people, and we would like to further explore the use of interactive technologies over a distance (Neustaedter and Greenberg, 2012; Mueller et al., 2005; Chien et al., 2016). The question that guided our design is: *How can we develop an interactive device which utilizes one-liners to create a feeling of connectedness with loved ones who are physically distant?*

## Ways to Create a Personalized Signal: Colored Messages, Touches and Meaningful Images

There have been interactive devices which allow users to send personalized signals to connect people who are separated by distance (e.g., (Shen et al., 2019; Saadatian et al., 2014; Stawarz et al., 2012; Park et al., 2010)). For example, Mole Messenger (Shen et al., 2019) is a pair of connected creatures which help children to share and send messages to their loved ones. Mole Messenger is a box containing a mechanical mole. The mole can be tapped to deliver differently colored messages to represent the mood of the user. This device highlights that although phone calls and text messages can overcome family isolation in adults, they are not necessarily as effective for children (Shen et al., 2019). Another novel way of keeping in contact with friends or family who are apart is Friendship Lamps<sup>1</sup>. Touching a lamp changes its color, and paired lamps light up in the same color. Users can select between ten different colors and connect an indefinite number of lamps. Sending a message in the form of colored lights is a simple way to show your loved ones that you are thinking of them. Another example of connecting people over a distance is Lovebox<sup>2</sup>. Loved ones can use their mobile phone to send short messages or images to the Lovebox, on which an external heart spins until the lid

<sup>1</sup> Friendship Lamps: Long Distance Friendship Lamps, <https://www.friendlamps.com>

<sup>2</sup> Lovebox: A modern take on the classic love note, <https://en.lovebox.love>

is removed. The sent message is then displayed to the box owner. To reciprocate, the owner can spin the heart with their hand after reading the message, sending a cascade of digital hearts in return. The box itself has a simple and aesthetically pleasing design which blends into the surroundings of most homes. Our HiveToHive (more details in the next section) takes inspiration from the three products above; however, HiveToHive features key differences: (1) the messages written in HiveToHive are all hand-drawn, making each correspondence feel more personal such as the feeling of reading something personalized like handwritten letters, (2) interaction with HiveToHive is done with hand gestures, making it feel fresh and different, and (3) HiveToHive is an ambient device; the messages are not a disturbance, but rather something noticed when the user has time to read and respond to the message. When receiving a message using a typical communication device such as a phone, smartwatch, or PC, one's feelings are oftentimes associated with uncomfortable or stressful responsibilities. The screen size of HiveToHive allows only one-liners to be transmitted. In this way, HiveToHive intends to change the experience of receiving messages to a positive one, and (4) HiveToHive is not only a means of communication, but also designed to be an aesthetically complementary fixture in your home.

HiveToHive provides an alternative form of communication with your loved ones. Under COVID-19's severe constraints on physical contact, we believe that a tool like HiveToHive would support individuals' connections with each other.

## The Design of HiveToHive

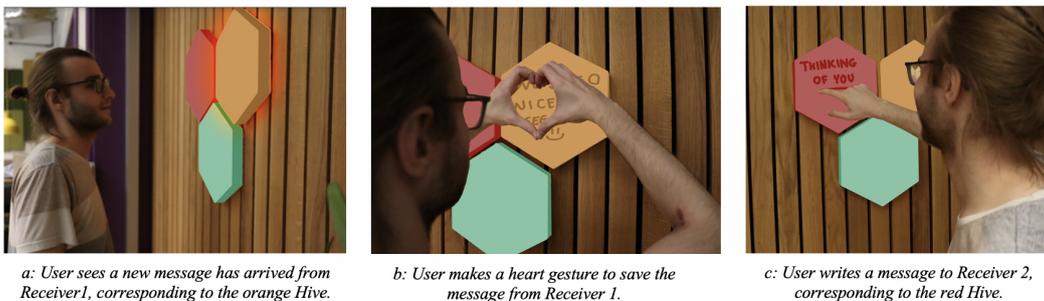


Figure 2. User looking at a HiveToHive comprised of three Hives, each corresponding to a specific individual.

HiveToHive aims to establish a special line of communication between users and their loved ones in an effort to create a sense of connectedness. The concept is built around hexagon-shaped cells, or Hives (Fig. 2), which can be used to communicate with drawings or written one-liner text messages. Each Hive represents a single loved one, creating a one-to-one relationship between participants and Hives. The Hives are mounted adjacent to each other on a wall, forming a network of one-to-one communication with loved ones. The Hives can be taken off the wall and moved around, allowing the user to draw or write on them, as they see fit. Multiple

ideations through sketching and brainstorming led to the hexagonal shape, as it stood out from the typical round and square electronic shapes. More importantly, this allowed for a fun and practical way to grab each Hive and connect multiple Hives together. The materials and dimensions were chosen to make it light enough to hang on a wall, and handy to hold when writing or drawing messages. When a message is received, the recipient Hive shines with colored lights to make the user aware of the message's arrival (Fig. 2a). The user color-codes each Hive to assist them in remembering to whom they correspond. We chose to add lights rather than sound or some other forms of feedback in order to make the Hives less disturbing, like many other communication devices can be.

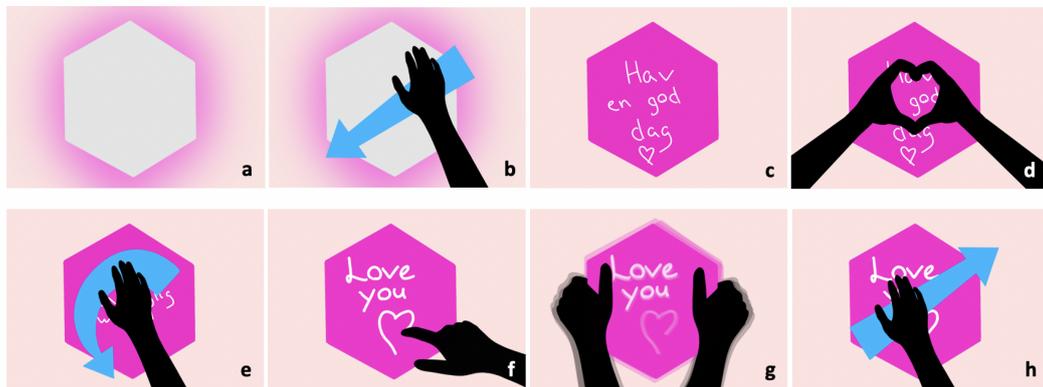


Figure 3. *HiveToHive's Eight Interaction Modes.*

Light shines from behind every side of the Hive, illuminating the wall behind it (Fig. 3a). The user makes a right-to-left swipe over the surface of the Hive (Fig. 3b) to open incoming messages (Fig. 3c). The user can save a message within a given timeframe by making a hand gesture of a heart over a Hive (Fig. 3d). If the user wants to view their saved messages, they can make a hand gesture similar to that of turning a dial (Fig. 3e), thereby allowing them to scroll through their saved messages as they please. To return to the Hive's default state, the user makes another right-to-left swipe. To send a message, the user taps the screen of the Hive corresponding to the loved one whom they want to message. The tap activates a drawing state in which a short message or figure can be written or drawn (Fig. 3f). If the user is not satisfied with the message, the Hive can be shaken, erasing the last drawn line (Fig. 3g). When the user is satisfied with a message, they can send it with a left-to-right swipe (Fig. 3h). To demonstrate the interactivity of HiveToHive, we attached our concept video<sup>3</sup>.

### Technical Implementation of HiveToHive

The prototype was made by creating the hexagonal shape out of foamcore and polyurethane foam. As the prototype was modelled to be used in the user

<sup>3</sup> Please follow this link: <https://youtu.be/fX7CSLx8XRM>

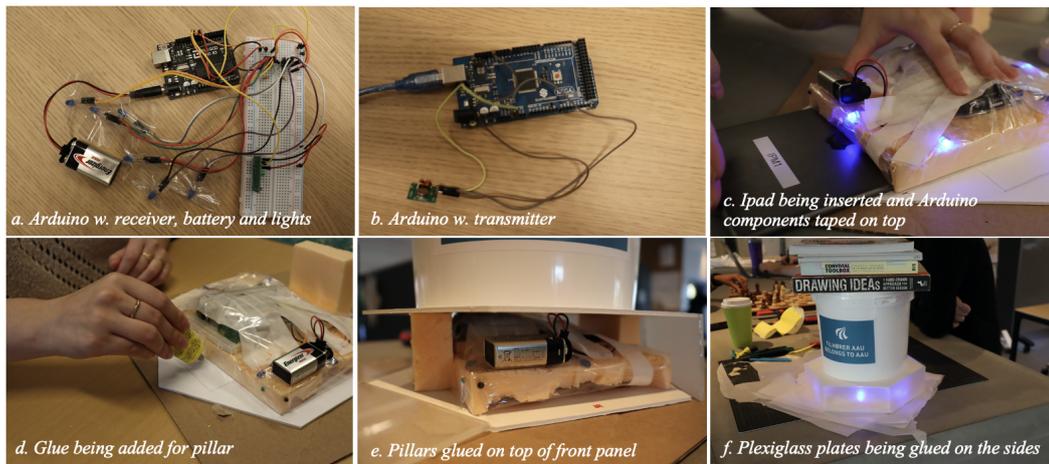


Figure 4. *Creation of the Prototype.*

evaluations, we used the wizard-of-oz approach to simulate the various interactions through interior lights and a screen. Inside the prototype were lights, controlled with two Arduinos. The first Arduino in the prototype had a receiver, a battery and was connected to the lights, as illustrated in Fig. 4a. The second had a transmitter, which could control the lights inside the prototype (Fig. 4b). The two Arduinos were programmed to turn the lights on and off through a radio-signal. In order to simulate a drawing experience in our user evaluation, a touchscreen in the form of an iPad Mini was added, and controlled using TeamViewer.

## Evaluation

To get an understanding of whether HiveToHive could create a feeling of connectedness, we conducted a user experience test of our prototype. The test focused on how users understand our design concept and interact with HiveToHive. Furthermore, as previous study (Rettie, 2016) has shown, one-liners can create a feeling of connectedness, we would like to see if this applies for our prototype in the context of connecting to distant loved ones. The evaluations were conducted in a Usability lab, as seen in Fig. 5, where each evaluation could be monitored from a control room, thus we were able to use the Wizard of Oz method, by controlling the prototype from the control room, without any disturbance to participants. Our evaluation included six participants completing 11 activities, allowing each to experience the features of the product. The choice of participants were restricted because of COVID-19, and as such we did not find an adequately diverse group for our evaluations. Five of the participants were aged 19-25 and one was 57, among these were four women and two men. Two of them were unemployed, two were university students, one worked in an electronic store and one was a nurse. During user testing, the participants were asked to complete the following activities: (1) activate the screen by tapping it with your finger, (2)

use your finger to write 'Hello' on the screen to a person you care about, (3) send the message by using a left-to-right swipe hand movement, (4) put the Hive back on the wall, (5) open a received message by swiping your hand right-to-left, (6) save the message by forming a heart with your hands, (7) see your saved messages by making a screw hand gesture, as you would when turning a dial, (8) go back by using a right-to-left swipe gesture, (9) activate the screen by tapping it with your finger, (10) draw a house, and, (11) delete the drawing by shaking the screen.



Figure 5. Evaluation: *a. Illustrations of interactions, and low-fi prototypes hanging on the wall, b. A user experience test in progress.*

Following the activities, a semi-structured interview was conducted containing questions about the system, its influence on connectedness, the different interactions, and its aesthetics.

### Interacting with HiveToHive

All six participants (P1-P6) mentioned that they enjoyed interacting with the product through hand gestures and thought it was easy. One participant (P4) added "*I don't think it could really be done any more intuitively,*" and another (P1) said, "*It is idiot-proof.*" The participants generally found the interactions simple and easy to remember, however some participants (P1, P4, P5 & P6) mentioned experiencing slight confusion when to swipe left or right. Some participants (P4 & P6) suggested adding animation to remedy this confusion. When asked whether they would like auditory feedback to assist them, a few (P2 & P6) expressed an interest, while another (P4) deliberated, "*I would prefer it if it was mute but with animation. You have all sorts of other devices in your home that make sounds already,*" indicating that it might be useful if the product had sound features, but also an option to disable sounds completely. Participants were divided on the hand gesture for saving messages. Some (P1 & P2) felt it was a cute function, and could relate it to other social media features. Others (P3, P4 & P6) found it a bit awkward.

## Personalization

The majority of participants (P1, P2, P3, P5 & P6) specifically mentioned that they would prefer if each Hive had their own colored light, as they felt it adds a personal touch, having a color correspond to a certain loved one. Some (P1, P3, P5 & P6) mentioned that it would be difficult to tell connections apart if they had many Hives mounted on their wall. One participant (P5) suggested adding a signature to each message to identify the sender, thus allowing the Hives to have the same color, "[...] *different colors is really good. Otherwise, you would need names [on the messages]*". Two participants (P2 & P5) mentioned that they especially enjoyed drawing instead of using a keyboard to formulate messages, as it made it more personal, one (P5) stating "[...] *it's your personal handwriting, and not just a keyboard. I think that is a lot more personal.*"

## Physicality

In terms of HiveToHive's physical dimensions, the participants (P1-P6) expressed an affinity for the hexagonal shapes, mentioning that they seemed both different and contemporary, and that the Hives' size and shape fit well into their hands. The participants (P1-P6) agreed on placing the product in a place where they spend much of their time. Most (P1-P5) suggested that they would place it in their living room and some (P1, P3 & P4) mentioned that they would use the product as a decorative element, "*It is 'hyggeligt' that it is on display*" (P1). All participants (P1-P6) liked being able to pick a Hive off the wall and move around with it. Participants (P4 & P5) mentioned that a Hive was difficult to draw on when mounted, and impossible to delete a message from the mounted position, as one must physically shake a Hive to do so. A participant (P4) mentioned "*I think you kind of have to be able to do it [take a Hive off the wall], because you cannot really have it on the wall and still draw and write [...]*" (P4).

## Connectedness

All six participants (P1-P6) mentioned that they thought HiveToHive would positively influence their feeling of connectedness, if it were in their home. One participant (P4) mentioned in relation to the at-risk population, "*This would be a great tool for people that do not regularly go out [...]*", and another (P3) added, "*I have family in other countries with whom I do not communicate with very often, but with [Hive] you could create a better connection to them*". A different test method would be required to determine whether this is actually the case, for example, a field test that would allow a selection of users to bring a couple of further-developed Hives home to use over a period of time.

## Future Work and Conclusion

HiveToHive creates a sense of connectedness by utilizing the concept of one-liners among people of all ages. In this way, we tried to complement previous interactive devices. We were able to evaluate our prototype with members of our target group, resulting in substantial feedback, proving our concept's function. The findings of the user evaluations evoked reflections upon appropriate technologies and dimensions of the device. We hope that HiveToHive can contribute to the groundwork of intimate connectedness over a distance among loved ones. A further iteration would be to create a fully working prototype in order to conduct a field test, which would have allowed us to prove empirically that HiveToHive can be used to maintain social connectedness, and provide more data for possible improvements and broader insights.

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