

# Habitat: awareness of daily routines and rhythms over a distance using networked furniture

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**Abstract:** The demands of modern working life increasingly lead people to be separated from loved ones for prolonged periods of time. Habitat is a range of connected furniture for background awareness between distant partners in just such a situation. The project particularly focuses on conveying the patterns of daily routines and biorhythms that underlie our well-being, in order to provide a sense of reassurance and a context for communication between people in relationships.

## 1 Introduction

Intuition leads us to believe people have an innate desire to have an up-to-date understanding of the emotional and physiological state of loved ones. When two people form a close bond, awareness of each other is essential to convey feelings and needs to one another and ensures that the relationship can survive and flourish.

Awareness of a partners activities and biorhythms, such as sleeping, eating, socialising and working, is useful as these rhythms can be indicators of well-being - providing feelings of reassurance and connectedness, stimulating comparison and synchronisation between the pair-bond. The knowledge of any deviation from regular patterns and cycles is of equal significance. Today our lives are enriched by pervasive technology that conquers distance to such an extent that the anxiety of being apart is minimal. But a corollary to technology mediated relationships is that people can still feel disconnected or not attuned with their partner, especially if they happen to be in different time-zones. Old-fashioned methods of keeping in-touch such as letter-writing are accepted as conveying a greater sense of intimacy but lack the instantaneity we are now used to. The majority of modern communications technology such as telephones, text messaging and e-mail, cause untimely interruptions, can be in-contiguous or can require a significant amount of effort to use while doing other tasks.

Habitat explores the potential of addressing these issues by using household furniture as a network of distributed ambient display appliances that centre on the capture and visualisation of daily rhythms to convey a sense of awareness between partners separated by distance.

## 2 Background and Related Work

Research into the physiology of the brain is now starting to unravel some of the issues on why humans have such an affinity to one another [4]. The limbic brain, which was once believed to only co-ordinate sensations from the external world to internal organs, is now thought to be responsible for regulating our emotions. This mechanism for the mutual exchange and internal adaptation between two mammals, whereby they become attuned to each others internal states is known as limbic resonance. This theory is developed further, proposing that the human nervous system is not autonomous or self-contained but an open-loop system that is continually rewired through intimacy with nearby attachment figures - a process of interactive stabilisation, known as limbic regulation.

The field of psychobiology provides us with a body of experimental evidence on biorhythms and their impact on our well-being [2]. Our biorhythms and internal body clocks are affected by a number of external factors, most importantly people we are bonded to.

Habitat also draws upon ideas from previous projects in ubiquitous computing that employ furniture and architecture as display devices, such as Ambient Displays [10], Digital Picture Frames [5], Roomware [8], Peek-a-Drawer [7] and The RemoteHome (exhibition - London/Berlin 2003).

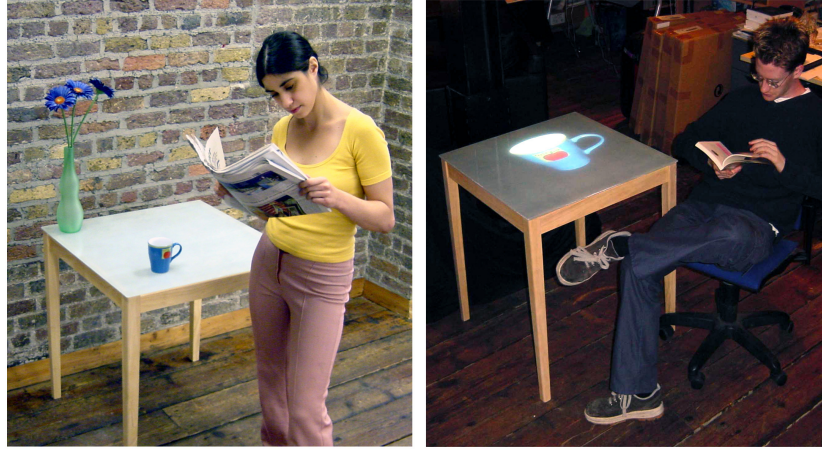


Figure 1: Habitat being used to link two distant partners.

### 3 Technology and Design Goals

The initial range of Habitat appliances are in the form of two geographically separate, networked coffee tables. Each station consists of a networked Linux computer, a RFID tag reader and a video projector.

Two people having a long distance relationship (Figure 1), use the Habitat system as follows: When objects (with a RFID tag embedded inside) are placed on the coffee table, they are sensed by the tag reader, which uniquely identifies each object. The tag reader is polled regularly by the computer to check if any items have been added or removed. Such events cause messages to be sent to the coffee table in the remote partners living space. The remote coffee table displays a corresponding representation of the opposite person's activity (Figure 2) and their overall daily cycle on the surface of the table, using an appropriately mounted video projector. When items are removed, the displaying coffee table gradually fades away that representation.

Habitat takes into consideration several design guidelines in creating connectedness applications [1]: -

- The system should behave like an appliance that is always on and connected, to foster a sense of continuity - an open link between the users.
- Participating with Habitat should require no change in the user's normal behavior and not alter the furniture's original use.
- The visualisations should be non-distracting, so they can be viewed across the room and in the periphery of vision without distraction. The visualisations are designed to indicate the presence of the remote partner over a duration of time, so that observers are free to move around the living space and not have to constantly watch the display.
- The system should express the notion of a digital wake. A digital wake is a visual construct that allows the users to ascertain the history of previous interactions. When an activity ends, its representation gradually fades out but is never completely removed from the display. This gives users who return to their living space a mechanism to interpret what took place while they were absent.

Privacy and trust issues are dealt with implicitly as the furniture only connects into the personal space of a loved one, a person with whom a high level of trust is already shared. Users are also made well aware of the specific artifacts that trigger the communication between Habitat stations. Reciprocity is important for limbic regulation, since each station is a duplicate, awareness flows in both directions in a continual feedback loop.

### 4 Proposed Experiments

The aim of this research is to determine if we can successfully convey awareness of rhythms over a distance and if doing so can provide similar levels of reassurance and intimacy as physical proximity of partners in

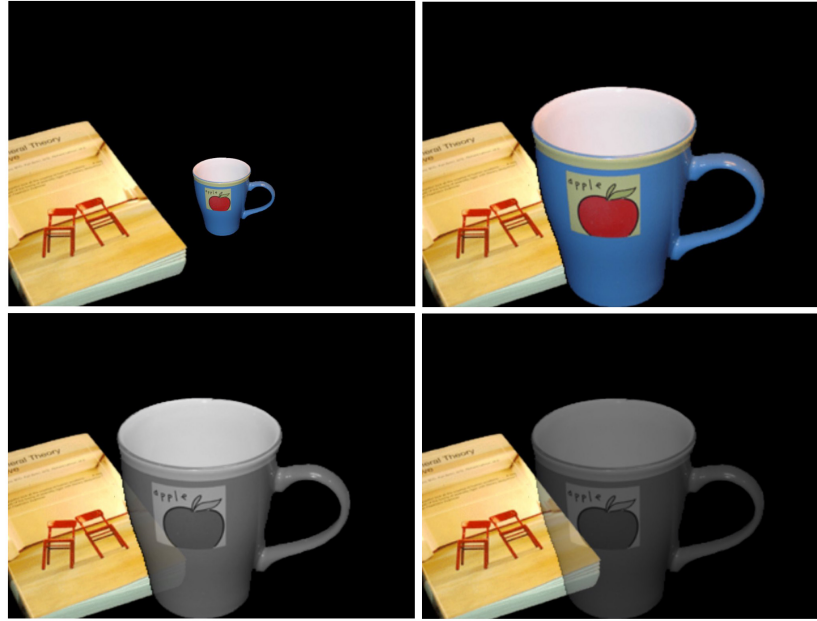


Figure 2: A typical sequence within a visualisation (clockwise from top right): remote partner begins coffee break, mug image appears (a), continues to drink coffee, mug image grows (b), ends coffee break, mug image turns greyscale (c), remote partner removes mug from table, image fades gradually away (d)

a domestic setting. We propose to use the Habitat prototypes as a platform for conducting experiments and collecting data to validate these claims.

In particular, we plan to use of questionnaires, interviews and observation, to investigate the following areas:-

- Reassurance - with extended trials we want to understand the level of reassurance provided by Habitat. Does such a system afford a sense of reassurance to its users? Are these levels of reassurance experienced equally by both members in the relationship? How does the experience of using Habitat vary from using conventional technologies such as the telephone?
- Continuity - how do we ascertain notions of continuity of awareness between partners? Can Habitat provide a sense of continuous connectedness between the partners? How can we measure this continuity, in situations where partners are using other technologies to communicate and convey well-being between each other (including word of mouth from other people)?
- Ambient awareness - how do we determine the extent of which habitat is a tool for non-distracting, background awareness? Do some types of visualisations fare better than others? Previous evaluations in this area [9] may only provide us with a limited set of leads or heuristics, but none the less, inform our work. How do we quantify the ability of the system to convey a sense of presence and duration [6], whilst in the periphery of our users' attention? What methodologies can we employ to allow the control of (real or perceived) changes in privacy [3] between the partners?

## 5 Conclusions and Future Direction

The first phase of Habitat is complete, a proof of concept demonstrator system which captures and conveys daily rhythms and routines over a distance. A range of visualisations that describe remote activities have been created.

Future versions of Habitat will concentrate on the capture of more complex routines and activities. We plan to use biomedical technologies in concert with the connected furniture platform, to monitor users body temperatures, heart rates and other well known metrics for tracking biorhythms with additional accuracy. Humans have several bodily rhythms that affect how we feel in addition to circadian rhythms,

such as ultradian ( $\sim 90$  minutes), infradian (many days) and circannual ( $\sim 1$  year). There are also several environmental factors that alter or reset body clocks (known as zeitgebers) that could be accounted for within visualisations.

The eventual goal would be to install suitably evolved iterations of the technology with many groups of people outside of the laboratory environment and assess their use in a study - prime candidates being people who endure separation from family and partners for prolonged periods of time, such as off-shore workers or military personnel.

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