
Moodcasting: Home as Shared Emotional Space

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The home experience revolves around an intangible yet pervasive dynamic: shared emotional space, in which members of the home are influenced by each other's expressions of mood as well as the associated values, activities, people and spaces that influence mood. The Moodcasting system is a set of pervasive and ambient technologies designed to interactively enhance mood awareness and understanding in a home by representing mood and the supporting contexts in easy-to-understand and actionable representations.

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General Terms

Human Factors

Introduction

Moodcasting is a visual platform that aims to facilitate the collective sharing and interpretation of mood within a home space as a sort of looking glass—a retrospective and introspective interface into the collective moods of the household from the past, present and future. From first concept to the existing prototype, user-centered design guided our research on how inhabitants' awareness of mood and emotion impact the notion of home. Front-end user research revealed that there are values that were common to household members that create shared experiences in the home. Most notably was the notion that home is the space where mood can be openly shared; thus home can be defined as the space where shared mood expression collectively occurs. From this notion we

have created a system that collects affective data from verbal expressions that occur in public spaces of a home and presents that data back to inhabitants through a variety of visualization modalities. The Moodcasting platform becomes an ambient centerpiece that creates opportunities for communication and shared emotional space of the home.

Literature Review

Throughout the development of the Moodcasting system, we gained insight related to the output of qualitative data from an emerging discipline of affective, pervasive, ambient, and ubiquitous computing literature. Graves Petersen's work on technologies that create engaging experiences in domestic spaces contributed to our design vision, in particular the notion of "remarkable" technology, which motivates designers to relate the possibilities of the technology to the actual needs of the users [6]. While refining the interface our system to do just this, we also reviewed "We Feel Fine," a web-based artwork whose mission is to collect the world's emotions to help people better understand themselves and others. This website demonstrated one method of displaying affective data through meaningful and diverse visualization modalities [5]. The work of Felton and the wider "Quantified Self" community led us to investigate how people track, organize, and represent their own activities and life patterns. Other affective systems like The Love Bomb, a mobile and persuasive device that allows people to anonymously communicate feelings of love and sadness [3] and MobiMood, a proof-of-concept social mobile application that enables groups of friends to share their moods with each other [1], demonstrated the possibilities of affective interfaces.

In keeping within the genre of ambient/tangible technology, our system was inspired by the work of Ishii and his notion of systems that can reach different aspects of human senses, particularly through the designing for foreground interactions and background perception (through ambient light, sound, airflow, and water flow) [4]. Furthermore, the work of Gaver influenced our thinking about creating open-ended artifacts that facilitate flexible engagement and allow users to build their own interactions through inherent curiosity and exploration in the home environment [2].

Investigative Research: Methods & Analysis

Our research began with the intent of creating cohesion in the home space through enhanced understanding of mood patterns, a complex goal given that notions of home, mood, and the relationship between the two is unique to the individual and circumstance. We developed a research plan to investigate users' awareness, cognition, and communication of mood and emotion explicitly. Our aim was to ensure that our presumptions of home were not based in the physical structure of place or a particular relationship of the cohabitants.

Our first phase of research focused on one household of four individuals who regularly congregated in the common and transitional space of the house. The participants all met each other several years prior to our research and had been living together for two months; they had not lived together previously. Each participant reported to have lived in an emotionally difficult living situation prior to their current household and wanted to live together because of their familiarity with each other. Focusing our research to one household enabled us to contain the number of

variables affecting our data, to more deeply engage with each household member, and find deeper parallels between users' conduct and expressions of home. We performed open interviews and two forms of experience sampling methods (ESM) (delivered remotely via SMS and voicemail) as our primary research tools to investigate the different ways people express mood. Participants were asked to leave a voicemail at the end of each day at a specific number, answering questions about their observations of others moods, both at home and away, as a means to gather data on how our particular participants observed the moods of others and how those moods affected them. Text messages were also sent out two times per day to each of the participants' cell phones at random time intervals. Participants were asked to respond to questions about their current activities and associated feelings, how they had recently expressed their mood, and how they felt while leaving/entering their home space. These data were used to gauge how participants viewed their personal moods and gauge their awareness of their own mood state.

We conducted one open interview with each of the four household members over the course a week. Each participant met with us independently and was asked about both home and mood. Each interview lasted 45 minutes and was held at a location of the participant's choosing. Transcriptions of each participant's interview and text messages were coded and modeled into a series of affinity diagrams, which revealed participant's specific notions of home and mood, trends between all participant's ideas and values, and a set of shared values of home and expression of mood for the household (Figure 1).



Figure 1. Affinity Diagrams

We analyzed the text message data according to the primary trends and contexts of each user's mood experience, how they expressed their mood, and by current location and time. We identified the most common moods expressed, ranked them according to negativity and positivity, and graphed mood points by user and time. From this we found correlation between each participant's moods and it's relationship to context in understanding the meaning of mood. Insight gleaned from the text message analysis steered us toward analyzing the data on participants' understanding of home prior to analysis of trends in mood data; mood is often expressed in a social, spatial, or time based context.

Data yielded from the interviews were categorized into four primary data types: *Mood Meaning/Context*, *Mood Expression*, *Home Meaning*, and *Home Expression*. Developing profiles on each participant based on these categories showed unique conceptualizations of home based on childhood home environment, familial relationships, and other previous housing experiences. The data categorized into *Home Meaning* and *Home Expression* showed that users' experiences and expressions of home exist in two different realms: the public and the private. Our user research demonstrated that home as a public realm is conceived by what is verbally shared in that public space: expression of mood and emotion.

Each participant's expressions of mood in their home's public space were based in the contexts of place, activity, and people. Participants expressed values given according to each context. The values common among all users that distinguished home as the place for shared mood expression included: flexibility,

occupancy, communication, intimacy, peacefulness, comfort, and enjoyment in the public space of the home. We also noted that moods and emotions are individual but relate and impact inter- and intra-personal concepts of self and society in a variety of ways and can occur in the home's public and private spaces. However, for the purpose of our research we choose to focus on the contexts in which mood is expressed, rather than *why* mood arises.

Investigative Research: Design Requirements

We reviewed our findings to capture the abstract essence of mood expression in the home and to create a system that would fit the needs of our participants, and support the values derived from our research and exclusively limit input/output to the home dwellers. We designed our system to capture verbal expression of mood information in the shared home space because it best reflected the way our participants related affective information to each other. Furthermore, we wanted our system to collect and input affect data in the least invasive way as possible. Underlying trust among household members proved to be a precondition for appropriate use of the system that could be established through a process of consent prior to install.

Picard et al. discusses the intelligent handling of affective states in systems that can sense, recognize, and respond to the human communication of emotion, which includes the potentiality of machine learning of accumulated data [7]. We applied the notion of concurrent expression such that the Moodcasting system could sense affective expression in parallel with the user's primary task, without the user having to stop what he or she is doing to report his or her feelings. We

opted to use embedded wireless microphones in the public space of the home as the primary input device, which would respond to a GPS sensor attached to a physical item owned and carried by each user in the home space; keys, computer, backpack, etc. When users entered the shared space, the microphones would be triggered on to collect input. Data would be wirelessly sent to a remote API that would perform linguistic processing on the data. Natural language processing for sentiment detection would help decipher in the verbal modality how household members respond to digital representations of mood data.

The value of Moodcasting lies in its ability to take raw mood input data, enrich it with contextual information, and present it in a standardized format that makes it accessible, relatable, and actionable to the user. While the input of expressions requires an affect processing system that recognizes and responds intelligently to emotions, the output display platform itself does not collect affective data itself (although verbal expressions of mood would be concurrently collected through the embedded microphones).

Moodcasting: Interface

The Moodcasting system was designed to incorporate a range of interface modalities to ensure usability of the collected and processed mood data. We wanted to ensure that the each household member was able to interpret the data in a way that resonated with their cognitive sensibilities; each of the following representations was developed based on insight gained from user research.

Graphical Display: Each of the following views allows a progressive disclosure of data associated with mood

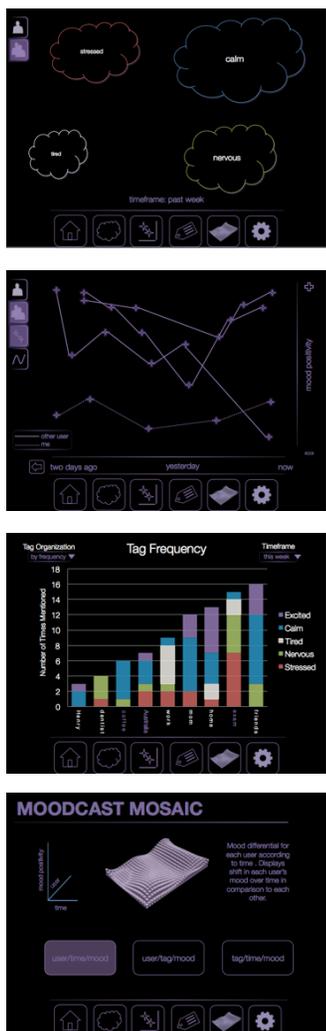


Figure 2. Graphical Display Moodcasting prototype display screens, from top to bottom: Cloud View, Graph View, Tag View, Mosaic View

expression, and creates a natural path of discovery through investigation of each view. The screen interface would be embedded into a TV, computer screen, or other digital display in the 'public' home (Figure 2). User studies indicated that embedding the output in a device that is already pervasive to the household's routines would increase the likelihood of use. The four following views were created to explore what kinds of graphics (passive, analytical, contextual and ambient) best convey and solicit a response to aspects of mood.

- 1) *Cloud View*: A lightweight "at a glance" aggregated display of mood data in the form of clouds grouped by users can click on a cloud to see and manipulate the expressions within that mood set.
- 2) *Graph View*: An comparative and analytical approach to mood data which shows trends in mood over time with respect to mood degree within the household and for the current individual user. Data points along a trend line can be selected to detail each mood expression.
- 3) *Tag View*: A context-based mood display emphasizing the activities, thoughts, people, and situations that lead to various moods expressed in the home by frequency.
- 4) *Mosaic View*: A control panel for the MoodMosaic.

Light-Based Display: The MoodMosaic, a relief based light interface actuated as a wall hanging, and was designed to create an example of other more tangible, yet ambient ways of representing mood data in ways that instigate open expression of mood (Figure 3).

Prototype and Usability Testing

The development of the Moodcasting interface evolved through a series of prototypes, heuristic evaluations,

cognitive walkthroughs, and usability testing. Our prototypes guided the development of our output modalities in extent, while our user research, affinity diagramming and user testing sessions honed our prototype with respect to aesthetics, usability and data representation. Focusing on the feasibility of designing the output system, our initial sketches and storyboards led to a mid-fidelity prototype using Microsoft PowerPoint, with interactive navigation between the different views and animation to reflect realistic placement of the prototype within a screen-based view (such as a TV or other form of digital media display). Initial cognitive walkthroughs and heuristic evaluations uncovered the need to better support user recall, and to introduce an error recovery protocol. At this stage we also recognized the opportunity for an ambient device to augment mood data and experience in dynamic form, while enhancing the notion of pervasive, shared mood within a common home space. Several small-scale models were created to explore ideas that became the MoodMosaic.

We conducted usability testing on the graphical user interface with twelve participants across three separate households, using the think aloud protocol to further develop our prototype. Participant selection was based on criteria set during the initial research phase so we could focus development on our target users. All of the testing was done in the most public space in each respective house. All research team members were present for testing and performed roles of note-taker, prototype operator, and facilitator. Test sessions lasted an hour and a half, during which we observed the group dynamics of the participants and inquired about the logic and graphic representation of the data

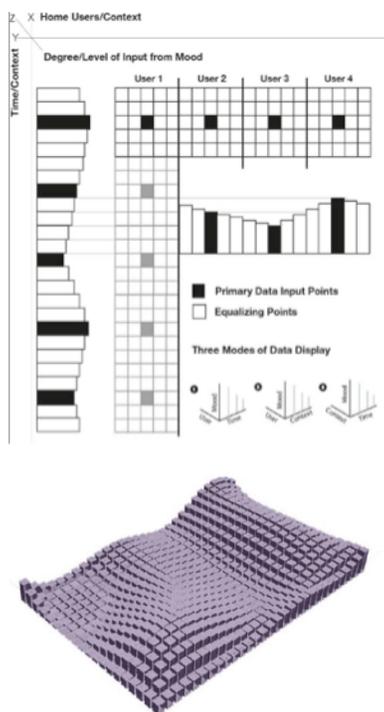


Figure 3. Light-based Display

Moodmoasic: Modular in form each block contains 25 motorized light columns. The center pin of each block receives mood information, and pins within the block equalize to the adjacent columns. Depending on the amount of users and desired contexts, the blocks can be stacked and equalize accordingly.

presented, and conducted individual testing on each component of the interface.

The results of our testing revealed a number of problems with our screen-based system, some aesthetic, others rooted in the underlying functionality. Notable issues included: the user's inability to distinguish between data for the entire household and data for a specific individual, the system's ability to truthfully reflect reality, and inconsistent use of color. Furthermore, participants were concerned about privacy of personal information and the opportunity for settings to adjust the disclosure of information.

The complete high-fidelity prototype incorporates adaptations to address these issues along with improved animation features between modalities for a better user experience. We showcase four views in the system with simulated interactivity. In addition, usability testing of the physical artifact showed that our users were keenly interested in physical devices. We created a 3D demonstration of the Moodcasting Mosaic, inviting users to imagine interaction with mood data in a passive, ambient way.

Conclusions

Mood sharing and mutual understanding is at the core of the home experience because it reinforces and enhances the individual and group dynamics that make up the very foundation of the home. The Moodcasting system leverages different modalities of visual data understanding within the home. Though we conducted extensive design and testing of various visual display strategies with our users, future exploration into different ways to render mood data will further augment our design such that we may equip users to

better deduce and respond to mood data. Empowering users to actively interpret and act on shared expression, the Moodcasting system provides enriched understanding of the mood of the home, and of the complex circumstances, individuals, and tenets that make up the very experience of home from within and without.

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