InPhase: A Communication System Focused on "Happy Coincidences" of Daily Behaviors

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Abstract
To supplement existing forms of communication such as telephone and e-mail, this research proposes a new method of communicating "awareness" between people who are separated by long distances. In this paper, we investigate cases where coincidences in daily behaviors lead to casual conversation and thus intimacy and togetherness. We propose a new method of communicating these "happy coincidences" between a pair of remotely located houses. By equipping furniture and appliances such as doors, sofas, refrigerators and televisions with sensors, we developed a system where these items are connected to remote equivalents and their near simultaneous use is communicated.

Keywords
Coincidences, Awareness, Communication, Synchronization

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction

In order to facilitate successful relationships, people adjust their behavior to others around them by imitating each other's actions unconsciously. In psychology, this behavior is known as "Conformity effects" or mirroring [1]. This action also creates a greater sense of intimacy and closeness for the other. If one wants to create a bond with another person, imitating what the other is doing (e.g., taking a drink of water together) is effective in creating a connection.

We all experience this in our daily lives - when a friend or partner shares a behavior, such as watching the same TV program, this leads to conversation or intimacy. In this way, we feel that "coincident daily behaviors" are a very important factor for our personal relationships to succeed. However, we can only experience "coincident daily behavior" when we happen to be in the same location at the same time. Thusly, people living apart, such as family, friends or couples, only find out later if at all. Therefore, most people living apart never experience this level of intimacy.

In order to address this issue, we propose a new system to facilitate remote "awareness" by communicating the occurrence of coincidental, simultaneous and similar actions of both parties, thus, prompting traditional forms of contact such as a telephone call or e-mail.

Design and Usage Scenarios

In this paper, we investigate the daily lives of people by measuring when similar actions of two people in different locations happen simultaneously, and use this information to develop an "InPhase" system that can notify them of these coincidences through cues in their natural environment. For example, as seen in Fig.1, families or couples living apart have their doors connected to sensors which will sound a chime if both doors are opened at the same time.

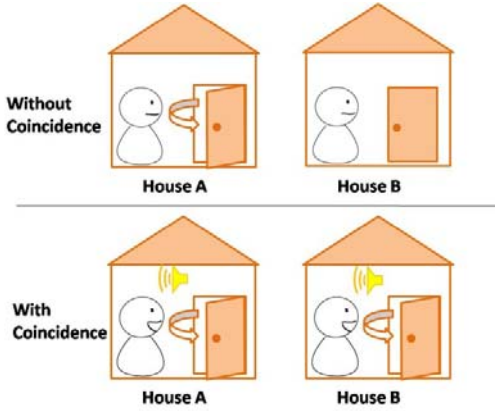

figure 1. InPhase concept.

The InPhase system is an ambient indicator that will notify two remote users when, for example, they are both opening doors, windows or curtains, watching the same TV channel, sitting on a sofa, or in the kitchen at the same time. When this system is utilized, the following scenarios can be envisioned.

Scenario 1: A husband posted away from his family and living apart from them, wakes up in the morning and opens the window. Coincidentally, the wife, in a different city, also opens the window of her home. At this time, a chime sounds and both people know that they opened the window "together". Both feel as if they are under the same roof and are happier. Afterwards, the wife sends her husband an e-mail asking "Did you just wake up? Isn't the weather nice?"

Scenario 2: Two romantically involved people realize that they are watching the same TV program at the same time when the systems chime sounds. At this point, the girlfriend sends a text mentioning how nice the scene on the TV was. The boyfriend replies with a message mentioning that they should go to the place mentioned in the TV show - thereby, encouraging conversation between the couple.

The Merits of the System

As mentioned above, with this system, it becomes possible to learn when similar actions happen in a natural day-to-day setting, thus enhancing intimacy and closeness and potentially initiating other forms of communication. Furthermore, when considering systems that transmit daily actions remotely, our system has two distinct advantages.

First, in a system that continually transmits actions, the persons on the receiving end may be disturbed when they are sleeping or annoyed when they are working [6]. In our system, information about one another's actions is only transmitted when the actions are synchronized. Therefore, there is a certain expectation on the receiving end about an action when they are also doing the same thing, thereby reducing the general annoyance towards the system.

People may feel that they are being spied on when a system transmits more information on daily activities than is received from others. The second advantage of this system is that it is fair and minimizes privacy concerns, because the amount of the information sent to both parties is exactly the same. For example, one party may not want the other to know which TV program he/she is watching. However, when the couple is watching the same program, this fact could probably be shared.

Classifying Coincidences

There are many ways to define how the system senses a person's action. Additionally, there are actions that are unlikely to coincide very often. For example, watching the same TV program in each house may happen with high frequency, but the simultaneous opening and closing of the refrigerator door is considerably less frequent.

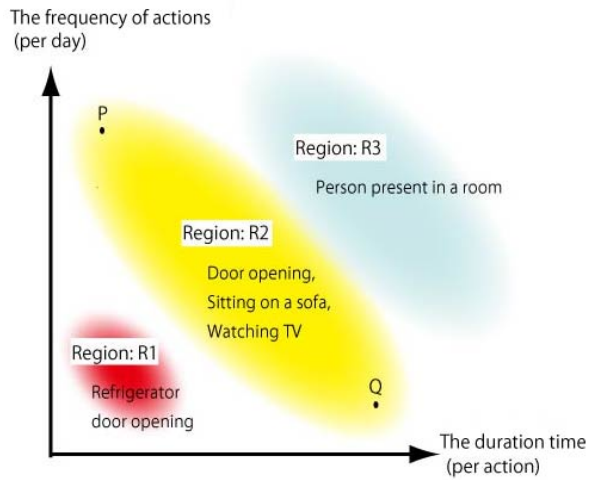

figure 2. Classification of coincidences based on frequency and duration.

In determining "frequency of coincidences", i.e. the number of times that two remote actions happen simultaneously per day, there are two factors. They are the number of actions that can happen in one day, and the length of time that an action takes. Figure 2 shows

figure 4. A motion sensor in the corner of the room.

figure 5. Pressure sensors under the cushions.

some of daily actions and behaviors mapped over the two factors. The example P (an action that occurs with high frequency but of short duration) and Q (an action that occurs with low frequency, but of long duration) might have the same frequency of coincidences.

Depending on the frequency of coincidences, the level of activity in the receiver would vary. Therefore, we propose changing the sound of the chime depending on the frequency of coincidences for certain groups of actions. First, as seen in Fig.2, we grouped actions by the frequency of coincidences. In R1, we defined the group where the coincidence occurs less than about 0.3 times per day. In R2, we define the group where a coincidence happens around once per day. Finally, in R3, we define the group where a coincidence occurs more than once a day. Therefore, in a low occurring coincidence R1, we play a longer tune, and in a higher occurring coincidental action R2, we play a simple tone. In the highest frequency of coincidences R3, we would want to produce something that is not disturbing to the receiving party. Likewise, it is possible to use lights or actuators (instead of sounds) to notify the receiving party.

There is also the possibility that the system could adjust how coincidences are calculated. For example, as shown in Fig, 3, when detecting the opening and closing of a door in each house, the frequency of coincidences would be very low due to its short duration. The frequency of coincidences may increase if the signal is extended a few seconds longer than the actual close time. Conversely, it might be important to eliminate short duration inputs with high frequency of occurrence. For example, it may be appropriate to eliminate frequent sitting and standing events during dinner or input from the TV remote control while channel surfing. However, if the system adjusts actual events too much, it may reduce the effectiveness of the system. More research is needed to determine the appropriate adjustments.

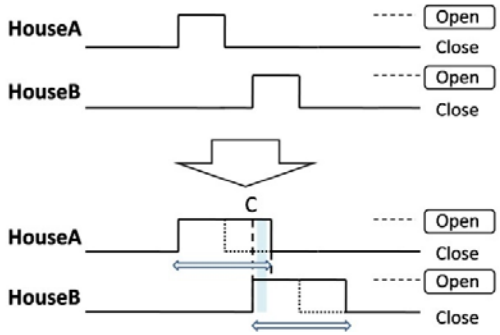

figure 3. Upper timing chart shows open/close event of doors. Lower is a result of adjustment of duration time. The system notifies the coincidence at "C."

Implementation

Among many kinds of daily activities, we selected events with different frequencies and durations. Although lifestyle and family composition would affect these factors, we made general assumption based on the author's lifestyle. The selected events were expected to trigger other forms of communication such as phone, e-mail, and on-line chat. The following describes each in-depth.

The first event we have chosen is to determine if person is present in a common space (i.e., living room) by placing a pyroelectric infrared motion sensor in the corner of a room (Fig. 4). A living room will be used often for a longer period of time, thus this event falls

figure 6. A reed switch at the entrance door.

figure 7. A reed switch at the refrigerator door.

figure 8. Infrared TV remote controller with a small wireless keyboard.

into R3 category per Fig. 2. When people are present in both remote rooms, the system will play a pleasant natural sound. For the second event, we chose a sofa, wired with three separate pressure sensors placed under the cushions (Fig. 5), where the usage rate is lower but occurs for a longer duration – R2 category. When there is simultaneous use of sofas in both locations, the system plays a chime sound. The living room door opening is selected as a third event. While the door has a high frequency of usage, the event itself is very short and therefore this event is in the R2 category where the system will play a chime sound. A refrigerator door opening is chosen as the fourth event. The refrigerator has a low frequency of usage as well as a very short duration putting it in the R1 category where the system will play a trumpet sound. Both the door and the refrigerator door are fitted with a magnetic reed switch (Figs. 6 and 7). The fifth event is watching the same TV program. For detecting TV programs, we have replaced the infrared TV remote controller with a small wireless keyboard (Fig. 8). Considering that users of our system would be a family member or close couple, they would tend to have similar preferences in TV program. Therefore we place it in the R3 category where the system will play a soft chime for minimal interruption.

The overview of the InPhase system is described in Fig. 9. In this example, House A and House B each have a PC, connected via the Internet, with an InPhase system installed. Each PC includes a Ruby based program that collects data from the various sensors. When an action occurs on one of the PC's, it is sent to the opposite PC's server application via a separate and independent web server.

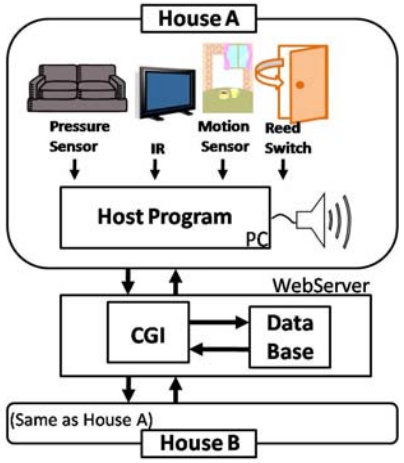

figure 9. Overview of the InPhase components.

Field Test

To determine the effectiveness of the system, we conducted the following field test. For events with significantly different frequencies, we selected a door and refrigerator. For a two months trial, we set our system up in two laboratory rooms separated by a distance of 70 m on the same university campus. We installed magnetic reed switches to the entrance door and the refrigerator in each room. There were 3-4 students working in each room on average. During the test, they were asked to go about their normal daily lives. We logged the opening and closing events for both doors and refrigerators.

During the field test, there were an average of 59.6 and 73.0 entrance door events, and 5.5 and 9.6 refrigerator door events per day, from each room, respectively. This resulted in an average of 1.8 coincidences per day for the entrance doors and no coincidences for the

figure 10. A screen shots of Twitter.

refrigerator. The refrigerator door was used far less frequently than the entrance door, and thus failed to initiate coincidences. However, if the system extended the duration of opening the refrigerator door by 10 seconds, as explained in Fig. 3, the number of coincidences increases to about 0.2 per day. From this data, we were able to confirm that the mapping for these doors in Fig. 2 were generally correct.

Following this test, participants commented about feeling both happy and excited when they heard the chime signifying a coincidence. This led to students starting conversations (i.e., who is currently working, what are they doing, etc.) and even posting messages to Twitter [2] as shown in Fig. 10.

Related work

Many research projects have explored the issue of remote awareness. Digital Family Portrait [5] is one of several electronic picture frames that can display the daily activities of remote family members. Physical awareness proxies [4] convey a remote user's availability using a tangible interface. Tangible Bits [3] enables user awareness by using ambient display media such as light, sound, airflow, and water movement. SyncDecor [6] are pairs of traditional appliances remotely synchronized to provide awareness about their partners.

Those investigations are all based on the unconditional conveyance of remote parties' activities through some physical means (i.e., synchronized devices or appliances) of notification. Our research focuses on conveying only the coincidental natural day-to-day interactions, thus reducing annoyance of the remote party as well as maintaining their privacy.

Conclusion and Future Plan

By investigating the coincidental actions that happen in the daily lives of people living apart, we describe a system that notifies pairs of users of similar events that happen nearly simultaneously between them. By sensing the opening and closing of entrance doors and refrigerator doors in our laboratory, we conducted a two months field test for our system that determines coincidences and notifies the users. The participants of the test commented about feeling both happy and excited when they are notified of such coincidences.

We are planning to test our system for other coincidence of daily events such as watching TV, turning on lights as well as opening windows and curtains. We also plan to deploy the system into actual houses for separated families and close couples.

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