

# SyncDecor: Communication Appliances for Virtual Cohabitation

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## ABSTRACT

Despite the fact that various means of communication such as mobile phones, instant messenger and e-mail are now widespread; many romantic couples separated by long distances worry about the health of their relationships. Likewise, these couples have a greater desire to feel a sense of connection and synchronicity with their partners than traditional inter-family bonds. In many prior research projects, unique devices were developed that required a level of interpretation which did not directly affect one's daily routine - and therefore were more casual in nature. However, this paper concentrates on the use of common, day-to-day items and modifying them to communicate everyday actions while maintaining a sustained and natural usage pattern for strongly paired romantic couples. For this purpose, we propose the "SyncDecor" system, which pairs traditional appliances and allow them to remotely synchronize and provide awareness or cognizance about their partners - thereby creating a virtual "living together" feeling. We present evidence, from a 3-month long field study, where traditional appliances provided a significantly more natural, varied and sustained usage patterns which ultimately enhanced communications between the couples.

## Categories and Subject Descriptors

H.5.2 [Information Interfaces and Presentation]: User Interfaces - *input devices and strategies, user-centered design, prototyping.*

## General Terms

Design, Human Factors

## Keywords

Awareness, Communication, Synchronization

## 1. INTRODUCTION

Although various means of inexpensive communication such as mobile phones, video phones, instant messenger (chat) systems, and e-mail are available, many romantically involved couples,

separated by long distances, don't feel they adequately "keep in touch".

In sociology there is a principle called "Bossard's Law" - we tend to marry (or date) someone who lives or works 20 miles from where we live or work. This means that a long-distance romantic relationship is hard by its very nature. In this paper, we define "long-distance" as the minimum separation distance required to cause difficulties within a romantic relationship which would not occur if both couples could meet on a regular, frequent and as needed basis.

In the study area of remote communication, this matter is widely recognized. There have been a number of papers discussing the enhancement of awareness between persons separated by great distances. However, these systems reported differences in expectation and therefore emotional gain depended on the family member involved. For example, Peek-A-Drawer [1] focused on supporting communication between a grandparent and grandchild. It described that the frequency of usage and the acceptance of the system where the grandparent actively used the system but the grandchild did not. However, to the question "Did you feel closer to the other person because of the system?" would elicit two different responses depending on the person. For example, from the parents of a married son, they would reply positively. Conversely, the daughter-in-law, asked the same question, had a distinctively different negative response.

Compared to family members living apart, we believe that romantically involved couples, separated by long distances, have a very similar strong motivation to communicate and bond. Our paper talks about the unique situation where romantically involved couples want more interactive, impactful yet natural mechanism which enables a more connected communication environment and hence warmer relationship.

Continuing from our previous research [2], we investigate the system more thoroughly including after the participants "graduated" from the fun/novel stage. Additionally, two additional devices are introduced and their detailed usage results as well as various unexpected/serendipitous uses beyond its traditional/normal application were reported. Finally, this field test also collected numerous detailed system logs as well as participant journals which were analyzed for the findings during a longer three month period.

## 2. SyncDecor

The basic concept of the SyncDecor system involves the synchronization of pairs of daily appliances such as lights, trash

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boxes, and TVs - that are located at a distance from each other to create a virtual "togetherness" experience. For example, when a person turns on his/her light, the light of his/her partner also gets turned on at the same brightness or when a person throws away garbage, the lid on his/her partner's trashcan would also move. If this couple were living together, these actions would happen naturally on a daily basis. Therefore, to simulate this experience, this system eliminates the need to engage in special actions such as sending an e-mail and therefore leads to a natural and sustained use. However, since this system is linked to one's daily routine, at times, it may be perceived as intrusive. Furthermore, it may lead to instances where one may curtail the use of a particular device, such as the lamp or TV, based on concern for the other partner. Nevertheless, even with these hurdles, couples who yearn for a richer, more connected and stronger relationship will overcome these hurdles to enjoy better communication by augmenting traditional means such as cell phones and e-mail. In effect, just like a relationship where the couples live together, this system creates an environment where the relationship grows stronger through the concern for one another.

We developed four prototype systems based on what most people interacted on a daily basis: SyncLamp, SyncTrash, SyncAroma and SyncTV.

### 2.1 SyncLamp

A light source, such as a lamp, is an appliance that is an essential part of our daily life and reflects our activities. Light can also reflect our "presence", "state" and even feelings. Using SyncLamp, when a person controls the brightness of his/her lamp, his/her partner's lamp also changes to the same brightness.

### 2.2 SyncTrash

The disposal of trash can also reflect not only the "presence" of an individual, but our "activity" in the form of starting/finishing actions (e.g., eating). SyncTrash is a system for sharing the states (i.e. open and close) of the lids of trash boxes. When a person opens the lid of his/her trash box, the lid of the other distant trash box opens.

### 2.3 SyncAroma

SyncAroma is a system for synchronizing smells between couples and to transmit his/her partner's "feeling" and "state" through an alternative, non-visual medium.

### 2.4 SyncTV

SyncTV is a system for sharing a common TV channel where a person selects a channel to watch, the TV channel of the other person will also change to the same channel. From there, they will have common topics that may initiate other means of communication such as e-mailing or telephoning.

## 3. System Architecture

The system architecture of the SyncDecor is described in Figure 1. In this example, House A and House B each have a PC with a SyncDecor system attached. Each PC includes middleware software running on Ruby which controls the X10, Phidgets and IR servers. These two remote PC's are connected over the internet via a central web based server which handles connection management, filtering and logging.

With the SyncLamp and SyncAroma device, an X10 controller is used. The SyncTrash system consists of a pair of trash boxes with servo motors and foot switches. The servo motor is equipped on the side of a trash box for opening/closing the lid and is connected

to a computer with a Phidgets Servo device. The foot switch connects to the computer via a Phidgets Interface Kit. The SyncTV system utilizes a USB based PC IR transceiver. The X10, Phidgets and IR transceiver all have accompanying server components.

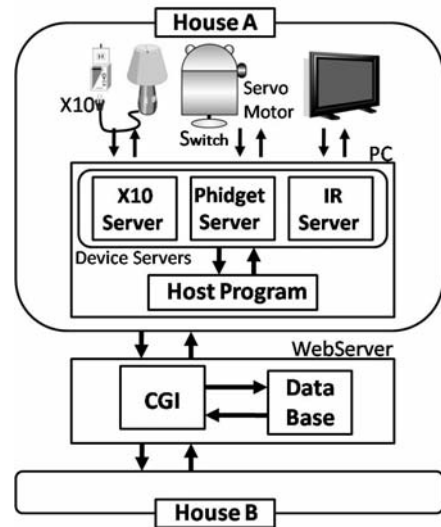


Figure 1. Overview of the SyncDecor architecture.

## 4. Field Test

In the previous paper, we carried out a field test with the SyncLamp and SyncTrash devices over a period of seven months. The participants were a male (29-year-old office worker) and a female (24-year-old graduate student) living in different cities. The distance between the cities was about 600 km. They had been living apart for three years. We installed a pair of SyncLamp and SyncTrash devices in their rooms (see Figure 2).

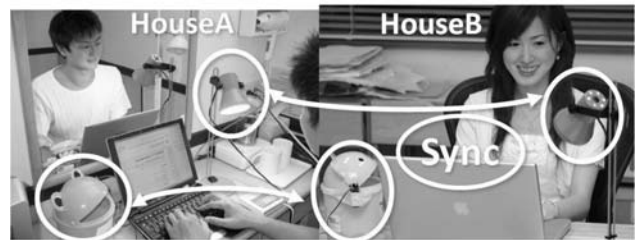


Figure 2. Field test image.

Based on the feedback from the initial field test, we then carried out this field test over a period of three months with the two additional couples (for a total of three couples – six participants).

In this section, first we describe the aim of the field test and approach of the SyncDecor system. Afterwards, we describe the results and discussion.

### 4.1 The aim of field test

The aim is to reveal the following.

Did the current SyncDecor devices support enhanced communication?

Did the effects and feeling of SyncDecor depend on the type of SyncDecor device?

What other kinds of SyncDecor device is better suited for supporting enhanced communication?

## 4.2 How the field tests were conducted

We first surveyed the participants using a questionnaire before installing the SyncDecor devices. Basic information such as age, occupation, daily schedule and type of relationship were collected. In addition, we also asked about their daily communication habits.

Next, we installed the SyncDecor devices in their rooms and asked the participants to keep a daily journal to provide feedback on the SyncDecor devices. Separately, we recorded detailed system logs of the field test. In this test, we used the SyncLamp, SyncTrash and SyncAroma devices.

The first relationship was the same from the initial field test. They had almost the same living cycle and habit. The main means of communication were via mobile phone (once or twice per day) and e-mail (once or twice per day).

The second relationship was a male (24-year-old graduate student) and a female (24-year-old graduate student) living in different cities about 1800 km apart. They had been living apart for three years. They had roughly the same living cycle and habit. The main means of communication were via mobile phone (once per day) and e-mail (several times per day). Overall, they kept in frequent contact with each other using these methods.

The third relationship was a male (25-year-old office worker) and a female (24-year-old graduate student) living in different cities about 570 km apart. They had been living apart for two years. They had different living cycle and habit. The main means of communication were via e-mail (once or twice per day). They were not in frequent contact with each other.

## 4.3 Observation

The results of field test revealed the following.

All participants actively used the SyncTrash device for casual communication. For example, they would open and close the trash box repeatedly to attract their partner's attention. Using the SyncDecor system, the couples felt a certain "warmth" which then often triggered the participants to initiate other means of communication such as e-mailing or telephoning. Often times, they used SyncDecor as a "Good Morning" greeting and woke their partner up by opening and closing the trash box repeatedly. Some sample journal entries included comments such as: "*When I called him, he was sleeping. So I opened and closed the trash box to try and wake him up, but he didn't wake up. At this point, I felt a little angry.*" "*I opened and closed the trash box and tried to wake her up. When she woke up, I was happy to get her attention.*" "*I woke up because he opened and closed the trash box. Honestly, I was a little perturbed.*" During the initial experimental period, the participants regarded the SyncDecor system as novelty devices for explicit communication. However, after the early stages of field tests, they regarded them as a daily appliance with implicit communication capability.

Since the SyncDecor system used familiar, everyday objects, the participant's family also took part in communications. In one journal entry, "*He got home early and turned on the lamp. I was not at home but my family noticed that the light was turned on and sent me a message stating his early arrival.*" In this case, he (the

partner) didn't send a message to her about his early arrival. However, the family sending her a message about his early arrival added a different level of closeness to the relationship. While this was a rare use case, the subject's family became part of the relationship – which, in the past, was typically the case before the advent of modern communications technology.

Each member of the couple could feel the daily activities (i.e. disposing of the trash, turning off a lamp, going to sleep) of the other. Moreover, we had many instances where couples guessed their partner's state by the movements of the SyncDecor system as in this quote: "*I felt a bit of hesitation about using the trash box because I came home late. However, after I used it, I didn't receive feedback from her and assumed she must be sleeping*". The effects of SyncDecor system also depended on the participant's lifestyle. In this sampling, the male participant usually lived alone in a small apartment; the female lived with her family in a large home. As a result, the male participants were more sensitive to the movements or activities of a SyncDecor device. In the case where SyncTrash was installed in the female's room shared with her sister, her partner was more concerned about her sister than her. As a result, the male participant avoided unnecessary opening and closing of the trash box. In the example where a male participant's parent stayed at his home from an extended period of time (one month), the female participant, who normally used the SyncDecor system quite frequently, noted her curtailed use of the system in deference to the parent's visit.

Usage of the SyncDecor system also depends on the participants' living schedules. For example, a couple having different schedules didn't get many chances to show each other's "live" activities such as seeing their lamps and trash box change state. As a result, they developed an alternate use for the SyncDecor system. For example, the male participant turned the lamp on when he left for work. When the female's participant woke up and saw the lamp, this extra action or "thought" itself made the female participant happy. Afterwards, when she left home and turned the lamp off, he also felt certain "warmth" when returning knowing she instinctively took that "extra" step for each other.

The mood and demeanor of the person affect how the SyncDecor system is used. For example, during the field test, all three couples experienced some level of quarrel. All three male participants tried to mend the relationship by using the SyncDecor system. Eventually, it was determined that the SyncDecor system was effective in minor tussles, but wasn't effective (even counterproductive) during serious fights. This was noted in the following journal entry: "*I was still in bad a mood, but when he tried to improve the situation using the SyncDecor system, it went from bad to worse.*"

Finally, the frequency of use depended on each devices. The SyncTrash was used most frequently for explicit communication because the lid of trash boxes changes more dynamically and is transient in nature. On the other hand, participants didn't use the SyncAroma device as frequently because they didn't have the habit of using an aroma pot or the habit of initiating smell.



Figure 3. SyncLamp, SyncTrash and SyncAroma installed in a participants' room.

#### 4.4 Discussion

First, we answer, did the SyncDecor system have any effect on the romantically involved participants by enhancing communications? Based on post research survey of the participants measuring traditional communications (i.e. number of phone calls and e-mails) before and after the SyncDecor system was installed, four participants said there was no significant change. Two participants specifically mentioned that their initial communications increased mainly to confirm the proper functionality of the SyncDecor device. However, based on the questionnaire regarding whether or not they thought more about the other person, five participants said that their feelings for the other had increased. Within this group of five, several mentioned that they became more cognizant of the others and started wondering what the other was doing - including even hesitating to use certain SyncDecor devices so as not to bother the other person. The remaining one participant mentioned that they thought less of the other. However, this was actually the result of the SyncDecor system providing feedback letting the person know when the other was at home or not - leading to reassurances about the persons wellbeing and hence less worry and therefore further thought.

Based on the results, we feel that the communications between distant couples were enhanced through the user of the SyncDecor system.

Next, we will discuss the difference in how the various SyncDecor devices were used and felt. In figure 4, we show results from the log data obtained from the server during a 3-month span. The three lines in the graph describe the total SyncTrash, SyncLamp and SyncAroma usage/request from the six participants.

Compared to the other device, we found that the SyncTrash device was used the most. We believe that this is because the device was actually used on a daily basis for disposing of garbage. In the diaries of the participants, it was even noted that the SyncTrash device was used explicitly for initiating other forms of communication. However, after the initial novelty of the device wore off, the usage leveled off to a more natural day-to-day usage pattern. This was within our expectation, proving how a natural device allows for natural usage and doesn't let it be forgotten or fade completely from usage once the novelty wears off.

Based on the survey, four of the participants felt that the SyncTrash device was the most useful. The other two devices (SyncLamp and SyncAroma) usage was lower than the SyncTrash device. In this experiment, the SyncLamp device was desk lamp provided to the participants. We later found that certain participants were not in the habit or too busy to use a desk and therefore a desk lamp. Based on this observation, it clearly shows

that something which is not a day-to-day object for the participants leads to lower overall usage rates. If however, the light source was something more day-to-day (i.e. room light), the results were most likely different. Nevertheless, two other participants felt that the SyncLamp device was the most useful communication tool. The reason behind this was explained as the SyncLamp device not being transient in nature (i.e. either stays on or off) compared with the SyncTrash device.

The SyncAroma device, four participants mentioned in their survey that they used the device based on its novelty, but that their interest quickly waned due it not being a normal day-to-day action.

Based on this observation, it can be concluded that the participants had a higher usage rate of a device if it was a normal day-to-day object which did not require proactive effort above-and-beyond natural usage patterns.

Finally, based on the participants survey, we would like to discuss what other devices would be better suited for this type of remote communication. Based on the participant's responses, ideas included a warmth synchronized bed, synchronized open/closing curtains and synchronized audio/TV. The last idea, synchronized audio/TV was most popular with three nominations. The explanation behind this included wanting to "fight" over TV channels and/or have a common discussion topic to alleviate loneliness. Furthermore, since the SyncDecor system recorded all synchronization transactions, several participants who had different living schedules wanted the ability to view past activity logs. Therefore, when both parties were on different schedules, there was an increased desire for seeing what actions had taken place. With the SyncDecor system, the participants had an expectation of togetherness. Therefore, perhaps making the log data available can help alleviate that.

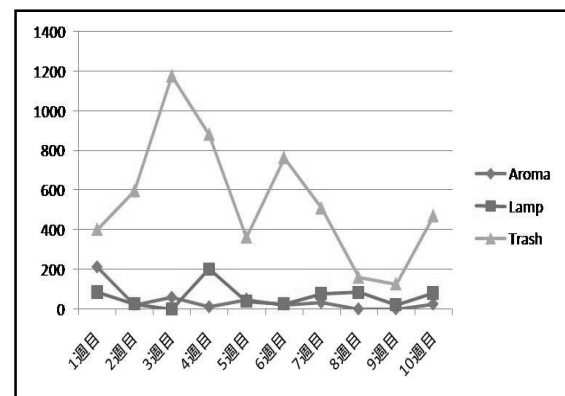


Figure 4. Usage graph of the various devices over a 10-week period.

#### 5. References and Citations

Many research projects have explored the issue of remote awareness. Digital Family Portrait [3] is one of several electronic picture frames that can display the daily activities of family members who live far from their families. For example, it could be used to display the daily activities of an elderly person who lives far from his family. Feather, Scent, and Shaker [4] are elegant design based systems that enable long-distance couples to communicate. MeetingPot [1] is a device that can inform people

of a coffee break, in a common office area, by using the aroma of coffee. Physical awareness proxies [5] convey a remote user's (mainly co-workers or laboratory members) availability, using a tangible interface. Tangible Bits [6] enables users to be aware of background bits at the periphery of human perception using ambient display media such as light, sound, airflow, and water movement in an augmented space. Building Flexible Displays for Awareness and Interaction [7] described a set of flexible ambient devices that can be connected to any available information source and that provide a simple means for people to move from awareness into interaction. In these examples, the devices were designed for asymmetric, one-way communication, which separate the user sensing portion from the information presenting function, thus having no immediate or natural relationship between the user's action and the corresponding remote display. These devices are more passive in nature and only enhance awareness of weaker feeling and ties. We propose devices for symmetric, bi-directional (two-way) communication that combine both the sensing of user action or situation with a correspondingly similar information presentation. In doing so, we support and motivate communications between romantically involved couples, separated by long distances.

LumiTouch [8] is a pair of photo frames, and ComSlipper [9] is a pair of slippers to indicate the activities of a partner who lives far away. ComTouch [10] converts a pressing force to the vibration of the corresponding ComTouch device. Lover's Cup [11] is a communication tool for drinking-together interaction between long-distance couples. The bed [12] is a bed environment that creates the virtual existence of a person (who lives far away) in a bed. inTouch [13] is a pair of communication devices with cylindrical rollers that rotate synchronously. These investigations were optimized more towards communication mechanisms that are more "passive" or casual in nature. Our paper talks about situations where romantically involved couples want more interactive, impactful yet natural mechanisms which enable a more connected/realistic communication environment and hence warmer relationship. Moreover, SyncDecor tries to reflect a person's actions directly onto the remote devices. Our design is based on the synchronization of familiar, everyday objects, without modifying their original function. SyncDecor system can create a virtual "togetherness" experience.

## 6. Conclusion

We have described the SyncDecor system, which pair remotely installed appliances and electronics so they may synchronize with each other. The objective of this is to create a virtual "togetherness" that enables the couple to share their daily activities with ease through subtle awareness of each other's actions. We built four prototype systems - SyncLamp, SyncTrash, SyncAroma and SyncTV and had three, long distance, romantically involved couples using these devices in a normal, day-to-day setting collecting numerous logs and usage diaries. Based on this usage, we determined the unique ways "feelings" were conveyed through the SyncDecor system as well as the different ways the various devices were utilized within them.

Finally, since we presented a system that leveraged familiar commonplace items, it did not require any extra training or

interpretation to use. This allowed for participation beyond the principal romantic parties involved and created instances of spontaneous interaction (and provided additional findings) from other individuals (i.e. family members).

## 7. ACKNOWLEDGMENTS

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